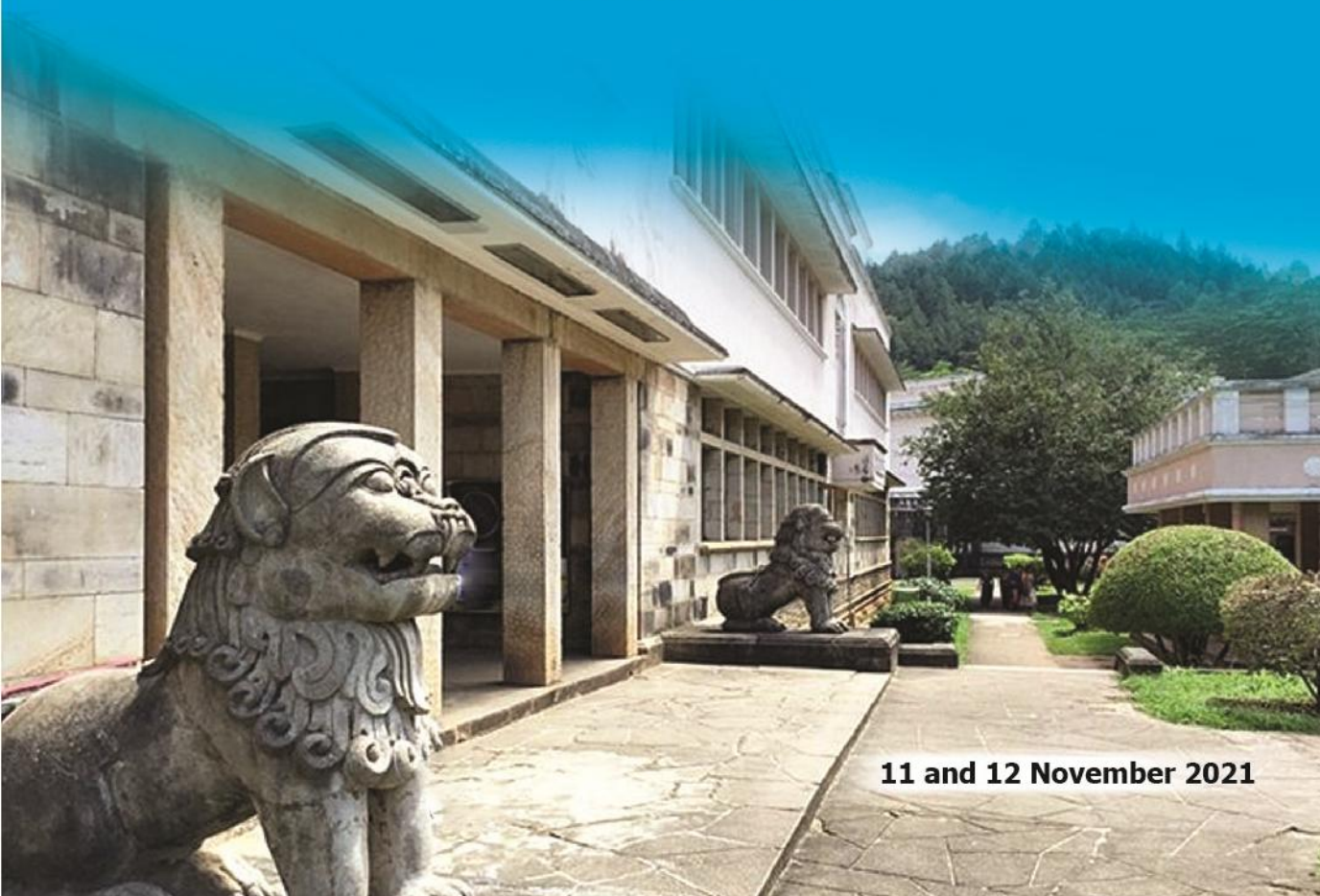# PURSE 2021

PERADENIYA UNIVERSITY INTERNATIONAL RESEARCH SESSIONS

Research and Innovation for an Inclusive Society

PROCEEDINGS

Peradeniya University
International Research Sessions
2021

Volume 23

11 and 12 November 2021

UNIVERSITY OF PERADENIYA

SRI LANKA

"Research and Innovation for an Inclusive Society"

PROCEEDINGS

PERADENIYA UNIVERSITY INTERNATIONAL RESEARCH SESSIONS (*i*PURSE) 2021

Volume 23

11th & 12th November 2021

Hosted by

Faculty of Arts
University of Peradeniya
Sri Lanka

Proceedings of the
PERADENIYA UNIVERSITY INTERNATIONAL RESEARCH SESSIONS
(*i*PURSE) 2021

CONTENTS

MESSAGE FROM THE VICE-CHANCELLOR

University of Peradeniya

Peradeniya University International Research Sessions (iPURSE) 2021

I am extremely happy that all steps have been taken to hold iPURSE 2021, despite the pandemic and its consequences. The conference theme "Research and Innovation for an Inclusive Society" is highly appropriate in the current complex milieu and also is aligned with the ethos of the University which has a comprehensive range of study programs. Therefore, I believe, the conference could create opportunities for greater integration of multi-disciplinary, cross-disciplinary, and interdisciplinary approaches to knowledge generation and sharing.

I congratulate the Faculty of Arts in general and the Organizing Committee headed by the immediate past Dean of the Faculty of Arts Professor O.G. Dayaratne Banda in particular for the efforts taken to hold the iPURSE, even at a time of a global crisis. I also congratulate all the presenters and thank all the participants for your share of contribution to the success of the conference.

I wish iPURSE 2021 all the very best.

Professor M.D. Lamawansa
Vice-Chancellor
University of Peradeniya

MESSAGE FROM THE CHIEF GUEST

Vice-Chancellor, University of Colombo

Peradeniya University International Research Sessions (iPURSE) 2021

It is my privilege and pleasure to convey my sincere felicitations for the flagship event of the University of Peradeniya's annual research calendar – iPURSE 2021.

Teaching-learning, research, and scholarship are the fundamental constituents that portray the quality and relevance of any seat of higher learning. The Annual International Research Symposium of your esteemed university has chosen the theme "Research and Innovation for an Inclusive Society", which portrays the diverse mix of research excellence with the requisite potential for creativity and innovation among the academic staff and students. The research submissions received, which are close to 600 in number, and skilfully categorized into eight pragmatic themes, confirms that academic research of multiple disciplines have progressed in Sri Lanka, despite the multiple challenges imposed by the pandemic. This personifies the resilience and determination among our own academic and scientific communities, which is most encouraging. Your innovative contributions towards the prevention and control of COVID19 were many, with that achieved through the field of material sciences and nanotechnology with commercialization permeating to every region and sector of Sri Lanka. Such innovations add greater value to the role of higher educational institutions in Sri Lanka and help foster closer ties between universities, the industry and wider society. Such an effective networking would undoubtedly pave the way for more productive collaborations across disicplines, that would benefit the multitude of communities and sectors in which we live, work and serve.

I also take this opportunity to felicitate the organizing team, researchers, and students, so ably led by Conference Chair Professor Dayaratne Banda, and the multitude of administrators and support staff alike for your continued commitment to uphold research and development in Sri Lanka.

I convey my very best wishes for the most rewarding discussions and deliberations that will help upscale your research and innovative capabilities to the next level.

Senior Professor Chandrika Wijeyaratne
Vice-Chancellor
University of Colombo

MESSAGE FROM THE CHAIRPERSON OF iPURSE 2021

Peradeniya University International Research Sessions (iPURSE) 2021

On behalf of the Organizing Committee of iPURSE 2021, I am honoured and delighted to welcome you all to the Peradeniya University International Research Sessions 2021, hosted by the Faculty of Arts, University of Peradeniya, in the most scenic and the highest ranked university in Sri Lanka amidst the challenges of Covid-19 pandemic that has devastated the entire world posing a huge threat to the existence of the humankind.

This year's iPURSE includes close to 600 abstracts from almost all the disciplines in the humanities and social sciences, the sciences, management, engineering, medical sciences, and agricultural and veterinary sciences. iPURSE has been the national and international platform of the University of Peradeniya for sharing and disseminating its rich and advanced research outcomes to a wider global community while providing an opportunity for all the scholars and scientists in the diverse fields to network with fellow researchers. It is our fervent expectation that the research outcomes disseminated at iPURSE would be immensely beneficial to the policy makers in redesigning policies at both national and global levels, while providing researchers from diverse disciplines directions for further research.

iPURSE 2021 is being organized amidst the unprecedented challenges posed by the Covid-19 pandemic. Each one of us strongly feels that 'I just want to go back to normal'. However, the devastation that we are seeing today is a direct outcome of the 'Normal' that we maintained for centuries through over-production, over-consumption, and serious damage to the environment causing climate change to a point that nature has seriously started to agitate against the very purpose and the behaviour of the humankind. Nature has forced us to live in isolation, to make less damage to the environment, to produce less, to consume less, and to be spiritually better humans. It is not however clear whether the humankind has understood the message issued by nature. What we should do is not to return to the pre-pandemic status quo but rather to strive to reach a state that is better than what had been considered normal.

Many have played their part in making iPURSE 2021 a reality. On behalf of the Organizing Committee, I would like to pay our gratitude to the Vice Chancellor of the University of Peradeniya and the Dean of the Faculty of Arts for their guidance and support throughout the process. I would also like to convey my warm thanks to the members of the Organizing Committee and all those who worked hard to make iPURSE 2021 a reality especially at a time of an unprecedented global pandemic. I sincerely hope that iPURSE 2021 will provide a solid platform for all to engage in meaningful scientific debates and discussions. It is my sincere wish that iPURSE 2021 will be a resounding success.

Professor O.G. Dayaratna-Banda
Chairperson / iPURSE 2021
University of Peradeniya

KEYNOTE ADDRESS

The Complex Interplay: Writer – Text – Reader – Context

Abstract

Professor Wimal Dissanayake

Academy of Creative Media, Faculty of Arts, University of Hawaii at Manoa, Honolulu, Hawaii 96822, USA

During the past four decades or so we have witnessed a stupendous growth in literary theory not only in the West but in most parts of the world. This phenomenon has great consequences for the study and appreciation of creative literature. The aim of this lecture is to familiarize the intelligent laypersons, the non-literary scholars, with the contours of these transformations so that they would be in a better position to appreciate the newer landscape of literary study.

We have witnessed, during the past forty years or so, the proliferation of such literary fields of inquiry as structuralism, semiotics, phenomenology, deconstruction, varieties of Marxism, feminism, new historicism, postmodernism, post-colonial theory. These are complex and challenging pathways of inquiry that demand sustained thinking. In this lecture I have selected the four basic building blocks of literary study – the writer, text, reader and context to gain entry to this complex field and illuminate it in a way that the intelligent layperson can productively follow. To understand this complex interplay is to understand the changing face of the discourse of literary interpretation.

I plan to pursue this objective by focusing on the complex, multi-faceted, ever evolving interplay between the writer, the text, the reader and the context. By exploring the dynamic interplay between these four entities, we would be in a better position to comprehend the nature and significance of the reading experience and appreciate the changing visage of literary communication. This interplay is at the base of primitive story telling as well as the most advanced and sophisticated art of modern fiction. It is important to bear in mind the fact that the four entities that I reference are not independent and self-contained but interdependent and mutually interactive and they are facets of a larger discourse of narrative production. Each entity achieves self-metamorphosis through the interaction with the other three.

Of the four entities associated with narrative literature that I have identified, it is the writer or the teller of the stories who first attracted the attention of students of literature. The writer was at the center of the literary experience. He or she was in full command of

the text and exercised complete authority. The work was understood in relation to the creator. Literary creeds such as phenomenology sought to underline this fact. The Belgian critic, George Poulet, a prime propagator of phenomenological criticism once said that the foundation for everything else in literature is the consciousness of the author. The focus on the writer served to emphasize the importance of biographical studies, psychological studies, philosophical studies influenced by the writing of Freud, Jung, Lacan and so on. There is a vast body of writing on the broad topic of psychology and literature that focuses on the centrality of the writer.

Second, the text becomes important; the emphasis shifted from the writer to the text. The text was regarded as the ultimate determiner of meaning. It is also a plenitude of meaning. Modes of literary inquiry such as New Criticism, Russian Formalism, Structuralism, Semiotics, Narratology and deconstruction underlined the supremacy of the text. Some deconstructionists, somewhat misleadingly claimed that there was nothing outside of the text. A pervasive textualism began to inflect literary study. The fact that the emphasis shifted from the author to the text does not mean that the author was erased from the scene; he or she continues to play an important, although a diminished, role despite the assertions of thinkers such as Roland Barthes and Michel Foucault to the effect that the author is dead. We need to keep in mind that the shift of emphasis from the writer to the text is not linear but interactional and that it is at these meeting-points that important insights related to literary communication are generated.

Third, the reader, who had up until now, not played a central role in the production of textual meaning, began to assume a position of importance. The reader became the ultimate arbiter of meaning. The alleged death of the author served to focus on the rebirth of the reader. Various forms of Reader Response Theories that emerged in Germany and the United States sought to highlight the centrality of the reader. Literary theorists such as Stanley Fish and Wolfgang Iser played an important role in demonstrating the possibilities of Reader Response Theories. Later, the idea of a resisting rather than assenting reader took shape highlighting the salience of interventionist literary readings. It needs to be pointed out, however, that this approach is not alien to the spirit of Asian thinking. For example, in classical Sanskrit language and literary studies, theorists such as Bharta Muni, Anandavardhana, Abhinavagupta and Bhartrihari highlighted the crucial role played by the listener or reader in generation of aesthetic emotion of verbal meaning.

Fourth, in the subsequent stage, the attention of literary scholars shifted from the reader to the context. The idea of the context is a capacious one. It serves to call attention to the important role pated by history, culture, ideology, language, tradition and so on as determining factors of textual meaning as well as to the importance of exploring the whole field of cultural production as scholars like Pierre Bourdieu have delineated.

Feminism, Marxism New Historicism, post- colonial theory endeavored to emphasis the importance of contextual factors. The context, which had up till now, remained a part of the background assumed a position of centrality and moved to the foreground. Let us for example consider the significance of ideology. One of the objectives of socially-informed literary criticism is to bring out the concealed, and often repressed, layers of social meaning from the pages of a literary text. This effort is vitally linked to questions of ideology as theorists such as Fredric Jameson have pointed out.

So the interplay among the writer, the text, the reader and context is important to understand the nature of the reading experience and changing paradigms of literary analysis. It also helps us to come to grips with some of the contentious issues in literary theory and map the circulating energies within literary hermeneutics. For example, J. Hillis Miller, who has played a central role in gaining visibility for deconstruction in the United States is torn between the demands of textual supremacy and creative role of the reader in the production of textual meaning. Such issues can be profitably unpacked through a study of the four entities I plan to discuss in my lecture. Writers, texts, readers and contexts are not readily separable entities with immutable properties but are variable functions located in a discursively produced nexus of relations. Such an orientation will enable us to understand more deeply the complex interplay that is the beating heart of this lecture.

In conclusion I wish to relate these observations to our own needs and imperatives of literary pedagogy in Sri Lanka by focusing on four important literary critics – E.F.C. Ludowyk, Ediriweera Sarachchandra, Martin Wickemasinghe and Gunadasa Amarasekera and my own evolving endeavors, however inconsequential they may be. Throughout this lecture, I have drawn on the insights of scholars and critics such as Walter Benjamin, Roland Barthes, Michel Foucault, Jacque Derrida, Paul de Man, Harold Bloom, Edward Said, Gayatri Spivak, Stanley Fish as well as classical Sanskrit theoreticians of literature. My interpretations grow out of my engagement with the discourses inscribed in and promoted by four of the languages that I know best – Sinhala, English, Sanskrit and French.

FOREWORD

iPURSE 2021, the signature conference of the University of Peradeniya, Sri Lanka, has brought together the outcome of a large number of research endeavours. The Proceedings comprises a total of 571 abstracts, organized under eight thematic areas: (1) Covid 19: Issues and Solutions [41 abstracts]; (2) Education for Transformation [33 abstracts]; (3) Environment and Natural Resources [65 abstracts]; (4) Food, Nutrition and Livestock [58 abstracts]; (5) Health and Society [128 abstracts]; (6) Language, Culture and Thought [64 abstracts]; (7) Science, Technology and Industry [156 abstracts]; and (8) Socioeconomic Progress and Governance [26 abstracts]. Each of these thematic areas comprises research studies undertaken from a multiplicity of disciplinary perspectives. While the majority of the research studies are firmly rooted within individual disciplines, there are a significant number of studies that reflect multidisciplinary and interdisciplinary efforts.

I take this opportunity to convey my heartfelt gratitude to all the expert reviewers who took part in the review process. They played a key role in ensuring that the output of iPURSE 2021 is of quality and handard. I also wish to add my warm thanks to the members of the Editorial Committee of iPURSE 2021, the members of the Faculty-level Editorial Subcommittees, and everyone who extended their support towards the editorial activities. Without their invaluable support iPURSE 2021 would not simply have been possible. Mr. Prabhath Gunathilake, Administrator/Peradeniya Conference Management System (PCMS), deserves a special note of appreciation for his unwavering support throughout the editorial process. I also add special thanks to Ms. Udani Amanda Wijeratne, Secretary/iPURSE 2021, for the indispensable role that she played in facilitating the editorial activities. Last but not least, I convey my heartfelt gratitude to Prof. O.G. Dayaratne-Banda (Chairperson/iPURSE 2021), Prof. Tilak Hewawasam and Prof. Wasantha Athukorala (Co-coordinators/iPURSE 2021), and the rest of the members of the iPURSE 2021 Organizing Committee for their continuous support throughout the process.

Dr. Nandaka Maduranga Kalugampitiya
Editor-in-Chief
iPURSE 2021

LIST OF ABSTRACTS

Education for Transformation

Food, Nutrition and Livestock

Health and Society

Language, Culture and Thought

Socioeconomic Progress and Governance

COVID-19:

ISSUES AND SOLUTIONS

Flexibility and Resilience of Rice Value Chain: A Case of Urban Food Supplies in Sri Lanka during Covid-19 Pandemic

K.C.J. Premarathna* and D.A.M. De Silva

*Department of Agribusiness Management, Faculty of Agricultural Sciences,
Sabaragamuwa University of Sri Lanka, Belihuloya 70140, Sri Lanka
chamathkapremarathna@gmail.com

Covid 19, a fatal virus, has challenged the livelihood of people around the world and has created a tough time not only for poor countries but also for powerful nations. Agricultural value chains, feeding the people, flows through the diverse landscapes have lost their connection due to lockdowns, curfews, restricted movements, import and export bans, and the closure of ports and airports. We attempted to explore the flexibility, resilience and risk of the rice value chain in urban food supplies during the Covid 19 pandemic. The study sample encompassed 110 rice value chain actors including farmers, collectors, millers, wholesalers and retailers who are supplying rice to the Colombo and Gampaha districts. A structured questionnaire was the main data collection tool and in-depth interviews with key players were instrumental in collecting qualitative data on value chain risks, flexibilities and resilience during the pandemic. Intermediaries, especially the collectors, millers and wholesalers were placed more attention on delivery and logistic costs compared to farm gate prices. The main risks of the rice value chain identified were the logistic issues along with barriers on connection with upstream of the value chain, fragile distribution networks, limited market access, the risk of competition due to alternative suppliers, and health regulations. The risks were managed through flexible arrangements made by the value chain actors; direct sourcing, collaborative efforts, cross-functional engagement and mobile markets and through digital networks like e-commerce and mobile commerce interventions. Due to the increase in demand for rice supply chains during the Covid 19 pandemic, the retail sector was given more prominence for resilience as the value chain lost its connection with the customers. Home deliveries, online orders through mobile phones, credit facilities were introduced to meet this situation.

Keywords: Flexibilities, Risks, Rice value chain, Resilience

Digital Infrastructure and Interpersonal Relationship Influence on Employees' Perception on Self-Productivity during Work-from-Home

T.A.D. Sewwandi*, A.L. Sandika and T.W.M.K.K. Weerasinghe

Department of Agricultural Economics, Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitiya 81100, Sri Lanka
*sdinusha18@gmail.com

The Covid-19 pandemic has boosted unprecedented negative impacts on the labor market. Businesses in different sectors have taken a challenging decision to minimize the congregation of people by allowing work from home (WFH). However, the occupational heterogeneity in the work context determines the employee's ability to WFH. This study examines the physical and social factors that affect self-reported productivity of the employees and their preference for continuity of this "hybrid way of working" even after the Covid-19 crisis has passed in Sri Lanka. A google questionnaire was used to collect data from randomly selected 150 employees who WFH during the second quarter of the pandemic. Data were analyzed using SPSS Package. The majority, 59% of participants were females. The sample represents 21% of Government, 17% of Semi-government and 62% of Private Sector employees. The Chi- square test revealed that the availability of infrastructure facilities like network connection, hard-ware, soft-ware, and interpersonal relationships with partners, management staff, co-workers and, customers were significant to the employees' performance and achieving job tasks effectively (p= $0.000(\alpha<0.05)$). The employees' perception of self-productivity during WFH is positively correlated with infrastructure facilities (p = $0.002(\alpha<0.05)$. However, the employees' self-productivity has changed with interpersonal relationships not only related to the job but also related to their family. There is a relationship between marital status and self-productivity with an associated significance level of $0.003(\alpha<0.05)$. Married employees manifested lower productivity during WFH due to matters connected with home care. Family commitments in particular is expected to be much more prevalent than previously as employees in the sample prefer WFH even after the pandemic (p = 0.047 $(\alpha<0.05)$). This survey in turn helps inform policy-makers to understand that WFH itself has largely been beneficial if the main issues are being addressed.

Keywords: Working from home, Perception on self-productivity**,** Interpersonal relationship, Digital infrastructure

A Study of Consumer Behavior on Demanding Indigenous Medications during COVID-19 Pandemic – With Reference to Sri Lanka

C.G. Jayasekara[1]* and K.K.H. Pavithra[2]

[1]Department of Economics [2]Department of Sociology
Faculty of Arts, University of Colombo, Colombo 00700, Sri Lanka
*gimhanichethana8@gmail.com

The COVID 19 pandemic situation has given risen to new trends of consumer behaviors due to disrupted buying habits. This study shed light to a situation in Sri Lankan markets which emerged during COVID 19 with an untypical demand towards the "Indigenous medications" including Coriander, Ginger, and Turmeric. The research question was to identify what the public opinion is, on the most reliable method of getting prevented from COVID 19. Primary data were collected on the objective of identifying the patterns of consumer behavior in demanding indigenous medications during COVID 19 crisis. Eighty students studying for a Bachelor of Arts degree in Economics were selected from University of Colombo representing all their family members, while focusing on gender representation of the sample. Required qualitative and quantitative data were collected through questionnaires as it was difficult to conduct interviews during COVID 19 Pandemic. Eighty-five percent of the total sample were practicing indigenous medicine with western medical treatments while the rest (15%) of the sample was using indigenous medicines only. Thorough statistical analysis the questionnaires revealed that 64% of the users who are using both indigenous and western medications have been biased towards using indigenous medications as method of prevention for COVID 19. The research was able to identify that behind these behavioral changes social media has done a 49% contribution while TV, Radio and rumors have also impacted with 19% of contribution to the changes in consumer behaviors. It was identified that 25% of the consumers who were using both indigenous and western medications are planning to continue using indigenous medications as a precautionary method of COVID 19 even at a higher price level than the normal price levels, concluding that majority of the sample have moved on with the trend of using indigenous medications as a precaution for COVID 19.

Keywords: Consumers, COVID 19, Indigenous medications, Western medicines, Pandemic

Covid-19: Issues and Solutions

Effect of COVID-19 Pandemic on Physical Activity among Sri Lankan Population: A Cross-Sectional Study

P.J. Wijkeumar[1], V.A. Samaranada[2] and K.T.G. Kanchana[3]*

[1]Department of Biomedical Science
[2]Department of Medical Science in Acupuncture
[3]Department of Nursing
Faculty of Health Sciences, Kaatsu International University,
Battaramulla 10120, Sri Lanka
*gayani@kiu.ac.lk

The impact of the COVID-19 pandemic on the general population is massive, and one of the effective strategies to reduce the spread is to maintain social distancing. Further, it was facilitated by imposing a nationwide curfew during May 2020. The routine lifestyle of the Sri Lankan population has been affected due to a nationwide curfew. Therefore, the study was conducted to assess the changes in physical activity before and during the COVID-19 pandemic among the Sri Lankan population. A descriptive cross-sectional survey was carried out among the Sri Lankan population during the nationwide curfew in May 2020. Even though the calculated sample size was 384 (Cochrane's formula), 562 data were collected using a pre-tested questionnaire consisting of socio-demographic data (10 questions) and questions addressing the frequency of physical activities carried out before and during the curfew period (16 questions) during the three weeks, that the questionnaire was open to the public. The sample was achieved through snowball sampling technique with ethical approval of KIU (KIU/ERC/20/47). Data were analyzed using descriptive statistics in SPSS version 25. The mean age of the sample was 24.83 ± 5.74 years, and the majority (49.8%) were graduates, while 17.3% of the sample represented the Colombo district. In assessing the physical activity, it was categorized as moderate and vigorous. The majority of the sample (89%) had followed moderate physical activity before the curfew; however, this has been reduced to 1.8% during the curfew. At the same time, 29.7% of the sample followed moderate physical activity between 30-60 minutes per day before the curfew, where only 34.5% of them followed physical activity for more than 60 minutes during the curfew. Under the vigorous-intense physical activities, 49.6% followed no activity before the curfew; however, this has increased to 55% during the curfew (p=0.001). In conclusion, even though the majority had followed a moderate level of physical activity during curfew, it shows a significant increase (p=0.001) of following vigorous-intense physical activities compared to before the curfew. Since regular physical activities act as a protective factor for many non-communicable diseases and mental health, there is a necessity to raise awareness of the recommended thresholds of physical activity to improve quality of life.

Keywords: Physical activity, Sri Lanka, COVID-19, Survey

Ayurveda and Traditional Perception, Preparedness and Public Awareness Related to the Outbreak of COVID-19 in Sri Lanka – A Pilot Study

K.M. Jansz[1]*, W.K.T. Dushmantha[1], T.N.W.M.S. Nanayakkara[1] and Y.S.G. Wimalasiri[2]

[1]*Institute of Indigenous Medicine*
[2]*Unit of Swasthavritta, Institute of Indigenous Medicine,*
University of Colombo, Rajagiriya 10100, Sri Lanka
*kavishkajansz@gmail.com

In Ayurveda, *Acharya Caraka* and *Susruta* both describe pandemic diseases and their causes, modes of *transmission,* preventive and therapeutic measures under *Janapadodvaṃsa and Aupsargika Roga.* COVID-19 is a deadly disease, transmitted through droplet infection which was initially identified in Wuhan, China. There was a trend in China to implement traditional preventive measures but hard to find existing information in Sri Lanka. Therefore, this survey was conducted to study the public awareness of Ayurveda and Traditional perception, preparedness related to the COVID-19 outbreak. A cross-sectional survey was conducted to obtain data from an educational institute in the Kandy district during June to August 2020. The data collection tool was a self-administered questionnaire. It was designed and developed referring to Ayurveda and Sri Lankan Traditional Medical texts. It was validated with subject expertise and a pilot study with ten individuals. The sample was selected randomly and the size was 50. The responses to the study were evaluated by percentages. 46 responses were collected out of 50 questioners, 93.6% of them were females and 6.4% were males. 85.1% of the responded were aware that there are Ayurveda/ Traditional medicines available for pandemics. Results showed that 57.4% have applied *Perumkayam, Vadakaha* during the pandemic and 91.5% of them knew that they are capable of enhancing immunity. Also, 78.7% of the sample have inhaled medicated steam during COVID-19, out of them 84.6% have used hot water, 30.8% included *Pawatta* leaves and 12.8% added *Maduruthala* leaves. *Ov*erall 61.7% from the sample agree to the idea of having an Ayurveda or Traditional treatment protocol for *COVID-19. Therefore a* treatment protocol from Ayurveda or Traditional medicine can be proposed since there is no specific treatment to cure COVID-19 yet. This survey can be conducted island wide to make the public aware on Ayurveda and Traditional perceptions of COVID-19.

Keywords: Ayurveda, Traditional medicine, COVID-19 pandemic

Knowledge, Attitudes and Practices towards COVID-19 Outbreak and Preventive Methods among Non-Medical Undergraduates in a Selected State University of Sri Lanka

T.D. Wimalaweera* and A.A.T.D. Amarasekara

Department of Nursing and Midwifery, Faculty of Allied Health Sciences, University of Sri Jayewardenepura, Nugegoda 10250, Sri Lanka
dinushawimalaweera@gmail.com

Coronavirus disease 2019 (COVID-19) has been recognized as a pandemic by the World Health Organization on the 11th of March 2020. Since this is a highly contagious virus, the spread of the disease depends on the level of public awareness. Therefore, assessing the awareness of this topic among non-medical undergraduates is vital. The objective of this study was to assess the knowledge, attitudes and practices towards COVID-19 outbreak and preventive methods among non-medical students in a state University, Sri Lanka. A descriptive cross-sectional study was conducted among 205 non-medical undergraduates in the University of Sri Jayewardenepura. The data collection duration of the study was from October to November 2020. A self-administered questionnaire was used as a google form and the questionnaire was taken from the study conducted in Pakistan with the permission of the author. Questionnaire consisted of four section: socio-demographic data, knowledge, attitudes and practices regarding COVID-19. Data were analyzed in descriptive statistics by using SPSS (Statistical Package for Social Sciences) software. Knowledge scores were categorized as good (12-15), moderate (8-11) and poor (0-7). Practice scores were categorized as good (28-36), moderate (19-27), poor (0-18). The majority of participants (53.2%) were females. The total mean scores COVID-19 knowledge regardless of faculty was 13.73(SD±1.19). There is a significant association between gender and knowledge. (p<0.001). Overall positive attitudes were high in females than males. The total mean score of COVID-19 practice related prevention is 30.28(SD±3.76). The majority of them had a good level of knowledge and positive attitude towards the COVID-19. Majority of the undergraduates had good level of Practice related to the prevention of the COVID-19. It's recommended to conduct health education programs regarding COVID-19 among non-medical undergraduates in order to increase their awareness on this topic.

Keywords: COVID 19, Non-medical university students, Knowledge, Attitude, Practice

Government Interventions and COVID-19 Pandemic:
An Economic Review of Financial Markets in Sri Lanka

H.A.C. Anuraga, T.P.S.R. Guruge* and J.M.M. Udugama

Department of Agribusiness Management, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP) 60170, Sri Lanka
*guruge84@wyb.ac.lk

The COVID-19 pandemic was an unexpected event which has been spreading in Sri Lanka since early 2020. To mitigate the public health threat, the country had to enforce a variety of measures, including social distancing, public awareness programmes, testing, and quarantine policies. Further, there were many lockdowns, to minimize face-to-face human interactions between the infected and the susceptible. Though these vigilant measures saved lives, they also generated a substantial negative economic shock that disrupted trade within the country. Therefore, the government had to implement income support packages to protect the people. Even though the long-term effect of these government actions is yet to be seen, in this study, we examine the economic impact of COVID-19 in Sri Lanka through the analysis of stock market returns. This was analysed through a multiple regression using daily data collected for multiple variables: Stringency Index, Economic Support Index, Containment and Health Index, COVID-19 Cases, and the effect of such actions on stock market returns through the All-Share Price Index (ASPI) from January 01 to June 30, 2020. It was revealed that stock market returns have been drastically affected in a negative manner with respect to the daily increase in COVID-19 cases. Then, stock market returns have gradually increased along with time, due to government announcements regarding public awareness programmes, testing and quarantine policies, and income support packages. Thus, some of the government measures also have indirect economic benefits which is difficult to predict. More studies need to be done with the availability of further data to better understand the economic impact of such government measures which are crucial in designing better government responses in future because the frequency of pandemics and contagious diseases has increased over recent decades.

Keywords: COVID-19, Economic impacts, Government interventions, Stock market

Right to Health Care during Covid-19 Pandemic:
A Critical Review of Sri Lankan Law against International Standards

K.A.A.N. Thilakarathna[1]* and D.J.P.K. Heiyanthuduwage[2]

[1]Institute of Human Resource Advancement, University of Colombo, Colombo 00700
[2]Directorate of Legal Service, Army Headquarters, Sri Jayawardenepura Kotte 10100, Sri Lanka
*akalanka@ihra.cmb.ac.lk

Right to healthcare has become a stimulating topic during the COVID-19 pandemic. Many of the international human right treaties recognize the right to health including the United Nations Declaration on Human Rights (UDHR) where Article 25 recognizes the right to health care as being one of the fundamental rights of an individual. The International Covenant on Economic, Social and Cultural Rights (ICESCR) also recognizes the right to health under Article 12 where it states that, everyone has a right to the 'enjoyment of the highest attainable standard of physical and mental health'. It may also be added that the right to health means having access to the health services they need, when and where they need them, without suffering financial hardship. Therefore, under international human rights law, there is a specific right granted upon the individuals regarding the right to health and healthcare facilities. In this backdrop, using a qualitative methodology with the use of the black letter approach through a critical evaluation of the existing international legal instruments including, treaties, covenants, declarations and accords, this study aims to critically analyze the Sri Lankan context regarding the right to health care, and in particular, the right to vaccination under the Sri Lankan law. The findings reveal that the 1978 Constitution fails to recognize many of the vital rights, including the right to healthcare. Even under the directive principles enshrined under Article 27 of the Constitution, there is no reference to healthcare. However, the judiciary through its powers of interpretation with the aid of Article 12 of the Constitution has interpreted into the Constitutions rights such as, right to life, environment, and right to receive information. Still, it has not been able to hint on the right to healthcare. In such a background it is recommended that Sri Lanka must take necessary steps in providing adequate healthcare facilities including vaccination to overcome the COVID-19 pandemic as Sri Lanka cannot escape its international responsibility in providing healthcare for its individuals, especially during the COVID-19 pandemic.

Keywords: Covid-19, Right to healthcare, Vaccination, Sri Lankan law, Human rights

Foreign Students' Adaptation to Social Media in China during Covid-19

A. Lokumannage

Department of Mass Media, Sri Palee Campus, University of Colombo,
Horana 12400, Sri Lanka
amila@spc.cmb.ac.lk

This study analyzed how foreign students used social media in China during the COVID-19 pandemic. The objectives of this study were to study how foreign students engaged using WeChat in China, to understand how WeChat groups and news pages facilitated foreign students in China and to determine how foreign students use WeChat as an educational tool. The researchers used close-ended questions to ask from students and used the Likert-scale for the answers by using a five-point measure questionnaire. The researcher gave an online questionnaire to 100 students from 10 different countries that were enrolled in 05 universities in Beijing. Since every university has foreign students, the researcher selected only universities in Beijing. All of them were studying for their Bachelor's degree. As a research method, case study was used for this and the sample was collected by using the simple random sampling technique, a type of probability sampling. The findings show that large numbers of students have been using WeChat due to the influence of friends and classmates. Students also used WeChat to release stress and to find joy and happiness. WeChat not only allows foreign users to access but also allows users to refer this to their friends and family living outside China. Around 69% of students were using WeChat for more than 02 hours in a day. Around 42% of respondents agree with the statement "My family uses WeChat and encourages me to use" and 61% of the respondents showed a positive response to the statement "WeChat plays a significant role for me in obtaining information". Around 72% responded saying that WeChat helps their classroom activities and education. During the quarantine period foreign students used WeChat as an educational tool & shared information about the COVID-19 pandemic.

Keywords: China, Covid-19, Social media, WeChat, Foreign students

Study on Parents' Factors Influencing Children's Online Learning during Covid-19 Period

A.W.K.G. Wijesingha[1]* and L.H.D.L. Ranasuriya[2]

[1]*Department of Education and Training*
[2]*Department of Language Studies*
University of Vocational Technology, Ratmalana 10390, Sri Lanka
**awkasuni@gmail.com*

The widespread COVID-19 pandemic was the reason for the sudden closure of Sri Lankan schools and the collapse of the traditional classroom-based learning system. Therefore, many school children were assigned to get school education through online learning. It creates a great weight on their parents because they had to make great efforts to provide their children with the facilities required for online learning from home. Thus, this research aimed to study the extent to which parents' factors influence children's online learning during the COVID-19 period. The descriptive research design was used to gather panel data from a sample of students (n=30) and parents (n=20) whose children studied in primary classes in a school in the Ratnapura district of Sri Lanka applying a convenience sampling technique. Personal semi-structured interviews were the main instruments of data collection to get an insight into the real-life experiences of parents and students about online learning. Moreover, a structured questionnaire was employed. In the application of the questionnaire, participants were asked to rate how much they agreed with the statements on a five-point Likert scale, ranging from 'strongly disagree' to 'strongly agree.' Data were analysed using descriptive statistical analysis techniques. The results revealed that parents' awareness related to the utilization of technological devices, online educational applications and internet facilities, parents educational background, and parents' socio-economic background are the factors which have influenced significantly and positively on the children's online learning. The findings suggest the initiation of seminars, training programmes, workshops for parents to enhance the knowledge and skills related to online education. Besides, the results encourage the provision of reliable internet connections, equipped with the necessary online educational applications and prompt financial aid to low-income families where necessary.

Keywords: COVID-19, Online learning, Parents support, Children, Impact factors

Impact of Patriotism on Motives for COVID-19 Prevention: An Experimental Survey

D.I.J. Samaranayake[1]*, P.H.R.R.P.K. Munasinghe[2] and S. Jayasooriya[3]

[1]Department of Management Studies
[2]Department of Human Resource Management
Faculty of Management, University of Peradeniya, Peradeniya 20400, Sri Lanka
[3]Innovation4Development Consultants, Sri Lanka
*dijs@pdn.ac.lk

This study investigates the possibilities of plausible impact from patriotism on the pro-sociality and the motives of citizens towards COVID-19 prevention. The study focuses on the empirical evidence of plausible motivations of Sri Lankan citizens to cooperate with the State in minimising the socio-economic and health costs of the pandemic. Thus, the role and significance of patriotism, pro-sociality, attitudes, and beliefs of Sri Lankan citizens in COVID-19 prevention is examined. Accordingly, the study was designed as an online experiment consisting of two simultaneous trials to test two broad hypotheses. Accordingly, the initial objective of this study was to observe whether the pro-sociality of subjects improves the intentions and effort of Sri Lankan citizens in adopting COVID-19 prevention behaviour. This led to observing whether patriotism mediates the pro-sociality of citizens and affects their intentions and efforts in following COVID-19 prevention behaviour. The sample of the study consisted of 320 undergraduates representing 40 each per session. The experimental design consisted of two scenarios consisting a baseline and three treatments each of which represented situations with and without patriotism as an effect. Further, the differences across treatments were followed by self, close-prosocial and distance-prosocial concerns. The analysis averages the responses collected via 10-point Likert scales to observe the treatment effects and, clustered regressions to identify the significances and their magnitudes. Results verify that pro-sociality improves the intentions and effort on COVID-19 prevention behaviour. Further, we observed that the perceived public threat is more strongly associated with COVID-19 prevention intentions than the perceived personal threat when patriotism appeared. Thus, the results highlight the relative importance of pro-social motives and patriotism for COVID-19 prevention.

Keywords: COVID-19, Effort, Patriotism, Prevention intentions, Pro-sociality

Space (Un)seen: A Discussion on the Dismantled Classroom and Its Effects on the Pedagogical Space as a Result of COVID-19

S.S. Hapuarachchi*, H.M.C.S. Kulathunga and F.F. Fairooz

Department of English Language Teaching, University of Peradeniya,
Peradeniya 20400, Sri Lanka
*swapnihapuarachchi@gmail.com

This study explores how the traditional space of education has entered a virtual pedagogical space due to the COVID-19 pandemic, redefining the power dynamics of the classroom. The outbreak of the pandemic forced the educational institutions in the country to be shut down, shifting synchronous teaching and learning to an asynchronous one. The ada/option of the virtual education system shifted the space of education from the typical 'four-walled' classroom to the domestic sphere. In Michel Foucault's concept of *panopticism*, he states that a specific space is allocated for every function and that each of these spaces acts as a medium of power, discipline and governmentality. The pre-existed rigid boundaries of the classroom have now become fluid, thus demanding the need to reimagine the pedagogical space and the conditions that are associated with it. Hence, the objective of this study is to unpack how the disciplinary power that existed within the traditional classroom has now by and large taken a form of governmentality. This qualitative research has been conducted using the empirical method where information was gathered through interviews and informal discussions with ten members of academia and fifteen undergraduates from the Faculties of Arts and Allied Health Sciences of University of Peradeniya. It was observed that the pre-existed authority of the teacher has now dispersed among the students and the medium of teaching-technology. Unlike in the physical classroom, the flow of knowledge and the code of conduct of both the teacher and the student are under heavy surveillance in the virtual space through recording of lectures, social media and other technological agents such as third party recording applications. Therefore, this study provides a microscopic view of the new pedagogical space through the Foucauldian Eye.

Keywords: Pedagogy, Space, Technology, Power

Protecting Human Rights in Post Covid-19 Crisis: With Special Reference to Digital Rights

E.K.J. Kaushalya

Department of International Studies, Faculty of Social Sciences, University of Kelaniya, Kelaniya 11300, Sri Lanka
kaushalyajayani806@gmail.com

The COVID-19 pandemic isn't just a health issue. Due to COVID-19, the day-to-day life of people changed completely from what it was before. As the Coronavirus continues to spread around the world, governments have imposed regulations on the movement of people, the efficiency of services, and physical distance. In this context, technology affects the daily lives of citizens and ensures that they have access to health services, access to information and communication with competent authorities. Accordingly, during the COVID-19 period, the work of Governments and National institutions, Educational institutions, International organizations and other activists has been effectively carried out through technology. The world has become more digitized than ever before. The digital technology plays an important role in the post COVID-19 world. The COVID-19 crisis underscores the importance of digital transformation and digitally effective digital governance in every country. It's clear that the situation caused by the Coronavirus epidemic has already accelerated the pace of digital transformation. However, the rapid and long-term use of digital technologies impact on human rights and their adherence to the principles of transparency and accountability. The main objectives of this study are to explore main ways of digitalization, to identify the human rights associated with the digitalization and to explain the ways of protecting human rights in post COVID-19 period. The methodology followed in the study is qualitative in nature while the research is entirely based on secondary sources of data like books, journal articles, reports and documents. A descriptive analysis method is used by the researcher. The findings of the study determine that the digital rights of the people are affected in post COVID-19. On the principle of human rights, it's important to protect the digital rights of people for a universal approach to technology, data security, transparency and discrimination.

Keywords: Digitalization, Post Covid-19, Human rights, Digital rights, Technologies

Education under COVID 19: A Study on Differently Abled Students

W.S.N. Siriwardhana[1]* and I.M. Dissanayaka[2]

[1]Department of Sociology
[2]Department of Demography
Faculty of Arts, University of Colombo, Colombo 00700, Sri Lanka
*wsnsusi@gmail.com

Schools across Sri Lanka took immediate decisions to shut their doors and many schools and education centers have been following online methods for the whole education process to date. Students have never been more important but no one involved is taking part in the discussion about the differently abled students' education under COVID 19. The main objective of the study was identifying the difficulties faced by the differently abled students in online education. Sub objectives were understanding the perspectives of the teachers and supportive staff on online education, understanding the parents' perspective on online education and identifying strategies to overcome these difficulties in online education. The sample size was 12. Sample was taken under purposive sampling method and semi-structured interviews were conducted with educational supportive teaching staff of Rienzie Alagiyawanna School for the Deaf and Blind, Anuradhapura for the differently abled students (Number of 06) and parents of primary students (Age 06 – 12 with hearing difficulties) (Number of 06). Findings shows that majority of respondents have a lack of knowledge in online education technology (58.3%) and 100% of supportive staff mentioned that activities like lip reading cause many problems when it comes to online education. And majority (83.3%) of the sample mentioned that measuring their development and understanding the needs and changes in their physical and mental stability have been challenging. But in term of parents it was a good time to understand their children and support them (5 out of 6). This may causes exclusion and anomie. In concussion it was clear that fixed process of including and training parents and encouraging parents to volunteer is timely as a solution. Also a principle and authority intervention towards differently abled students has become essential to face upcoming calamities.

Keywords*: COVID 19, Different abled, Education, Online, Onsite*

Need for Online Learning for a Better Future for Young Bhikku Students

I.M. Dissanayaka[1]* and W.S.N. Siriwardhana[2]

[1]Department of Demography
[2]Department of Sociology
Faculty of Arts, University of Colombo, Colombo 00700, Sri Lanka
*imashamdshn@gmail.com

The study on Local impact of online learning during COVID 19, emphasizes the impact of the online learning process during the pandemic. Online learning process was a new experience to Sri Lankan students and undergraduates. The lockdown and social distancing implementations were introduced to prevent the spread of the coronavirus in Sri Lanka and it is happening in some universities and schools up to date. The education system was completely interrupted but continues with the academic process with the necessary changes. Then the traditional onsite format shifted to online learning, using Zoom and other applications. In the Sri Lankan education context, it is completely dependent on information technology. This study was carried out in the context of Bhikku University. In depth interviews (n = 25) were used as a main data collection tool and all the outcomes were analyzed through thematic and narrative analysis methods. The result shows that majority of the sample is interested in online learning and most of them have engaged in online classes and discussions during the lockdown period. They were interested in interacting with this new learning process and they were not seeking the traditional onsite, teacher centered process and collecting notes. According to the study it was clear that the knowledge on online education process among between young Bhikku students is quite fine but the lack of resources and important readings are the main issues. As the respondents have a good knowledge in dealing with information technology and applications, online learning teaching skills and learning skills must be improved furthermore. According to the findings, for a better future of young Bhikku students under the upcoming social changes, online education is really important.

Keywords: Bhikku students, COVID 19, Online learning, Social science

Impact of COVID-19 Pandemic on Field of Higher Education in Contemporary Sri Lanka (with Special Reference to Sri Lankan National University Education)

K.M.D.S. Karunarathna

Department of Mass Media, Sri Pali Campus, University of Colombo, Colombo 00700, Sri Lanka
Sandamalikarunarathna7@gmail.com

The global education landscape has transformed in favor of distance learning (Remote learning) in the wake of the COVID-19 pandemic. Thus, online learning system has become an integral part of the learning/ teaching process in the higher education sectors during the COVID-19 era. The COVID-19 pandemic posed a challenge to the traditional Sri Lankan higher education system. Prior to the pandemic, online education was rarely seen in the field of higher education in Sri Lanka. Thus, while promoting online education among the university student community as an alternative solution to the educational crisis that has arisen due to the closure of Sri Lankan national universities in the wake of the COVID-19 pandemic, there are many peculiarities that can be observed. This research seeks to provide an insight into the impact of the COVID-19 pandemic on university learning and teaching process and challenges faced by the students in maintaining the online education system. Moreover, the research methodology was used was content analysis and scientific statistics method. A team of 500 university students covering 14 national universities in Sri Lanka was selected as the research sample and observations, questionnaire, formal interviews and informal discussions were used to collect data. The findings of the research show that the university students face a number of challenges in organizing the work processes and time management, technical issues, computer literacy, distraction, understanding course expectation and lack of in-person interaction. The study argues that, moreover, in the face of the prevailing COVID-19 pandemic, the teaching and learning process in higher education sector needs to be more effective and focused on the hybrid education and training system as a solution to the problems observed in the online education system while introducing new trends and opportunities.

Keywords: COVID-19, Online education, Higher education, Sri Lankan national universities, University student community

Perceived Stress among Nurses Working in National Institute of Infectious Diseases: Sri Lanka during COVID-19 Pandemic

H.H.N.D. Dharmarathna*, D.D.V.N. Devapura, E.A.C.M. Ekanayake,
E.A.P.S. Ekanayake, A.R. Jayamaha, S.H.N.M. Jayasena and A.G.Y.S. Kumari

Department of Nursing, Faculty of Health Sciences, KAATSU International for Undergraduate-studies, Battaramulla 10120, Sri Lanka
*nishadi@kiu.ac.lk

During the COVID – 19 pandemic, nurses play a vital role in managing the health crisis in the country and face enormous challenges. The global prevalence of high levels of stress is 45% among nurses during the period of the COVID 19. There is a paucity of evidence regarding the level of stress among Sri Lankan nurses which is instrumental in planning and implementing appropriate strategies. The study aimed to assess perceived stress and its associated factors among nurses working in the National Institute of Infectious Diseases (IDH) in Sri Lanka during the COVID-19 Pandemic. A descriptive cross-sectional study was conducted among 160 nurses at IDH from August to October 2020. Data were collected using a pretested self-administered questionnaire which was developed by the researchers. Perceived Stress Scale (Sheldon Cohen- 10 item scale) was used to assess the level of stress. Descriptive statistics and Chi-square test were performed using the statistical package SPSS version 25 for data analysis. Ethical approval was obtained from the Ethics Review Committee of KIU (ERC/KIU/20/58). The mean age of the participants was 30±5 years and 84% were females. Nearly half (56%) of the participants were married and one-third of the participants (34%) graduated. The average working hours per day was 13±4 hours. Most (87%) of the participants were grade one nursing officers. The majority (80%) of the participants had a moderate level of perceived stress and the mean perceived stress score was 22.2±4.5. Age (p=0.02), working hours per day (p=<0.001), number of night shifts per week (p=<0.001), and training on COVID 19 infection prevention and control (p=0.01) were associated with the stress of the participants. The current study revealed that the nurses are having a moderate level of stress during the COVID 19 pandemic. Therefore, appropriate strategies to unravel the moderate level of stress should be implemented among nurses working in the National Institute of Infectious Diseases

Keywords: Perceived stress, Nurses, COVID 19, Pandemic

Mental Well-Being during Covid-19:
A Philosophical Study on *Thantric* Buddhist Concepts

A.M.R.M. Senewirathna

Postgraduate Institute of Humanities and Social Sciences, University of Peradeniya, Peradeniya 20400, Sri Lanka
rmadhushikasenevirathna@gmail.com

Religions offer psychological guidance in order to keep a sustainable mental well-being in humans. Religion usually prescribes both physical and the psychological aspects of living being. When studying about *Thantric* Buddhism, it is obvious that it is closely linked with positive psychological aspects and studies. In *Thantric* Buddhism, the concept of *Nirvana* has some distinct definitions and practices. One such distinct idea is not to abandon the desires but rather to use the power of the desires. To reach the noble state of *Nirvana*, the follower has to think of himself as one who has already embraced it. In this study, the importance of concepts and ideas in *Thantric* Buddhism in order to acquire a positive mental state, have been studied and presented as a research. The research problem of this study is to reveal the practical utility of the positive psychological perspectives in *Thantric* Buddhism as a resolution to the current pandemic situation. The study mainly covers the principle components in *Thantric* studies and the research limitation is marked focusing on the major objectives in order to absorb the maximum benefits from those studies. In order to assist this study, books and other sources of information were referred to. In conclusion, this is an overall study based on information from various resources and a collection of concepts which are related to the main components of *Thantric* Buddhism. There are two expected final outcomes of this study. The first is to highlight the importance of studies on human psychology during a pandemic situation and the second one is to raise of awareness on the importance of *Thantric* Buddhist studies which is of minor reference in the field of research.

Keywords: *Thantric* Buddhism, psychology, Positive, Mental well-being

Double Ticked: The Impact of Using WhatsApp as a Pedagogical Tool to Improve German Spoken Skills in Times of Covid-19

L.H.M.D.S. Lansakara

Sri Lanka Institute of Advanced Technological Education,
Anuradhapura 50000, Sri Lanka
sachilansakkara@gmail.com

Earlier in Sri Lanka, online learning was considered a supplement learning method and later was part and parcel of blended learning. However, with the pandemic outbreak, teaching and learning in Sri Lanka evolved into an only online based process. Electronic devices, online applications and social media platforms therefore received a vital role to be played in achieving the teaching learning targets. Improving the spoken skills of a foreign language on the other hand is greatly influenced by the current virtual learning trends. The purpose of the study, therefore, was to examine the impact of employing WhatsApp mobile application as a pedagogical tool to improve the German spoken skills of tertiary level learners. The study involved 30 second year students representing the Higher National Diploma in Tourism and Hospitality Management (SLIATE) who learn German as a foreign language. The learners joined in a WhatsApp chat group and the spoken activities were shared along with the guidelines for their oral responses. Pre and post-oral tests and a focus group discussion were carried out to collect data while Excel Analysis and Qualitative data analysis Model (Seidel,1998) were engaged in the analysis. The findings revealed utilizing WhatsApp to improve German spoken skills had a noticeable impact on the learners. Their familiarity with pronunciation, grammar and basic German expressions has been improved. The test results indicated that 73.3% of the learners have improved their spoken skills showing evident changes in the skill. Focus group discussions highlighted that most learners perceive WhatsApp based learning as a productive approach which is novel, interesting, and inspiring. The majority observes this method as an opportunity to communicate in German as in authentic scenarios. Thus, the study recommends German teachers to use WhatsApp as a pedagogical tool to enhance the spoken skills through online teaching as well as in blended learning approaches.

Keywords: German as a Foreign Language, WhatsApp, Online learning, Spoken skills, Pedagogy

Homestay and COVID-19: Challenges and Opportunities for Recovery in New Normal Conditions

V. Hewage* and R. Ranasinghe

Department of Tourism Studies, Faculty of Management,
Uva Wellassa University of Sri Lanka, Badulla 90000, Sri Lanka
*vinuharshi1992@gmail.com

The global COVID-19 pandemic has engulfed the tourism industry, putting a calamitous effect on the global economy to witness one of the most devastating economic recessions in the 21ˢᵗ century. Sri Lanka is undergoing a downturn in the sector due to international travel restrictions, suspension of international air flights and social distancing, resulting in zero tourist arrivals and closure of accommodation facilities. Homestays are currently struggling to carry out their operations and it is important to recognize the existing obstacles and potential prospects for their better survival in post COVID-19. Considering the lack of available scientific studies expressly focused on homestays, this study aimed to identify the challenges and opportunities available for homestay operators in the new normal conditions of COVID-19 pandemic. Entrusting a qualitative research approach, the primary data was collected from 8 homestay operators and 8 stakeholders in Ella Divisional secretariat and Mirissa which belong to the Weligama Divisional Secretariat, using the purposive sampling technique. Direct in-depth interviews were executed and thematic analysis was used to analyse the transcribed data. The study identified challenges and opportunities in terms of economy, environment, health and safety, socio-cultural and political aspects. Key findings revealed zero income generation, employment termination, lack of investment prospects and credit facilities, future low-price forecasts, and lack of readiness and training on health protocols. Regardless of the assumptions made by the scholars, it specifically exposed conflicting discoveries indicating that homestay operators do not want to get involved in the growing domestic tourism market to overcome their financial burden particularly influenced by the undesirable behaviours publicized by the domestic tourists leading to discrimination. The community is well-aware of the contribution of homestays to develop rural economy in new normal conditions, yet stresses on the proper screening of tourists and operators as they prioritize their safety. The study also observed a tendency in homestay operators shifting into non-tourism businesses due to the lack of revenue. It discloses opportunities such as moratorium, and loan services. Furthermore, the study recommends applying the "Safe and Secure" credential to homestays, to devise exclusive credit policies for homestays, and to plan post-COVID destination marketing campaigns emphasizing homestay operations while adopting diversification strategies and to extend the current market into new market segments at least in the short run to avoid the financial struggle.

Keywords: COVID-19, Challenges, Homestay, New normal conditions, Opportunities

Impact of External Locus of Control and Risk Perception on COVID-19 Related Stress among Undergraduates

T.J. Gunawardena*, G.R.K. Dissanayake, A. Bulathwatta, N. Hettiarachchi, P.Y.O. Perera, R.M. Rathnayake and P.M.G.U. Nirmani

Department of Psychology, Faculty of Arts, University of Peradeniya, Peradeniya 20400, Sri Lanka
*tehanijgt@arts.pdn.ac.lk

COVID-19 pandemic poses a major stressor for undergraduates worldwide with lockdown policies and the closure of the universities. Risk perception which contains emotional and cognitive types determines whether an individual would implement protective behaviors. Risk perception in the pandemic has led to the experience of stress due to the emergence of fatal novel strains of the virus and the unavailability of vaccination in parts of the country. According to Adams & Smith (2001), an individual's perception of the possibility of moderating or removing the risk, known as Locus of control (LOC) is central to risk perception. Many studies demonstrate the way in which risk perception mediates the relationship between LOC and stress reactivity. This study aims to explore whether LOC and risk perception play a role in stress among undergraduates. 371 undergraduates were recruited using convenient sampling method from the Faculty of Arts, University of Peradeniya. Data was collected online during the initial lockdown period from March-April 2020.The questionnaire consisted of demographic information and content and consensually validated LOC, COVID-19 related Risk Perception and COVID-19 Stress Scales. External LOC had a significant positive relationship with both COVID-19 related risk perception, $r(369) = .151$, $p = .004$ and COVID-19 related stress, $r(369) = .131$, $p = .012$, indicating an increase in external LOC which leads to an increase in risk perception and COVID-19 related. Higher levels of risk perception lead to an increase in COVID-19 stress, $r(369) = .431$, $p = .000$. A Sobel test-based mediator analysis indicated emotional risk perception mediating the relationship between external LOC and COVID-19 stress. Emotional risk perception is a potential intervention point for managing stress among students whose sense of agency is external in the face of a pandemic.

Keywords: COVID-19, External locus of control, COVID-19 stress, COVID-19 risk perception, Undergraduates

Impact of Network Coverage and Strength on Undergraduates' Distance Learning in Sri Lanka during COVID-19

W.M.S.S. Dias*, C.S. Arambegedara,
W.V.W.S.K. Rathnayake and Y.G.P.D.K. Jayasekara

*Department of Geography, Faculty of Arts, University of Peradeniya,
Peradeniya 20400, Sri Lanka
mihirdias@arts.pdn.ac.lk

The second wave of the COVID-19 pandemic has encouraged the establishment of a virtual learning system among the higher education institutions in Sri Lanka. As a result, the students who live all over the country have been required to commit to distance learning from their residence. However, this virtual learning process has created several concerns of participation such as poor internet connection, data cost, inaccessibility to devices, power failures etc. According to the previous studies, more than 75% of the undergraduates have faced network coverage and strength related issues rather than other participating difficulties. Therefore, this study aimed to examine the impact of network coverage and strength on undergraduates' distance learning by analysing the satisfaction of students on online learning vs. their network strength and performing a mapping analysis to detect the spatial unevenness of network coverage in Sri Lanka. To fulfil the above objectives, network coverage data was collected from secondary sources, and primary data was collected by using a virtual questionnaire survey from 254 undergraduates (74 males & 182 females) in 163 Divisional Secretary's Divisions considering their permanent residency and the availability of 2G, 3G, & 4G coverage. Data was analysed quantitatively with the support of Excel & ArcGIS data analysis tools. The mapping analysis reflected that out of the total area of Sri Lanka (excluding forest & inland water bodies), 1.6%, 15.5%, and 11.5% do not have 2G, 3G, and 4G coverage respectively. Moreover, the undergraduates who live in areas with 2G coverage were very dissatisfied about the distance learning compared to the students in 3G and 4G areas; the students' satisfactory levels in 2G, 3G and 4G areas were 21%, 44% and 60% respectively. Therefore, the results suggest that authorities have to minimise the spatial unevenness of network coverage to provide a better virtual learning experience to the undergraduates.

Keywords: Distance learning, Network coverage and strength, COVID-19, Undergraduates

Natural Language Processing-Based Solution for the Management of Covid-19 Infodemic

G.A.D. Ganepola

Department of Information Technology, Faculty of Computing, General Sir John Kotelawala Defense University, Ratmalana 10390, Sri Lanka dasunig@kdu.ac.lk

The Covid-19 pandemic outbreak occurred when technology is expeditious for information generation and sharing. This created an "Infodemic"; a continuous amplification of health information leading to an information overload. This has challenged the human population because the mismanagement of information disrupts the processes of preventing the virus from the spread and safeguarding the public resulting in decreasing effectiveness to end this pandemic situation. A key segment of the Infodemic is medical and scientific research publications related to the virus and the pandemic. Research has been conducted countlessly worldwide since the outbreak leading to immeasurable numbers of publications, which has made scientists difficult to keep pace with ongoing and potential research related to Covid-19. Hence, urgent assistance for information management is required. This research aims at information management through Artificial Intelligence utilizing the technologies in Natural Language Processing. The objective of this research is to develop a model that can discover abstract topics and themes in the English language with respect to Covid-19 related scientific publications by text analytics. Covid-19 Open Research Dataset was used for this research. Publications during the period from January 2020 to January 2021 were selected for the discovery of contemporary topics and themes. The abstracts of those publications were selected as they are summaries of publications. Thereafter, abstracts were tested for text similarity by Cosine similarity metric and were grouped based on the score. Afterward, data cleaning process, removing punctuation, lower casing, and stop words were carried out. Tokenization & Lemmatization and creating trigrams were performed before generating the Corpus & Dictionary. The topic model was developed from Latent Dirichlet Algorithm, and hyper-parameter tuning was performed for model optimization. Model performance was evaluated through coherence score and the initial score resulted in 0.6501. Continuous model performance evaluation is being performed to ensure improved model performance.

Keywords: Information overload, Information management, Natural language processing, Topic model, Latent dirichlet algorithm

Low-Income Urban Dwellers' Perception on Social Stigmatization during a Pandemic Situation: A Study Based on "Sayurupura" Multi-Storied Housing in Angulana

H.L.S. De Zoysa

Department of Sociology, Faculty of Humanities and Social Sciences,
University of Ruhuna, Matara 81000, Sri Lanka
lszoysa96@gmail.com

The COVID-19 pandemic situation has impacted on humans' social, economic, political and cultural behaviour. Low-income urban dwellers have also been affected by the COVID 19 pandemic. This community has faced several problems when they had to adhere to the new health care practices. Therefore, this study focused on identifying how low-income urban dwellers reflect upon their existing stigmatized identity corresponding to the pandemic. Phenomenology was used and data was collected from twenty in-depth interviews with community members in Sayurupura multi-storied housing in Angulana. Thematic analysis was used for the data analysis process. Experiences of stigmatization in the pre-COVID-19 period, experiences during the pandemic situation, socio-cultural issues during the pandemic and reflections of the community members were some identified themes of this research. The analysis indicates that the low-income urban dwellers were already a stigmatized community even before the pandemic situation since they belong to a sub-cultural group, however they were highly likely to encounter social stigmatization due to several experiences during the pandemic as well. Labelling as a "Corona spreading community" in the neighbourhood areas, diminishing the interpersonal relationships with familiar middle-income urban dwellers, being humiliated due to the higher number of family members in a family and the inability to adapt to the new healthcare practices were some identified types of stigmatization. Consequently, the inhabitants were likely to be discriminated in accessing social services and securing their day-to-day opportunities, for instance, getting disqualified from job interviews, being humiliated in the grocery shops and even in public transportation. These types of stigmatization led this community to be isolated and be hopeless during the pandemic. In conclusion, social stigmatization is identified to be an existing threatening issue for the urban low-income communities and during the pandemic, their social stigmatization has taken a turn for the worse.

Keywords: Condominium, COVID19, Low income, Stigmatization, Urban

A Critical Study of the Impact of Covid-19 on Religious Practices and Faith

N. Sugatharakkhitha

¹Department of Pali, Faculty of Language Studies, Buddhist and Pali University,
Homagama 10200, Sri Lanka
sugatha.lk@gmail.com

Religion has long played a major role in bringing solace to people, both young and old. Any kind of pandemic can disrupt the daily routine of the wider society as a whole and likewise, one specific social manifestation that is affected is the activities related to religious practises and the faith bestowed on religion. There are numerous limitations and restrictions imposed on religious activities locally and internationally to contain and prevent the transmission of the deadly virus. Religious observances that gather crowds are halted, and pilgrimages are cancelled. This research focuses on the changes that have taken place in religious practises Sri Lanka and how the faith of the devotees has been affected due to these unprecedented changes during the prevailing COVID-19 situation. In order to achieve the set objectives, a structured questionnaire was handed out to 25 members of devoted Buddhist families around the area of Colombo which aimed to gather quantitative data. The sampling technique used was convenience sampling. In discussing the changes, the research revealed new implementations carried out by Buddhist temples to perform the most necessary services to avoid social gathering. The research revealed that the number of devotees visiting temples had significantly declined due to the pandemic which had a negative impact on the faith of the devotees. Due to the increasing health issues and challenges being encountered most devotees were struggling to keep their faith alive. A number of recommendations to strengthen the faith of devotees, especially of the youth include carrying out Sunday religious classes via online platforms such as Zoom and conducting competitions with incentives that were related to Buddhist activities. Overall, religion had been significantly affected due to the pandemic and measures needed to be taken to protect and strengthen the faith of the community for the future.

Keywords: Religion, COVID 19, Faith, Religious practices, Buddhism

Students' Perspectives on E-learning Environment and Perceived Stress during COVID-19 Pandemic: A Study of Allied Health Science Students of University of Peradeniya, Sri Lanka

R.M.A. Chamika*, M.L. Pathirathna and M.A.J.C. Marasinghe

Department of Nursing, Faculty of Allied Health Sciences, University of Peradeniya, Peradeniya 20400, Sri Lanka
*anjalirathnayaka@ahs.pdn.ac.lk

COVID-19 pandemic is one of the greatest challenges that the current education systems have ever faced. It emphasized the importance of using online models and applications to achieve learning outcomes. Although E-learning has its own advantages, sometimes switching to E-learning may cause an increase in the level of stress among students. The present study aimed to explore the perspectives and perceived stress of the E-learning environment during the COVID-19 pandemic among allied health sciences students of University of Peradeniya, Sri Lanka. A cross-sectional descriptive survey was conducted by enrolling 547 students of the Faculty of Allied Health Sciences, University of Peradeniya. Data was collected using an online survey which consisted of four components: Socio-demographic characteristics, COVID-19 related factors, Perceived Stress Scale (PSS), and students' perspective scale on E-learning during COVID-19 pandemic. T-test and ANOVA test were performed to examine the mean differences between groups, and correlation analysis was used to examine the relationship between perceived stress and students' perspectives on E-learning. The average score for the PSS and students' perspective scale were 19.81 ± 4.925 (2-40) and 28.49 ± 6.36 (10-50) respectively. A majority of students (92.9%) were concerned about academic delays due to COVID-19 and 95.1% of students were actively engaged in E-learning activities conducted by the faculty. Further, a majority of students (77.9%) accessed E-learning via smartphone. Students who had the experience of living in a lockdown area ($P<0.05$) and students who were concerned about academic delays ($P<0.05$) had higher PSS scores than their counterparts. Results of correlation analysis indicated a negative significant correlation between perceived stress and students' perspectives on E-learning ($P<0.01$). COVID-19 may have an immense influence on perceived stress among health sciences students and stress is making a significant negative impact on students' perspective on E-learning.

Keywords: COVID-19, E-learning, Perceived stress, Students' perspectives

COVID-19: An Analysis of the Impact of Pandemic Lockdown on Daily Wage Earners in Katugastota Area

A.M.N.A.D.J.S. Nanayakkara[1], P.A.D.M. Perera[1],
V.P. Ratwatte[1] and P.P.A.W Athukorala[2*]

[1]Postgraduate Institute of Humanities and Social Sciences
[2]Department of Economics and Statistics
University of Peradeniya, Peradeniya 20400, Sri Lanka
*wathukorala@yahoo.com

The Coronavirus pandemic (COVID-19) has created serious economic consequences to all households in Sri Lanka, particularly the daily wage earners. The government imposed travel restrictions and curfews that caused tremendous changes to their livelihood. The objective of this study is to analyse the impact of the pandemic lockdown on daily wage earners, by investigating how it affected their income and the strategic changes made in the business to fulfil their basic requirements during and after the lockdown period. The study used 150 daily wage earners in the Katugastota area where a relatively large number of daily wage earners gather to sell their goods. The time periods considered in the study are from March 2020 to May 2020 (lockdown period) and from June 2020 to October 2020 (second wave of the pandemic). This study used a convenience sampling method and included 11 categories of daily wage earners. The primary data was collected using a semi-structured questionnaire. Data gathered from in-depth interviews was analysed using the descriptive statistical method. Findings include that immediately after the lockdown, there was a temporary discontinuation in the daily wage earners' occupation due to the buyer's reaction to the prevailing pandemic situation. As a result of the decrease in demand, their daily wage income decreased (35%) and it worsened during the second wave. They employed coping strategies such as pawning of assets, borrowing from formal and informal sectors, drawing from savings particularly to buy daily household requirements. While 6% of respondents have changed their occupation, 15% have been selling items according to seasonal demand and 33% borrowed money from informal lenders. In conclusion, the COVID-19 pandemic worsened the livelihoods of daily wage earners. This draws much needed attention towards a more inclusive social protection system that would support the daily wage earners effectively in times of crisis.

Keywords: Daily wage earners, Pandemic lockdown, Coping strategies, Unemployment, Wage fluctuation

Applicability of Modified Markovian Queueing Model for Economic Recession due to COVID-19

J.A.S. Dinushan* and C.K. Walgampaya

*Department of Engineering Mathematics, Faculty of Engineering,
University of Peradeniya, Peradeniya 20400, Sri Lanka
sanoj.j@eng.pdn.ac.lk

Businesses often offer lucrative deals and discounts so that customers feel encouraged to engage with those firms. Such arrivals are termed as encouraged arrivals. As a pandemic is overwhelming the world, it could be suggested that, for upbringing of declining businesses, this concept, now, deserves to be taken into account than ever in the past. Considering customer management, queueing theory deserves to be paid special attention as on many occasions waiting lines are formed when the arrival rate of customers outpaces the service rate of firms. Among many variations of queueing systems, as one of most practical applications of waiting lines, we decided to study the behavior of a queuing system having multiple service points. In order to describe mathematically the encouraged arrival process, Markovian queuing model is used and the parameter that represents the arrival rate is modified with percentage increase in the arrival rate of customers. We have investigated the behavior of measures of performances with and without encouraged arrivals for this queuing system. In the analysis it was possible to identify that a significant number of customers compared to the normal arrival process is engaged with the system when it is affiliated with the encouraged arrival process. It also shows that customers engage more and more with the system irrespective of the high rates of arrivals and low rates of services. In addition, it was uncovered that the profit increment due to encouraged arrivals is significantly higher than that due to normal arrivals. Considering all these aspects, it can be concluded that the concept of encouraged arrivals is preferable for upholding declining business and further developing undeveloped business. Furthermore, this concept could be taken into the consideration to successfully face the economic recession in this era due to COVID-19 pandemic.

Keywords: Encouraged arrivals, Queuing system, Economic recession, Covid-19

Home Cooking Trends Coming out of Early Covid-19 Period

M. Sivakaran

Home Economics Unit, Faculty of Arts, University of Jaffna, Jaffna 40000, Sri Lanka
jmenakaj@yahoo.com

The worldwide pandemic Covid-19 has had an impact on Sri Lanka as well. The lockdown implemented due to the harmful disease has affected routine life, jobs, education and travel plans of the people. Individuals began to prefer home prepared meals rather than purchasing food from outside. The purpose of the study was to explore the trend of home cooking in the Jaffna district due to the first wave of Covid-19 (March-April 2020). Local people were requested to fill out a questionnaire which contained questions related to cooking and food practices. Interviews were carried out with food corner employees. Bulk buying and storing of groceries before lockdowns were seen among the participants. Working women responded that home cooking gave an opportunity to enhance family bonding as members of the family actively engage in cooking. According to the survey, people used garlic, ginger, turmeric and asafoetida in their dishes, which they believed was effective to fight against the infection. 18% of the respondents did not purchase perishable foods externally due to the fear of spreading of virus. Instead, they used homegrown food ingredients for home cooking. Food safety measures such as washing fruits and vegetables with salt water, avoiding buying food from outside and not sharing food were practiced. People hesitated to buy food from outside due to considerations related to disease transmission. Movement restriction shifted their food practices towards home cooking. The trend of take away food from local food corners declined as people carry home-cooked lunch to work to optimize hygiene. Work from home and online learning caused a dramatic shift in food practices where home cooking was found to be the best choice with the limited groceries available during the pandemic. Despite many hardships experienced due to the pandemic, one positive outcome is people have discovered the joy of home cooking along with healthy food handling practices.

Keywords: Covid 19, Pandemic, Home cooking, Meal pattern, Food safety

Dental Students' Perception and Their Performance in Clinical Components of Final Year Examination during and Prior to COVID-19 Pandemic

I.P. Thilakumara[1]*, I.P.N. Batuwantudawa[1], S. Abeysundara[2], P. Wijekoon[3], M.C.N. Fonseka[4], A.A.A.K. Wimalarathna[1], J.A.V.P. Jayasinghe[1] and R.M. Jayasinghe[1]

[1]*Department of Prosthetic Dentistry, Faculty of Dental Sciences*
[2]*Department of Statistics and Computer Sciences, Faculty of Science*
[3]*Department of Oral and Maxillofacial Surgery, Faculty of Dental Sciences*
[4]*Department of Restorative Dentistry, Faculty of Dental Sciences*
University of Peradeniya, Peradeniya 20400, Sri Lanka
*ithilakumara@yahoo.com

The COVID-19 pandemic has forced the world into a health and economic crisis interrupting numerous regular routine activities including education. Continuing dental education in clinical training and assessments is a challenge during COVID-19 pandemic. Objective of this study was to assess the perception and performance of dental students on clinical component of the final year examination held during COVID-19 pandemic. Final year dental undergraduates (n=86) participated in the study. A pre tested, self-administered questionnaire (online Google form) was used to assess their perception with regard to knowledge, attitude and fear when participating in a changed clinical set up. Percentage marks obtained for each clinical component was used to assess their performance during and prior to the pandemic. The mean scores for knowledge, attitude and fear were 82%, 94% and 77% respectively. There was no statistical significance in the perception regarding the clinical set up for prosthetic dentistry ($p= 0.317$) and restorative dentistry ($p=0.384$) when students performing during and prior to COVID-19 pandemic were compared. However, a statistically significant difference was observed for oral surgery component ($p=0.005$) for the same. There was no significant correlation between the perception scores and the students' performance for all three clinical components. (Spearman r $\approx$ 0.000, p-value = 0.998). Similarly no significant correlation was found between actual performance and the statements 'they could have performed better'; 'needed more time' (Spearman r $\approx$ 0.057, p-value = 0.742) (spearman r $\approx$ -0.023, p-value = 0.778) were considered. Students' knowledge and attitude related to clinical components during COVID-19 pandemic is satisfactory. Assessments involving direct patient contact can be implemented with proper planning, patient selection and under recommended infection control guidelines. Students' performance was not significantly affected by their perception or subjective opinion in all three clinical components.

Keywords: Dental education, Perception, Assessments, COVID-19 pandemic

COVID-19 Related Dental Practice Modifications Could Make Some Dentists Optimistic: A Public Health Concern of Emerging Importance

C. Gunasena[1]*, I.R. Perera[3], S.Ratnapreya[4],
R.M.S.H.B. Medawela[1] and N.S.S. Jayasuriya[2]

[1]*Department of Oral Medicine and Periodontology*
[2]*Department of Oral and Maxillofacial Surgery*
Faculty of Dental Sciences, University of Peradeniya, Peradeniya 20400, Sri Lanka
[3]*Preventive Oral Health Unit, National Dental Hospital (Teaching),*
Colombo 7, 00700, Sri Lanka
[4]*Department of Dental Surgery, Asiri Surgical Hospital,*
Colombo 5, 00500, Sri Lanka
*cgunasena039@gmail.com

COVID-19 pandemic caused by SARS-CoV-2 denotes an unprecedented public health emergency. It has impacted profoundly and persistently on every aspect globally. Dental Surgeons have garnered recognition as a high-risk group. Recent explorations on perceptions of dental surgeons on COVID-19 induced dental practice modifications are painting a gloomy picture of pessimism, fears and uncertainties. In contrast to popular notion, we aim to highlight the positive perspectives and optimistic perceptions of a sample of dental surgeons from Sri Lanka. Males dominated the sample (74.1%). Their ages ranged from 24 years to 46 years. The majority were without any past medical conditions (81.5%) and had between 10-20 years of service (48.1%). Majority of them were practicing in the government and private sector (51.9%), while 29.6% were private practitioners and 18.5% were only serving in the government sector. The sample included 14.8% registrars, 11.1% intern dental surgeons and 3.1% pre intern dental surgeons. For psychological perspectives, majority (51.9%) strongly agreed they could contract COVID- 19 and transmitting it (55.6%). 37% opined that personal protective equipment (PPE) was safe. There were variable claims of societal fear of risk of transmission by association with dentists. Dentists perceived difficulties in adherence to guidelines issued by the ministry of health. Majority (66%) perceived that wearing the PPE was uncomfortable. There were mixed views of practicality of performing aerosol generating procedures. Majority were in opinion they find it difficult to communicate with patients. Majority believed telemedicine will cause misdiagnosis. Mixed views were expressed on reduced workload. Majority was optimistic on regaining their financial loss. These ranged from better infection control opportunities to patient communication and use of telemedicine. Further research is warranted in this regard across the globe both in developed and developing countries to boost the positive thinking in the dental fraternity.

Keywords: SARS-CoV-2 virus, COVID-19, Dentistry, Sri Lanka

Major Factors Causing Delay of Construction Projects during COVID-19 in Sri Lanka

S. Thusyanthan

Department of Quantity Surveying, University of Vocational Technology,
Rathmalana 10390, Sri Lanka
thushi0712@gmail.com

The building sector has been badly affected by the COVID-19 pandemic situation and is being threatened by several challenges in terms of contractual commitments, shortage of services, deliverables, health and safety policies and project delays or halts. During the pandemic, the construction industry encountered the problem of the inability to complete projects on time. The main purpose of this study is to identify the significant delay factors affecting the construction projects in Sri Lanka during the Covid-19 pandemic situation. The data were collected through a designed questionnaire by examining thirty one factors from four main categories: contractor, owner, consultant and external factors. The relative importance index (RII) formula was used to rank the respondent's opinion on categories of delay factors. The main finding of the study is the financial factor, which is the most influential factor in causing construction project delays in Sri Lanka during the pandemic period. Coordination issues have been identified as the second major cause of construction project delays. Further, the study shows that the contractor's side and owners' side, financial problems were the major factor in delaying construction projects during this pandemic time. From the side of the consultant, the identified cause of delays in construction projects is the lack of supervision. Finally, the most important external factor causing delays in construction projects is the lack of materials. Based on the findings and discussions of the study, it is recommended that financial support and appropriate coordination are highly important and essential for construction industry. The Covid-19 pandemic has highlighted new challenges that are affecting the management at all levels. Thus, programs should be re-designed so that there will be less labour on site at any given time to allow social distancing. Further, a greater use of pre-cast materials, as well as enhanced welfare facilities on site for employees, should be considered so that their safety will be ensured at work.

Keywords: Covid-19, Construction projects, Construction industry, Project management, Sri Lanka

A Study on Operational Excellence: Sustainable Supply Chains of Manufacturing Industries during Covid-19 Pandemic

M.T.D. Malsinghe, M.H.A. Gunathilaka*, I.P.C.D. Bandara, A.I. Wijerathne, N. Nagendrakumar and N. Madhavika

Department of Information Management, Sri Lanka Institute of Information Technology, Malabe 10115, Sri Lanka
*harithgunathilaka@gmail.com

This paper presents an investigation on operational excellence (OpEx) models of sustainable supply chains (SSCs) in Sri Lankan manufacturing organizations during the Covid-19 pandemic. The investigation was executed with the assistance from multiple case studies (namely, 5 cases) in the following manufacturing industries: manufacture of clothing, manufacture of furniture, manufacture rubber and plastic products, manufacture of electrical equipment, and manufacture of paper and paper products. In accordance with an extensive literature review, an accumulation of SSCs, OpEx, and associated models in different viewpoints of manufacturing organizations were identified in various literature works. This research was conducted as an exploratory case study utilizing a multi-mode research choice in which data is collected through in-depth interviews, and company website/reports. By using a deductive approach, this research derived findings based on critical success factors of an existing hypothesized model known as "sustainable OpEx model" in Sri Lankan context which was utilized by manufacturing organizations for the case studies. Thereby, the study shows which organization has the more sustainable approach in order to better manage the aforementioned sustainable OpEx model. The investigation is supported through the usage of Upper-Echelons theory, which gained an insight on the perspectives of top management during the prevailing period of Covid-19 pandemic. Accompanied by a thematic analysis, findings on critical success factors of OpEx models in SSCs of the case studies were displayed. The findings illustrate that those critical success factors affecting Sri Lankan manufacturing organizations' were sustainable to a certain extent. However, significant deviations were encountered despite the implementation of OpEx models in their SSCs, during the outbreak of Covid-19. These findings were considered non-generalizable beyond the presented case studies. A critical challenge that was faced in the duration of this research was dealing with a lack of literature work in relevance to Covid-19 pandemic.

Keywords: Operational excellence, Operational excellence models, Sustainable supply chains, Manufacturing organizations, Covid-19 pandemic, Sri Lanka

Emerging Entrepreneurial Innovations in the Pandemic: A Study of Small and Medium Enterprises in Sri Lanka

S.H.T. Kumudumali

*Department of Operations Management, Faculty of Management,
University of Peradeniya, Peradeniya 20400, Sri Lanka
thakshila@mgt.pdn.ac.lk*

Any of the organizations operating today's dynamic world faces enormous changes and it needs to know how to manage changes wisely. The business firms are the one of the major sectors within the competitive environment that the pace of change has considerably increased. The ability towards the adaptation of change efficiently is more vital and value creation activity for the any of the business. The Covid-19 pandemic is known as the black sawn event in the economy that has the severe influenced on the survival of the business. Yet the innovative ideas used by the entrepreneurs in managing pandemic are not that much inadequate. This paper explores the entrepreneurial innovations that were used to ensure the survival during the Covid-19 pandemic in the Small and Medium Enterprises (SME) in Sri Lanka with special consideration of manufacturing, service and agricultural sectors in economy. The opportunities for the entrepreneurs are to be innovative in the market place of SMEs in the pandemic. Thus, the paper is based on the theoretical triangulation of identifying emerging trends of the entrepreneurial innovation used for the survival of organizations. The main aim of the study is to evaluate on how the firms could survive during the pandemic and develop a conceptual framework. A comprehensive literature review facilitated to develop the conceptual framework. An empirical part of the study will be conducted using qualitative methodologies.

Keywords: Entrepreneurial innovations, SME, Covid-19, Sri Lanka

A Study on the Use of Humanitarian Concepts in Advertising to Enhance Human Qualities of the Consumer in Covid-19 Outbreak

L.D. Liyanage

Department of Mass Communication, Faculty of Social Sciences,
University of Kelaniya, Kelaniya 11600, Sri Lanka
dineesha@kln.ac.lk

In the modern world, advertising aims at somehow achieving marketing objectives in a competitive marketing environment. Consequently, advertising agencies are tempted to adopt different concepts for advertising. Currently, many advertising agencies use more and more humanitarian concepts in their advertisements, especially after the Covid-19 outbreak. The word "humanitarian" is defined as "caring or helping to enhance the well-being and happiness of the people". The term "humanitarian" is defined in the Oxford dictionary as "concerned with or seeking to promote human welfare". The focus of this study is to explore how humanitarian concepts are used in advertisements to enhance human qualities of the consumer during the Covid-19 outbreak. The hypothesis is that the use of humanitarian concepts in advertising is the most effective way to enhance the human qualities of the consumer as well as to attract the consumer to the advertisement. Here we used qualitative and quantitative research methods. Qualitative data was collected based on content analysis of 05 selected television advertisements. Quantitative data were collected through a questionnaire based on 50 data contributors under a random sampling method. The main conclusion of the study is that the use of humanitarian concepts in advertising is the most effective way to improve the human qualities of the consumer as well as to attract the consumer to the advertisements. The study suggests that if such human qualities can be incorporated into advertising, it will contribute to motivating the Sri Lankan consumer to be attracted to a product or service.

Keywords: Covid-19 outbreak, Advertising, Humanitarian concepts, Consumer, Persuasion

Attitude towards Online Learning/Teaching in Anatomy during COVID-19 Pandemic Period among Pre-Clinical Students in Faculty of Medicine, University of Peradeniya

E.W. Kosgallana*, N.J. Pahalawattage, A.K. Jayaweera, H.M.G.S. Hearath, S.B. Adikari and H.A. Amaratunga

Department of Anatomy, Faculty of Medicine, University of Peradeniya, Peradeniya 20400, Sri Lanka
*warukos@gmail.com

Covid-19 pandemic related University closure resulted in faculties moving quickly towards online education. The Department of Anatomy, University of Peradeniya, initiated its online teaching course for undergraduates late in March 2020. This survey was conducted to assess the attitudes and barriers faced by students during the online anatomy course. A questionnaire was designed using available feedback questionnaires from the faculty and the net consisting of 5-point Likert scale questions, which was pilot tested and finalized. It was distributed via Google-forms to 185 second-year students who had undergone 2 semesters of online teaching. A total of 115 Google-forms were received. Females represented 50.9%, with a mean age of 21.9±1.022 years. Smartphones (86%) tablets (68.4%) and laptops (41.2%) were used to access online material in combination. Mobile data was the commonest (79.8%) method used for internet access. Online learning tool usage was, Moodle-98.2% Zoom-94.7% and Youtube-66.7%. Attitudes towards online learning were positive with 77.2% finding this mode of teaching effective during the pandemic. Prior preparation for teaching sessions was as high as 97.4% and 81.6% claimed that they actively participated in the online sessions. Majority preferred Moodle (81.74%) for online lectures while for gross practical sessions it was Moodle (80.87%) and YouTube (41.74%). For histology practical sessions 89.57% and slide projections 82.74% preferred Moodle. For tutorials (70.44%) and question discussions (76.52%) majority preferred real time Zoom sessions. Of the respondents 57.9% feared lack of direct anatomy learning might have an impact on their clinical knowledge in future. The main problems of online learning were identified as lack of self-motivation, lack of onsite practical sessions, and prolonged screen time. Even though most students preferred onsite learning to online learning (70.5%) the attitude towards online learning appears to be mostly positive during the pandemic.

Keywords: COVID-19, Anatomy, Pre-clinical, Online learning/teaching, Medical education

Electrochemical Biosensor for Fast Detection of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2)

J. Disagini and M. Thanihaichelvan*

*Department of Physics, Faculty of Science, University of Jaffna,
Jaffna 40000, Sri Lanka
thanihai@univ.jfn.ac.lk

COVID-19 pandemic is the global challenge as of today and scientists are working on developing therapeutics and fast diagnosis techniques. Since the therapeutics are delayed, fast diagnosis techniques might be helpful to restore the normalcy. At present, the most reliable diagnosis method for COVID-19 caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is reverse transcription polymerase chain reaction (RT-PCR). Again, it is time consuming and needs experts and expensive machines. In recent past, many nanomaterial-based sensors have been reported for detection of biomolecules at very low concentrations. These molecular sensing techniques can be effectively used for fast detection of SARS-CoV-2. Moreover, the testing can be done within a minute with extremely high selectivity. In this work we developed and demonstrated a proof-of-concept diagnosis technique for COVID-19. The sensor was designed to target the RNA-dependent RNA polymerase gene (RdRp) sequence of the SARS-CoV-2. The control sequence was the same RdRp sequence of the severe acute respiratory syndrome (SARS) virus. The probe for the biosensor was then selected as the reverse sequence of the RdRp gene of SARS-CoV-2. The RdRp gene of the SARS virus has three mismatches in the reverse sequence when compared to that of SARS-CoV-2. Then we immobilized the selected probe sequence in a gold electrode and the response was measured using electrochemical impedance spectroscope from 1 MHz to 0.1 Hz. The results showed a clear concentration dependent response to the positive target sequence with a limit of detection of 100 fM. The response to the negative sequence was much lesser when compared to the positive sequence. The study was conducted with synthetic sequences and the results were promising. The results need to be validated along with the gold standard PCR data before going for a clinical trial.

Keywords: Biosensor, SARS-COV-2, Electrochemical impedance spectroscope, Impedimetric biosensor, Aptamer

Peak over Threshold Approach to Forecast the Probability of Covid-19 Outbreak in Sri Lanka

N.K. Boralessa

Department of Mathematical Sciences, Faculty of Applied Sciences, Wayamba University of Sri Lanka, Kuliyapitiya 60200, Sri Lanka
nathashakb123@gmail.com

Covid-19 is a contagious disease that causes illnesses in humans extending in severity from the common cold to Severe Acute Respiratory Syndrome (SARS). This disease has spread worldwide with considerable morbidity, mortality, and an enormous burden on worldwide public health. Massive job losses, shrinking of economies, and loss of livelihood have taken place due to the high transmissibility of the Covid-19 virus. Modelling and forecasting the probability of the spread of covid-19 is essential for public health planning and managing the economy, which is an emerging topic in research. This study developed a mathematical model using Extreme Value Theory (EVT) to forecast the probability of extreme cases of covid-19 outbreak. The daily covid-19 cases reported from 1st, January 2020 to 31st, October 2020 were obtained from the epidemiology unit official website of Sri Lanka. The Peak over Threshold (POT) approach of EVT was employed to model the covid-19 cases. The Mean Residual Life (MRL) plot was used to identify the linear range because selecting the optimum threshold from the MRL plot requires substantial expertise. The Kurtosis method was used to obtain the appropriate optimum threshold. After determining the threshold, extremes were modelled, and the parameters of the Generalized Pareto Distribution (GPD) were estimated through the maximum likelihood estimator method. The bootstrap goodness of fit test was applied to validate GPD. Finally, the annual maximum daily covid-19 cases were calculated for several return periods. It was revealed that the daily covid-19 cases were positively skewed with skewness 5.1018. The graph started to become linear from 0 and continue up to approximately 70 in the MRL plot. 34 covid-19 cases exceeded the optimum threshold of 63 and these exceedances can be best described by GPD ($\xi = 0.41902$, $\sigma = 97.3077$). The annual maximum daily covid-19 cases about 1356/1639/2070/2825 are predicted to occur once in every two/three/five/ten years, respectively.

Keywords: Covid-19 outbreak, Pot approach, Threshold, Generalized pareto distribution, Maximum likelihood estimator

Detection of COVID-19 Infection from Chest X-Ray Images Using Deep Learning

W.M.D.D.B. Wijesundara and C.T. Wannige*

Department of Computer Science, Faculty of Science, University of Ruhuna, Matara 81000, Sri Lanka
*wannige@dcs.ruh.ac.lk

The 2019 novel coronavirus (COVID-19) is a new species discovered in December 2019 in Wuhan, China, and has not been previously identified. This has now become a health problem that causes millions of deaths. Implementation of an automatic detection system as an expeditious alternative diagnosis option to diagnose COVID-19 is required. Many machine learning algorithms such as SVM, Naive Bayes, Random Forest were used in the recent past for the detection of COVID-19 infection from chest X-ray images. Among the other machine learning techniques, convolutional neural network (CNN)-based models have shown higher accuracy. Most researchers use CNN architectures such as COVIDX-Net, DenseNet to identify COVID-19. However, there is still a need for a more accurate, time-efficient method to replace humanly involved, time-consuming diagnosis of Covid-19 infection. Our study uses a convolutional neural network-based model to detect coronavirus pneumonia infected patients using their chest X-ray images. In this study, the CNN architectures are generated using chest X-rays as input images and we selected the best model that gives the best result. Considering the performance measures obtained in our model, it shows 92.45% validation accuracy for the dataset used (dataset 1: "https://data.mendeley.com/datasets/rscbjbr9sj/3" and dataset 2: "https://www.kaggle.com/alifrahman　/chestxraydataset"). The proposed CNN architecture consists of 7 convolutional layers, 2 dense layers, 1 average pooling layer, and 3 max-pooling layers. The model shows an accuracy of 87.5% for an independent dataset in acceptable time duration. The system achieved desired results on the currently available dataset, which can be further improved with the availability of a larger set of COVID-19 chest X-Ray images.

Keywords: Coronavirus pneumonia, COVID-19, X-ray image analysis, Deep learning

Analyzing and Predicting the Spread of SARS-Cov-2 Virus in Singapore Using a Time-Dependent SEIR Model

U.S.R.D.V. Bandara* and M.B. Dehideniya

*Department of Statistics and Computer Science, Faculty of Science,
University of Peradeniya, Peradeniya 20400, Sri Lanka
s15314@sci.pdn.ac.lk

Covid-19 is a devastating pandemic that has affected more than 200 countries. According to the World Health Organization, there are 113 million confirmed cases, 63.5 million recoveries by late February 2021. This study was carried out to model the spread of SARS-CoV-2 virus in Singapore. In addition, accurate predictions of the infected counts and recovered counts of the incidences help the authorities to evaluate, to apply and relax the interventions at the necessary time. Data were gathered from the daily situation reports published by the Ministry of Health, Singapore. In general Susceptible, Exposed, Infective, and Recovered (SEIR) modeling, parameters are assumed to be constant throughout the period. However, due to the variations in the reported patient count from 23rd January to 28th June, 2020, a time-dependent SEIR model was fitted to obtain accurate estimates for model parameters. The parameters were estimated for different sub-periods by solving a set of related Ordinary Differential Equations. Then, the variation in each model parameter with time was modeled using a cubic spline. When compared with the monthly estimated parameters, the most accurate results were obtained with weekly estimated parameters, resulting a minimum difference between the estimated and observed counts. Then, the prediction ability of the model was evaluated by computing 95% confidence intervals for the number of infected individuals and recovered individuals at the end of 5th July 2020, and they are (4008, 8709) and (39558, 45230), respectively, which capture the actual counts. Compared to short-term predictions, the proposed method will give relatively low accurate estimates for long-term predictions. Therefore, the proposed method is more suitable for short-term predictions.

Keywords: Covid-19, Cubic splines, Epidemiological modeling, Ordinary differential equations

Preparedness and Response to Coronavirus Disease-2019 (COVID-19) among Veterinary Practitioners in Sri Lanka

H.M.S. Wijekoon[1]*, K.A.N. Wijayawardhane[1], D.D.N. de Silva[1] and R.A.C. Rabel[2]

[1]Department of Veterinary Clinical Sciences
[2]Department of Farm Animal Production and Health
Faculty of Veterinary Medicine and Animal Science, University of Peradeniya,
Peradeniya 20400, Sri Lanka
*suranjisk@gmail.com

Coronavirus disease-2019 (COVID-19), first identified in Wuhan, China, was declared a "pandemic" by the World Health Organization in March 2020. This resulted in imposition of many short-term 'lockdowns' that temporarily suspended many veterinary-related activities. Therefore, veterinarians were compelled to adopt preventive practices as per guidelines issued by authorities to continue the essential work. The current study examines the level of awareness and adoption of such guidelines by veterinary practitioners in Sri Lanka by four months after the first case was reported. An online cross-sectional survey was circulated among veterinarians *via* email and social media. A total of 100 veterinary practitioners, of whom 74.5% were full-time companion animal practitioners, anonymously and voluntarily responded. Of the respondents, 64% were females and 70.4% were less than 40-years-old. Respondents identified fever (89.9%), respiratory illness (66.7%) and sore throat (60.6%) as the three commonest COVID-19 symptoms. Only 50% of the respondents were aware that asymptomatic COVID-19 is more common than the symptomatic disease. Most respondents (84.8%) were aware of the zooanthroponotic potential of SARS-CoV-2, the causative agent of COVID-19. Publications by health organizations (68.7%) and electronic media (69.7%) were identified as the major sources of COVID-19-related information. Hand-hygiene (98%) and mask-wearing (98%) were the most common preventive measures adopted by respondents. Most participants prioritized urgent visits in their practices (79.2%) and adopted telemedicine (75.3%) during lockdown periods. However, most practitioners failed to use isolation rooms for examining animals with suspected SARS-CoV-2 infection (88.6%) or to check the body temperature of staff (75.3%). Only 52.2% of the respondents had received COVID-19-related safety guidelines issued by the local authorities and of these, more than 70% were not satisfied about the quality of information received. This study highlights the need to educate veterinary practitioners about the guidelines for prevention and control of COVID-19 so that veterinarians can be better prepared to respond to similar situations in the future.

Keywords: COVID-19, Guidelines, Pandemic, Questionnaire, Veterinary practitioners

EDUCATION FOR TRANSFORMATION

Knowledge about Their Career among Sri Lankan First-Year Physiotherapy Undergraduates

P. Cinthuja

Department of Allied Health Sciences, Faculty of Medicine, University of Colombo, Colombo 00800, Sri Lanka
cinthuja@med.cmb.ac.lk

Inadequate knowledge will presumably result in the "wrong" people applying or the "right" people not applying for a specific degree programme. There is a need to analysis the awareness about their future career among Sri Lankan physiotherapy first year undergraduates. The objective was to assess the knowledge about their career among Sri Lankan first-year physiotherapy undergraduates. A cross-sectional descriptive study was conducted in three universities in Sri Lanka. Questionnaire was developed based on existing literature and checked for validity by conducting a pilot study among randomly selected undergraduates. Descriptive analysis was performed in SPSS. 58 participants (age 21.2±0.9, 42 females) participated in the study. 17% entered with their Advance Level first attempt. Among other results, 43% participants considered they have appropriate knowledge about their profession, 78% searched before applying to the degree programme, 91% were aware of exercise as a method of management, 94% know musculoskeletal conditions are treated by physiotherapists and 78% know it is required to have a valid license to practice. However, only 40% were aware that physiotherapists manage paediatric conditions, 47% were aware PhD can be completed as their postgraduate qualification and 38% were aware they can work as a researcher and 14% were aware that they can work in administrative positions. In conclusion, most of the participants had moderate level awareness about their career choice. However, not all the participants were fully aware about their future job description, role and regulations. As future recommendations, there is a need for a programme to make first-year undergraduates aware about their career, and it is ideal to be done as a career guidance programme during their advance level stage to ensure "right" people applying for this programme.

Keywords: First-year undergraduate, Physiotherapy, Sri Lanka, Vocational guidance

Motivations and Perceived Barriers towards Online Education among Nursing Undergraduates at KIU, Sri Lanka

C. Colombage*, K.W.P. Dilini, W.D.M.I. Abeywickrama, B.U.P. Karunarathna, W. Piyumale, H.H.N.D. Dharmarathna and K.T.G. Kanchana

Department of Nursing, Faculty of Nursing, Kaatsu International University, Koswatta, Battaramulla 10120, Sri Lanka
*gayani@kiu.ac.lk

The students are enrolling in online education methods in higher education and many educational institutes all over the world have moved to the online educational system due to its benefits and the demand. The objective of the study was to assess the motivations and perceived barriers towards online education among nursing undergraduates at KIU, Sri Lanka. A descriptive cross-sectional study was conducted among 325 nursing undergraduates using a google questionnaire form which was pre-tested. It consisted with 25 questions under subtopics of demographic data, perceived barrier factors and motivational factors. Data were analyzed using percentages and chi squire test using SPSS 25 version. The mean age of the respondents was 30.73 ($\pm$SD 3.05) years and 98.8% were female. The majority of the participants (94.8%) perceived that online education is more useful for educational curriculum, and 57.5% were motivated with online education, due to its benefit of "saving time". Isolation, while online education had been identified as a disadvantage of widening of knowledge by 75.1% of participants and 61.5%, suggested creating online group collaborative activities while conducting online education to be more interactive and effective. The major barriers towards the online education, according to the participants, were issues related to internet connection (84%) and occupational responsibilities (76.6%). Marital status shows significant association between the financial status as the perceived barrier over the online education among nursing undergraduates at KIU ($p=0.008$) and a significant association was observed between marital status with hours spent on online education per week among nursing undergraduates at KIU ($p=0.015$). In conclusion, increased job responsibilities and issues related to internet connections were the major barriers in online education. Further, marital status was significantly associated with financial status, and the number of hours spent on online learning among Nursing Undergraduates.

Keywords: Motivations, Perceived barriers, Online education, Nurses

Study on Learning Styles of Technology Stream Students in Sri Lankan University Context

T.S. Niroshan[1]* and V. Jerentulina[2]

[1]Department of Engineering Technology
[2]Department of Biosystems Technology
Faculty of Technology, University of Jaffna, Jaffna 40000, Sri Lanka
*samt@tech.jfn.ac.lk

"Learning styles" refer to the way in which different individuals learn. It is a Visual, Auditory and Kinesthetic approach to learning something new. The introduction of the Technology Stream became the answer for the passion of youngsters towards the innovative and creative world. However, due to the complexity in their university curricula, the failure rate of the students at undergraduate level remains at around 65%. This study focused on identifying the appropriate means to facilitate learning among students. A questionnaire was circulated among undergraduates from all the Technology Faculties in Sri Lankan universities in all levels of their academic programme, where they could respond to questions about their interests in learning, their preferences while performing the learning activities and their levels of comfort with their relevant study programmes. Based on data collection, an analytical study was carried out by grading their responses under the three major learning style domains. From the survey, auditory and kinesthetic styles of learning appears to have a better response than the visual style. Data obtained shows that auditory and kinesthetic styles are preferred by 34.99% and 34.98% of the target group respectively. Nearly 30.03% of the target population claimed a greater level of learning by auditory and kinesthetic rather than visual styles. The study concluded that auditory and kinesthetic learning styles were greatly preferred by students. It could be inferred that the active involvement and their outlook towards learning is boosted by auditory and kinesthetic styles. Since the survey consists of a small target group which shows a remarkable response, it is clear that the results can be further validated with the entire population. It can be stated that the teaching and learning activities consisting of auditory and kinesthetic styles will result in a noticeable outcome for both the facilitators as well as the learners.

Keywords: Learning styles, Visual, Auditory, Kinesthetic, Technology

Emotional Maturity and Leadership Styles among Secondary School Teachers in Sri Lanka

L.A.M.H.P. Udayakumari

Education Unit, Faculty of Humanities, University of Kelaniya,
Kelaniya 11600, Sri Lanka
hansaniliyadipita@yahoo.com

Emotion plays a vital role in one's personality. Emotional Maturity means a person's ability to control his/her emotions and express them in a socially desirable manner. If a person is emotionally matured, he or she can control his/her emotions. The teacher as the major guiding figure of the students in the school should have emotional maturity, and teachers with many years of experience should be more intimately involved in leadership and decision making in their schools. Leadership style is the approach of providing direction, implementing a plan and motivating people in attaining a goal. The researcher intended to identify the relationship between Emotional Maturity and Leadership styles of teachers and to find the significant difference in Emotional Maturity of teachers at different levels of education and at different ages. The convergent parallel mix method was used for the study. Questionnaires and interviews were used to collect data and the data gathered through interviews was analyzed using quotes, themes, and narrative descriptions. Questionnaires were processed using descriptive statistical methods. Participants for the study were selected from the Badulla District, Welimada Educational Zone using simple random sampling techniques. The results of the study revealed that most of the teachers possessed a moderate level of emotional maturity. Moreover, 68.89% of the teachers were highly autocratic, and 11.11% were extremely autocratic. 44.44% of teachers were highly democratic and 42.22% were extremely democratic. 6.67% were extreme followers of the Laissez-faire style, and 40% were moderate followers of the Laissez-faire style. The correlation value was 0.004 and it indicated that there was a significantly low positive correlation between Emotional maturity and Leadership style among the teachers in the schools in Sri Lanka.

Keywords: Emotion, Emotional maturity, Leadership style, Secondary education

Education for Transformation

Impact of Parental Socio-Economic Status on Academic Performance of Students: A Case Study of Island Educational Zone, Jaffna

S. Mathusha* and K. Kumudhini

Department of Economics and Statistics, Faculty of Arts, University of Peradeniya, Peradenuya 20400, Sri Lanka
*mathusiva92@gmail.com

Education is one of the important factors for development. As a developing country, Sri Lanka faces many issues due to the lack of educational facilities in the rural areas. Sri Lanka has faced 30 years of civil war. The Jaffna district is very vulnerable in educational achievements after the civil war. Particularly, the educational achievements of the island educational zone are low compared to other educational zones of the Jaffna district and at the country level. Therefore, the lack of educational achievement in the island educational zone is a problem of high significance in the research area. The objective of this study is to analyze how the parental socioeconomic status affects the academic performance of the students. Several studies related to the issues such as educational qualifications of teachers, class environment, gender differences and teaching methods have been conducted. However, research regarding the impact of parental socioeconomic status on students' academic performance is scarce. This study attempts to fill this research gap. The data was collected through structured questionnaires from 50 students and various socioeconomic factors were used for analysis. The findings show that 76% of the sample units belonged to the poor income group. The results of the regression analysis show that the education level of parents affects their child's education positively and significantly. However, the education level of the mother is more vital for children's performance in academics. Moreover, family income and the facilities available at home also impact student's performance positively and significantly. Further, public education facilities and student's personal interest in academics lead to better academic performance. The study suggests that the parents should improve their economic and social status to support their children. The government should make public policies and plans to improve education facilities. Public policies should be oriented more towards providing cheaper, more widespread, and better educational opportunities.

Keywords: Academic performance, Government facilities, Parental socioeconomic status, Random sample, Regression analysis

Knowledge and Practices on Classroom Strategies Used by Primary School Teachers of Selected Schools for the Hearing Impaired in Western Province

V.G.S. Madhuwanthi* and B.N. Jayasena

Department of Disability Studies, Faculty of Medicine, University of Kelaniya, Ragama, 11010, Sri Lanka
*madhuwanthi.vidanagamage@gmail.com

The objectives of the study were to determine teachers' knowledge about the classroom strategies and the needs of children who are deaf and the way in which classroom strategies are practiced for the children who are deaf. Data for this descriptive-quantitative study was gathered through a self-administered questionnaire that included statements on instructional strategies, visual strategies, environmental strategies and technological methods. Fifty-one primary school teachers rated their knowledge and practices of these strategies on a five-point Likert scale. Majority of the participants knew about instructional and visual strategies (98% and 94.1% respectively). Interestingly, about 50% of the participants practiced instructional, visual and environmental strategies in their teaching. The least known strategy was technological methods (21.6%), however about 50% of the teachers had students who wore hearing aids. Research studies by Reich & Lavay, 2009; Berndsen & Luckner, 2012 and Schultz et al. 2013 stated that visual and technological supports are important to facilitate learning for children with hearing impairment. Information and education on learning support strategies for hearing impaired children with amplification devices were reported as a skill area that teachers require input on with regards to teaching practices. It is possible to conclude that there is a strong need to promote the use of technological methods along with visual and instructional strategies and environmental modifications. Therefore, primary school teachers in schools for the hearing impaired should be given regular training and the schools should be provided with adequate physical resources in order to ensure successful implementation of these strategies.

Keywords: Classroom strategies, Knowledge, Practices, Primary school teachers

Experience in Online Learning among Nursing Undergraduates in a State University in Sri Lanka: A Quantitative Study

H.R.B.K. Rahinduwa[1]*, T.S. Amarasinghe[2], N.T. Wijesinghe[1], D.R.T.S. Dasanayake[1], S.D.B.P.P. Samarasekara[1], S. Sobika[1], R.A.M.S.D.L. Jayathilake[1] and A.U. Rathnayake[1]

[1]Faculty of Allied Health Sciences, University of Peradeniya, Peradeniya 20400, Sri Lanka
[2]Faculty of Nursing, University of Colombo, Nugegoda 10250, Sri Lanka
*buddhimakasun1@gmail.com

Online education is a novel concept in both primary and higher education in Sri Lanka which emerged after the current coronavirus pandemic. Delivering nursing via online platforms is challenging as it is a skill-based discipline. The objective of this study is to evaluate nursing undergraduates' experience in online learning. The study was conducted as a descriptive cross-sectional study, with a researcher-developed validated Google form distributed via social media and email groups. 117 (75%) nursing undergraduates registered for all academic years at the University of Peradeniya participated in the study. Among participants, 69.2% were females. 38.5% were from the 1st, 30.8% were from the 2nd, 13.7% were from the 3rd and 17.1% were from the 4th years. Synchronous teaching (97.5%), uploading videos to Moodle (97.5%), and recorded PowerPoint presentations (88%) were the most widespread learning techniques while online polls (2.6%), online blackboards (6%), webinars (10.3%), chat rooms (15.4%), group chats (35.9%), and online quizzes (59.8%) were the least implemented learning techniques. The ZOOM (100%) and the social media groups (51.3%) were the most used learning tools, while Kahoot, Edmodo, eduClipper (0.9%), and TED-Ed (4.3%) were the least used tools. Furthermore, students experienced technical problems, lack of motivation, and difficulty in concentration during online classes. The statement "I acquired skills related to nursing procedures through online learning" intended to compare participants' experience of practical sessions that were completed online with that of complementary face-to-face classroom sessions. Among the participants, 44.4% (n = 52) Disagreed and 28.2% (n= 33) Strongly Disagreed with the statement. 59.7% of the participants did not accept online learning as a good alternative to develop nursing skills. However, they have adapted to online learning to cover theory-based components. Further studies are needed to evaluate the effectiveness of online learning in the Sri Lankan context.

Keywords: Online learning, Nursing education, Experience, Online classes, Undergraduate

Usage of Library Resources and Services Provided by Agriculture Library, University of Peradeniya

H.N.K. Dissanayake

Agriculture Library, University of Peradeniya, Peradeniya 20400, Sri Lanka
harshanid@pdn.ac.lk

The Agriculture Library serves the Faculty of Agriculture and the Post Graduate Institute of Agriculture of the University of Peradeniya. During the past few decades, the information seeking behaviour of students has changed due to the availability of electronic resources on the Internet. Therefore, it is important to examine the usage of different information resources and services. The main objective of the study was to examine the usage of print and electronic resources provided by the library. The specific objectives were to examine the effective usage of services provided by the library and the student expectations about the library resources and services. A random sample of 112 final year students from three-degree programmes were selected for the study. A structured questionnaire was distributed among the participants. The response rate was 83.03%. The data was analysed using descriptive statistical methods. The students' awareness of the library was through friends (53.53%) and lecturers (36.5%). Library orientations were conducted for the students in their first year, and 72.04% students have not participated in the library orientation programme. The main purpose of using the library is to borrow books (56.98%) and to read books (53.76%). The highest usage of print materials is lending books (68.81%) followed by project reports (61.29%). More than 75% students use e-resources provided through Internet. The highest number of students that use the database AGORA (34.4%). The percentage of students who learn about e-resources from friends (39.78%) teachers (34.4%) and participating in information literacy courses conducted by the library (24.73%). The students were not satisfied with the space provided for discussions and the number of computers available for students in the library. The number of student computers and discussion areas needs to be increased. More user awareness programmes should be conducted by the library.

Keywords: Library usage, Library resources, Library services, Infrastructure

Private Tutoring and Its Impact on A/L Students: A Case Study

K.A.N.I. Kariyapperuma

Department of Economics and Statistics, Faculty of Arts,
University of Peradeniya, Peradeniya 20400, Sri Lanka
indeewarie93@gmail.com

Although Sri Lanka is one of the countries which provide free education for all students since 1945, private tutoring can be identified as another emerging education sector. The high demand for private tutoring, reflects a need to understand the real returns of private tutoring in Sri Lanka. The purpose of this study is to determine the relationship between private tutoring and academic achievement of the G.C.E.A/L students in Kuliyapitiya Education Zone, Sri Lanka. The two objectives of the research are: to estimate the impact of private tuition on academic achievement of G.C.E.A/L students and to determine the most influential factors affecting the private tutoring participation of G.C.E.A/L students. Data was collected through a primary survey and the research instruments used in the study were questionnaires and in-depth-interviews. Quantitative data were analysed using the OLS (Ordinary Least Square) regression model and descriptive charts. Qualitative data were analysed through thematic analysis, through organizing data into themes and sub-topics. The research findings when in co-operated with the primary objective show that private tutoring has a significant and positive impact on the students' achievement in terms of tuition expenditure, tuition hours and Tuition Satisfaction Index of students qualitatively. Also supporting to the secondary objective, micro-level factors like the income of household, parental educational level, regional location and peer groups and macro-level factors like inefficiencies in public education system, linkage between education and future success in the labour market, cultural values and nature educational system which uses formal examinations for education allocation and limited opportunities in entering for universities, determine the demand for private tutoring. This implies that private tuition yields enormous influence on students' academic achievement. Therefore, revision of the Sri Lankan education system, improving the quality of school education and well-systematic regulation of private tutoring should be highly focused on.

Keywords: Private tutoring, Academic achievement, G.C.E. A/L students, Mixed method analysis, Education system

Implementation of E-learning Platforms to Learn English among Tertiary ESL Learners with COVID-19 Outbreak: Benefits and Issues

R.D.K. Rajapaksha[1]*, W.K.N. Udara[2] and A.G.T. Dinushika[1]

*[1]Department of English, Faculty of Humanities and Social Sciences,
University of Ruhuna, Matara 81000, Sri Lanka
[2]Department of English Language Teaching, Faculty of Humanities,
University of Kelaniya, Kelaniya 11300, Sri Lanka
ruwan1994@gmail.com

The purpose of this research is to examine the potential benefits gained and issues encountered by tertiary ESL learners with the implementation of E-learning platforms to continue with their academics during the COVID-19 outbreak. Physical distancing has been implemented in all institutes, including universities, in accordance with the government's Covid-19 safety regulations, and all physical academic curriculums have been halted. As a result, higher education institutions have implemented e-learning platforms as the best alternative for resuming the disrupted academics. Fifty undergraduates from the Faculty of Social Sciences who are currently studying English for Social Sciences as a compulsory subject were selected as the research participants. Initially, a pilot survey was conducted to test the research tool, the questionnaire. A two-sectioned questionnaire with a Likert scale was then designed and distributed among the participants. The collected responses were then analyzed, and the recommendations were suggested. The findings prove the benefits and issues of using E-learning platforms to learn English among ESL undergraduates. Although students have mostly agreed that online learning platforms have a high range of accessibility regardless of the time and place, the findings highlight that some undergraduates still face several transformational issues. According to the analyzed data, E-learning leaves kinesthetic and reading/writing learners overlooked. Undergraduates have been hampered by technical difficulties and internet quota expenses. Learning satisfaction was found to be low for undergraduates with the limitations of e-learning. The study reveals that it was unfavorable for undergraduates when peer support and interactions were absent. A key limitation in this research was that lack of prior research studies on the topic. Although the findings question the efficacy of using online platforms, it can be suggested that inclusive, interactive pedagogical practices and equity of opportunities are required for implementing the productive delivery of academic programs via e-learning platforms.

Keywords: E-learning platforms, Benefits and issues, Tertiary ESL learners, COVID-19 outbreak

Education for Transformation

Postgraduate Students' Perception of Online Learning and Face-to-Face Learning

P.R.K.A. Vitharana*, E.M.P.C.S. Ekanayake and V. Lindakumbura

*Department of Education, Faculty of Arts, University of Peradeniya,
Peradeniya, 20400, Sri Lanka
pushpa.vitharana@yahoo.com

The COVID 19 pandemic has had an impact on higher education in Sri Lanka since March 2020. With principles of social distancing, all face-to-face classes were suspended and transformed in favour of online learning. The objective of the study was to examine the Postgraduate students' perceptions of online learning and face-to-face learning amid Coronavirus (COVID-19). The mixed method was used to conduct this study. In this study, an online questionnaire was distributed among all the Postgraduate Diploma in Education (PGDE) students (500) and 275 students who responded. In order to understand the situation, focus group interviews were conducted. The quantitative data were analysed using computer-based data analysis package and the qualitative data were analysed using thematic analysis. The results evidenced that the majority of students preferred online learning to face to face classes (63%) as online tools are easy to use (82%), comfortable (82%) and flexible (84%) in participating in online learning. A considerable number of students (26%) agreed that online learning is difficult than face to face learning. The majority of students (58%) like to participate in online lectures than face-to-face lectures after COVID-19 pandemic. Further, the most of the students (72%) perceived online teaching methods as effective than face to face learning whereas a less number of students (15%) negatively perceived online teaching methods. The interview data suggested that Postgraduate students perceived online learning as an easy mode of learning as they are adult learners and have other commitments. However, they were in the view that online learning mode for PGDE programme is not as successful as face-to-face learning as they lack social interactions and they are unable to acquire skills required for teachers. In conclusion, blended learning could be a better option for the PGDE programme as it provides both theoretical and practical components in the PGDE curriculum.

Keywords: COVID 19, Pandemic, Online learning, Blended learning, Face to face learning

Primary Teachers' Awareness on STEM Integration

P.R.K.A. Vitharana* and T.M.S.S.K. Yatigammana

*Department of Education, Faculty of Arts, University of Peradeniya,
Peradeniya 20400, Sri Lanka
pushpa.vitharana@yahoo.com

STEM is a curriculum approach based on the idea of educating students in four specific disciplines; Science, Technology, Engineering and Mathematics in an interdisciplinary approach. The purpose of this study was to find out primary teachers' awareness on integration of STEM through the subject Environment Related Activities (ERA) in the primary curriculum. A survey design was used in this study and a questionnaire was administered to 100 primary teachers selected from stratified random sampling. In addition, focus group interviews were held with 20 primary teachers in order to get a better understanding of teacher awareness. Data from questionnaires were analyzed quantitatively with the use of MS Excel while incorporating the views taken from interviews. Analysis of questionnaire revealed that only 19% of primary teachers have heard of STEM concept through the programs conducted by the Teacher Centers. The responses obtained from teachers further indicated that 92% of them were familiar with the integration concept which is considered the key characteristics of STEM. This was further evident from the examples of subject integration provided at the focus group interviews. However, their examples were limited to integration of science and mathematics with other subjects like first language and aesthetic subjects rather than Engineering and Technology. Furthermore 75% they were in the view that STEM can be integrated into primary curriculum and they indicated the themes in which STEM should be integrated. More than 90% of the teachers believed that introduction of STEM into primary curriculum helps students face the challenges in future life. Majority of teachers responded that teachers need training in order to integrate STEM into primary curriculum. In conclusion, although teachers are familiar with the concept of integration, it is not exactly what is expected from STEM integration into ERA in the primary curriculum.

Keywords: STEM, Integration, ERA, Primary curriculum

A Case Study on Teaching English as a Second Language (ESL) to Three Visually Impaired Students at Faculty of Humanities, University of Kelaniya

I.A. Rathnayake[1]* and C. Arsakulasuriya[2]

[1]*Department of English, Faculty of Humanities, University of Kelaniya, Kelaniya 11600, Sri Lanka*
[2]*Department of English and Linguistics, University of Ruhuna, Faculty of Humanities and Social Sciences, Matara 81000, Sri Lanka*
*Isururathnayake95@gmail.com

This study is based on the experiences of two researchers/lecturers in teaching three visually impaired students in their first year compulsory ESL (English as a Second Language) course at the Faculty of Humanities, University of Kelaniya in 2020. The objective of the study is to assess the significance of re-negotiating traditional pedagogical practices when teaching English as a Second Language to differently abled students. The study documents the efforts and solutions adopted to address the issues, challenges and problems faced by the researchers as well as the visually impaired students who took the course. The experiences gathered and the observations made during the course were analysed based on language teaching approaches such as multi-sensory approach and Howard Gardner's multiple intelligence theory to argue for the significance of re-negotiating traditional teaching methods to address specific language learning requirements of the students with disabilities. The researchers also identified the high prestige with which English is perceived in Sri Lanka as an agent of demotivation when teaching English to students with disabilities by focusing on the theorisations of Parakrama (1995) and Gunasekara (2005). The researchers also argue that the lack of exposure to technology among the students with disabilities as a significant barrier in their English education. Therefore, this study recommends the adoption of a blended learning approach that incorporates computer assisted learning, introducing innovative assessment methods and customising syllabi to address the language learning requirements of the students with disabilities in an ESL classroom.

Keywords: Visually impaired, ESL, Critical pedagogy, Blended learning, Case study

Education for Transformation

Taoist Philosophical Implications towards Individualized Teaching Method: A Comparative Study

N.M.B.P.K. Karunathilaka[1]* and A.M.R.M. Senewirathna[2]

[1]Department of Philosophy, Faculty of Arts
[2]Postgraduate Institute of Humanities and Social Sciences
University of Peradenya, Peradeniya 20400, Sri Lanka
*buddhinipoornima@gmail.com

Taoism, created through the writings of Lao Tzu, is one of the hundred schools of thought that existed in the ancient Chinese traditional philosophy. Individualized learning gives priority to the abilities, interests, and skills of the learners. It provides adequate tutorial guidance, and other supportive services suited to bring holistic development in the student by using methods like observation, critical and creative thinking, questioning strategies, and self and peer assessment. The research problem of this study is to inquire whether Taoist Philosophy could contribute to develop the effectiveness of teaching practice. The objectives of the study are to identify the contemporary relevance of Taoist Philosophy, its interconnection between modern teaching practice and how Taoist Philosophy could contribute to improve the effectiveness of the contemporary educational teaching and learning practice. The comparative and analytical method was used in this study. *Tao-Te-Ching* was used as the primary source of this study along with several secondary sources. The 81 chapters of *Tao-Te-Ching,* which are based on the right understanding of the origin of the cosmos and human nature, were analyzed in terms of individualized teaching practice. This study focuses on synthesizing both Taoist and individualized learning methods to enhance the effectiveness of learning practice along with a comparative analysis on psychological wellbeing, stress management, and skill development. This study concludes that Taoist practical teachings can be used as future pedagogies. It discusses how children identify their unique talents, how they should know themselves, how they can maintain the continuity of studies by reducing the stress level, and what the role of the teacher should be.

Keywords: Taoism, Individualized teaching, Learning, Practical teaching

Challenges and Opportunities of Digitalization of Higher Education: Student Perspectives (Faculty of Arts, University of Peradeniya)

A. Bandara[1]*, P. Sethunga[2] and A.T.L. Athukorala[2]

[1]*Kandy Regional Centre, The Open University of Sri Lanka, Polgolla 20250, Sri Lanka*
[2]*Department of Education, Faculty of Arts, University of Peradeniya, Peradeniya 20400, Sri Lanka*
*Anushka.bandarakrc@gmail.com

With the outbreak of the pandemic, universities had to find alternatives to continue their education instead of relying on conventional methods. Digitization of education may be the most effective way of tackling this challenge, which has eventually become a new trend world-wide. Since the requisite conversion was sudden and unexpected; all stakeholders have been exposed to different types of challenges along with benefits. This study examines student perspectives on challenges and opportunities of Digitization of education in study programmes in the fields of Humanities and Social Sciences in the University of Peradeniya. The Study attempts to address the following research questions. 1.What are the challenges and opportunities that students face in the process of digitizing education? 2. How do the students experience the process of digitizing education? Involved methodology for the study is a mixed method and quantitative data were collected using google form questionnaires, which were distributed among all 3rd and 4th year students and, 12.28% (n=231) responded out of 1881 students. Qualitative data were collected using focus group discussions through semi-structured interviews from students (n=30). Quantitative data were analyzed by SPSS, and thematic analyses were used to evaluate qualitative data. Out of the participants, 63% of students depicted good ICT knowledge while 3.1% exhibited poor ICT knowledge. 79% responded that the poor signal strength and constant interruptions in the internet connection as main disturbances pertaining to online learning. Apart from that, 59% stated that the students face difficulties in being able to pay internet bills. Majority of the respondents were dissatisfied with online learning due to its absence of social components of teaching and learning. Although students agreed that digitization of education opens up a number of opportunities for them to connect to global demands, 63.7% and 48.7% of students preferred F2F and blended teaching methods, respectively.

Keywords: Digitalization of education, Higher education, Humanities and social sciences, Student perspectives

Identification of School Clusters in Sabaragamuwa Province Using Geographic Information System

A.M. Rajah[1]*, M.T.M. Ansaf[1], K.L.E. Kumara[1],
K.P.A.R. Pathirana[1] and H.M.A.S. Herath[2]

[1]Provincial Department of Education, Sabaragamuwa, Ratnapura 70000, Sri Lanka
[2]Department of English Language Teaching, University of Peradeniya,
Peradeniya 20400, Sri Lanka
*rajahmail@gmail.com

The education sector in Sri Lanka has planned to make major structural changes in the school system under education reforms. Therefore, it is very important to analyse the data on education management to make better decisions. The Sabaragamuwa education management information system has analyzed the spatial and statistical data to form a suitable school cluster system. School clustering is a process to identify core schools and their feeder schools. This study describes how core schools and feeder schools in Sabaragamuwa Province have been identified using the Geographical Information System (GIS) in order to make an efficient school cluster system and to minimise students' movement between clusters. There are 1121 schools in Sabragamuwa Province where 126 schools have been selected as core schools using statistical and spatial data analysis. The feeder schools have been identified based on the core schools. The area enclosed by a cluster can be considered as the catchment areas of these core schools. The cluster validation was done in consultation with divisional directors using web maps and static maps of the clusters. Clustering was done separately for Sinhala medium and Tamil medium schools. The results show that the identified school clusters are the best catchment areas for student flow. They also reveal that students who reside in the catchment areas can access core schools. The study concludes that the application of GIS is very efficient in clustering schools and defining their catchment areas. Further, the methodology can be replicated in other provinces to make better clusters to facilitate a structural change in the school system.

Keywords: Education reforms, School cluster, Education management information system, Geographic information system, Catchment boundary

Students' Difficulty with Notation for Dance in School Dance Lessons in Sri Lanka

V.D.D. Aluthge

Postgraduate Institute of Humanities and Social Sciences, University of Peradeniya, Peradeniya 20400, Sri Lanka
vajdiss@gmail.com

Notation for dance (*prastarakaranaya*) has become an essential component of school dance education since the 1960s. The notation for dance question has become a compulsory question in the GCE A/L examination. During my ten-year career as a government school dance teacher, I identified many students who failed the notation for dance question for various reasons. In particular, they confuse fundamental symbols in notation – *tit* (^) and *tei* (/). This paper examines students' inability to succeed in the notation for dance question and introduces a new method to teach the symbols *tit* and *tei*. Traditional dancers in Sri Lanka used a rhythm system called *tit* system, which did not require notation on paper. After the 1960s, based on the Indian music notation system, a mathematical notation system was introduced to the school dance curriculum. This study was conducted as action research. The methodology included a diagnostic test for 28 students in Risikala Aesthetic College in Kandy, an intervention to use their hands as the *thalampota* when notating, a post-test, and a questionnaire to know students' education history. Only 11 marked *tit* and *tei* symbols correctly at the diagnostic test. After the intervention, 26 students out of 28 marked it correctly. The intervention was somewhat successful. However, it reveals pedagogical constraints, particularly for underprivileged students, to succeed in the notation for dance. As per the curriculum, students should learn the basics of notation in grades 6 and 7. However, in rural schools, some students did not have regular dance teachers. In rural schools, many students are underprivileged, and student-teacher interaction is generally low. Some students feel that teachers in grades 6 and 7 didn't explain the notation process systematically and gradually. It also reveals a relationship between students' mathematical skills and success in notation because both require certain cognitive skills which need further studies to elucidate.

Keywords: Notation for dance, Dance education, Underprivileged students

School Rationalization Study in Sabaragamuwa Province Using Spatial Data Model with Special Reference to Dehiovita and Deraniyagala Divisions

M.T.M. Ansaf[1]*, A.M. Rajah[1], K.L.E. Kumara[1], S.T.S. Wijerathne[1],
K.P.A.R. Pathirana[1] and H.M.A.S. Herath[2]

[1]*Provincial Department of Education, Sabaragamuwa,
Ratnapura 70000, Sri Lanka*
[2]*Department of English Language Teaching, University of Peradeniya,
Peradeniya 20400, Sri Lanka*
*ansafichem@gmail.com

The Sri Lankan education system manages 10,165 government schools and 246,592 government teachers with more than 4 million students. Schools with less than 50 students are 1468 (14.4%) and less than 100 are 2966 (29.1%).The total numbers of schools, teachers and students in the Sabaragamuwa Province are 1124, 25,335 and 387,844 respectively. 227 (20.2%) and 392 (34.9 %) schools serve below 50 and 100 students respectively. Challenges faced in ensuring equity in education are a result of the high economic burden and other factors. School rationalization has been debated among educational administrators and policy makers in Sri Lanka for a long period and is echoed in the political sphere too. The rationalization of schools is a task of national importance in this context. This study focused on schools below 50 students in the respective divisions and rationalizes focused schools. The purposive sampling method was used. Data was collected from published reports of the Ministry of Education, Department of Education and the data management system of the department, including respective divisional reports. A spatial data model was developed using GIS technology to locate the catchment area of the schools. The road vector network was used to find alternative schools to the focused schools and efficiency was calculated using student movement data. Factors such as transportation-access facility and cost-benefit analysis were considered in the study. Data validation was done through discussions with divisional and zonal directors. This study finally derives decisions regarding the existence of focused schools. The conclusion ensures that the spatial data model used in this study is highly beneficial as a tool in micro-planning studies. Further, this model and methodology can be extended to be used in the Sabaragamuwa and other provinces too.

Keywords: School rationalization, Micro planning, Geographic Information System, Education policy

Effectiveness of Cooperative Learning for English as a Second Language (ESL) Learners in Sri Lankan Universities

G.G.K.V. Galappaththy

Department of English Language Teaching, University of Peradeniya, Peradeniya, 20400, Sri Lanka
kasung@sci.pdn.ac.lk

Cooperative learning or small group discussions claim to be an effective means of language learning. Collaborative Strategic Reading Instruction Approach (CSR) is a learner centered reading approach closely related to cooperative learning theory proposed by Klingner and Vaughn (1996; 1998; 2000). In this peer mediated instruction model, learners gain cognitive strategic knowledge through peer scaffolding and achieve successful comprehension. Fostering learner autonomy is another expectation of this model. This study was conducted to identify the effectiveness of CSR to enhance academic reading skills of undergraduates. The study also aimed at recognizing learners' perceptions and attitudes towards CSR and cooperative learning style. The informants of the study were 67 lower intermediate level Engineering undergraduates from the University of Peradeniya. Data was collected through the mixed method approach. A quasi- experiment including a pre-test and a post-test, a questionnaire survey, group interviews, participant observation sheets and student learning logs were employed as instruments. Statistical data did not prove that CSR is better than the traditional approach. However, the data elicited from the questionnaire survey indicated that the learners prefer CSR method to the traditional teacher centered method. Furthermore, the interviews with the informants revealed that the approach has helped learners develop their reading proficiency and foster autonomous learning. During the intervention, some problems and dilemmas such as low proficiency level of some learners were identified. Thus, pedagogical implications for English instruction at university level in Sri Lanka and suggestions for future research based on the findings to further validate the impact and effectiveness of CSR are proposed.

Keywords: Collaborative strategic reading approach, Cooperative learning, Learner autonomy, Peer scaffolding

Use of E-Learning Resources by Dental Undergraduates of University of Peradeniya, Sri Lanka

W.B.M.C.R.D. Weerasekera[1]*, C. Gunasekera[2], S. Premarathne[2], and B.E.S. Bandara[3]

[1]Department of Community Dental Health, Faculty of Dental Sciences, University of Peradeniya, Peradeniya 20400, Sri Lanka
[2]Main Library, University of Peradeniya, Peradeniya 20400, Sri Lanka
[3]Main Library, South Eastern University, Oluvil 32360, Sri Lanka
*chandimaw@pdn.ac.lk

Electronic learning resources (E-resources) play a vital role in the provision of information by libraries at present. These are changing library usage patterns and academic libraries spend an increasing amount of annual allocation to subscribe to the E-resources. The impact of the updated usage patterns and the trend on E-resources have demanded interest among academic libraries to measure E-resources usage. The study aimed to find out the use of E-resources for academic purposes by the Dental Undergraduates in four academic years at the University of Peradeniya (UOP). Survey method was applied and a self-administered online questionnaire was distributed in January 2020 with ethical approval (ERC/FDS/UOP/I/2020/02). Out of the 280 undergraduates, a total of 175 responded. Data was analysed using SPSS 21. The study revealed that e-books (46%), e-databases (23%) and e-journals (19%) were the E-Learning resources often used by the Dental students. PUBMED CENTRAL (30%) and OXFORD (22%) were the mostly used academic databases. The majority (87%) used Google and 10% used Yahoo as search engines for accessing E-resources. The results further indicated that 19% accessed E-resources to gain general information while 20% accessed to get answers to a specific topic and 18% to watch and download videos. The study showed that all the students had their own electronic devices and 26% accessed through mobile phones. However, slow speed on the internet (71%), inadequacy of computers & hardware (48%) and the lack of materials (66%) related to Sri Lanka were the problems encountered by the respondents. Pearson correlation indicated a significant positive association between the students' perceptions of the usefulness of E-resources and their GPA values (r=.988, N=141, p <.001). Upgrading the existing internet facilities, the provision of free access to all the databases off-campus and the introduction of more training sessions on E-resources are recommended as future developments.

Keywords: Use of E-resources, Dental students, University of Peradeniya, Sri Lanka

Continuing Professional Development Practices of University Librarians in Sri Lanka: A Needs Assessment Survey

C. Gunasekera

Digital Resources Development and Staff Training Division, Main Library,
University of Peradeniya, Peradeniya 20400, Sri Lanka
chamanig@pdn.ac.lk

Many libraries focus on the increased emphasis on Continuing Professional Development (CPD) and actively encourage their staff to engage in activities that enhance and deepen their knowledge. In order to provide efficient and effective library services, library professionals need to acquire advanced knowledge with a new set of skills. This study examines the current status of CPD for university librarians in Sri Lanka and the future requirements in CPD. The study adopted the survey method and a structured questionnaire was used as the data collection tool. The collected data was analysed using SPSS (21.0). The questionnaire was distributed among all the university library professionals (128). Out of 128, a total of 57 responses were received. It was revealed that Library & Information Science (LIS) professionals in Sri Lanka showed a high level of engagement with different types of CPD programmes and, most of them participated in conventional forms of CPD programmes namely conferences (96%), seminars and workshops (82%). Among the reasons for participation in CPD, 'stay current with developments in the profession' (72%) and 'for tenure and/or promotion requirements' (63%) were the highest reported reasons. The study found that the majority preferred to have CPD programmes on newly developed current topics such as Open access and digital repositories, Publication writing and Bibliometrics which had the highest mean scores of 4.63, 4.58 and 4.22 respectively. The results further established that the university libraries have employed various strategies to encourage staff development such as paying some of the costs associated with attendance, allocating time to attend (56%) and bearing the cost of the course/ registration fee (53%). The findings and implications for this survey can therefore serve as a source of information for CPD programme planners in their efforts to develop programmes that are responsive to the needs of the librarians in the country.

Keywords: Continuing professional development, Information professionals, Staff development, University libraries, Sri Lanka

Familiarity with and Usage of Reference Management Software (RMS) among Undergraduates in Faculty of Dental Sciences, University of Peradeniya, Sri Lanka

W.H.D.K. Abeyrathne[1]* and S. Premarathne[2]

[1]*Medical Library, Faculty of Medicine*
[2]*Dental Science Library, Faculty of Dental Science*
University of Peradeniya, Peradeniya 20400, Sri Lanka
*dilanidka@gmail.com

Citations and references are an essential part of academic writing. Managing references in academic writing is a difficult task. Manual typing is a time-consuming process. The Reference Management Software (RMS) is designed for managing citations and references. Therefore, the objective of this study is to explore the familiarity and usage of RMS by the undergraduates in Faculty of Dental Sciences, University of Peradeniya, Sri Lanka. The quantitative method was adopted as a cross-sectional study. A sample of 70 final year undergraduates in the Faculty of Dental Sciences, University of Peradeniya, Sri Lanka was selected using simple random sampling. A closed ended questionnaire was administered to collect data. Finally, the data was analysed using Statistical Package for Social Sciences version 23. The response rate was 100%. Of the sample, 21.4% were male whereas 78.6% were female. The study revealed that 54.3% of the students managed their citations manually, 44.3% used word processor while 1.4% used online citation generators to manage citations. However, 84.4% were not familiar with RMS. 4.3% were familiar with RMS and they had already used it whereas 14.3 % had heard of it but had never used. Among the students who had already used RMS, MS word was the only RMS they had used. They had familiarized with RMS in different ways; by themselves, from a colleague or from a workshop/seminar. RMS had been used only for creating citations/bibliography and searching and retrieving information. Among the students who had never used RMS, 10% were not willing to change the way they manage references, 60% were not familiar with any RMS and 20% mentioned about the lack of assistance to learn RMS. According to the study, the majority of students were not familiar with RMS. Therefore there is a need for establishing an appropriate programme to make them aware of RMS.

Keywords: Reference management software, Citation, Bibliography, Undergraduates

Convergence of Online and Face-to-Face Education for Economics: Adopting Past Experience in the New Normal

A.N. Fernando[1]* and Y.K.N. Kandewatta[2]

[1]Department of Economics, University of Colombo, Colombo, 00300, Sri Lanka
[2]Department of Economics, University of Ruhuna, Matara, 81000, Sri Lanka
*ashani@econ.cmb.ac.lk

Economics is a discipline that takes a different approach from other social sciences. In general, students enrolled to the Faculty of Arts tend to have a natural distress for computer literacy and quantitative spheres of study. The motives for the experiment emerged to address two fundamental constraints faced by students specializing in Economics: poor understanding of basic mathematical derivations and the lack of basic computer literacy for data analysis. These shortcomings are critical as they directly influence the education attainment and career development. Therefore, Blended Learning (BL) tools were adopted in Econometrics Modules with the objective of achieving solutions to the above research problem. Hence, this study is based on an experimental research. The Rotation Model was used when introducing BL to the modules. This facilitated the requirements of the module to embed both classroom learning and computer lab sessions when designing the lesson plan. Further, it utilized both the Station Rotation and Flipped Classroom technique when lessons were conducted. Initially, the module content which was completely based on classroom teaching was transformed to incorporate BL tools. Students were provided insights in adopting online learning by introducing them to handle the Learning Management System (LMS) more frequently. In executing the course plan, videos were uploaded capturing practical exercises, which encouraged students to follow instructions and to do activities in their own pace. Both in-class and offline teaching techniques enabled students to complete assessments and engage in a continuous learning process in a smooth and student-centered pace in contrast to the past practices. Announcements were made on LMS on a regular basis. However, there were a few inevitable limitations as students were getting used to online methods; therefore, instructions had to be clear and precise. Learner satisfaction was evaluated through the feedback received from students during and after sessions through which students requested more lessons to be conducted in an active and practical manner as planned and discussed.

Keywords: Blended Learning (BL), Economics, Flipped classroom, Learning Management System (LMS), Rotation model

Effect of Twelve Week Conditioning and Coordination Exercise (CCE) Training Programme on Two-Point Shooting Accuracy among Male Basketball Players in Sabaragamuwa University of Sri Lanka

M.K.K. Perera* and J.M.D.D.M. Jayamanna

Department of Sports Sciences and Physical Education, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya, 70140, Sri Lanka
*mkkperera.kd@gmail.com

Shooting accuracy plays a meaningful role in gaining points in a basketball match. Ball shooting angle, shooting height, shooting velocity, shooting distance and shooting technique are the determinant factors of shooting accuracy in basketball. Due to the lack of shooting accuracy among the male basketball players in Sabaragamuwa University of Sri Lanka, a specific conditioning and coordination exercise training programme (CCE) was designed. The prime aim of this study was to analyse the impact of this CCE on two-point shooting accuracy among the male basketball players in Sabaragamuwa University of Sri Lanka. The study was carried out on a group of 15 basketball players (age (23 ± 1.2 years), weight (71.58 ± 4.71 kg), height (178.8 ± 3.47 cm) and training age (5 ± 1.6 years)). A twelve weeks CCE programme developed based on periodization was carried out for four sessions per week. Submaximal physical tests, the dynamic 60 seconds two-point shooting test, medicine ball put test, Sargent jump test and hand-eye coordination test were used as the pre-test and post-test to collect the data on two-point shooting accuracy, upper body power, lower body power, and hand-eye coordination respectively. The study was carried out under the pre-experimental research design. Descriptive statistics and a paired t-test were used to analyse data through Minitab 19 statistical software at the 95% confidence level because the data was normally distributed. The analysis demonstrated that there were statistically significant improvements on two-point shooting accuracy, upper body strength, lower body strength and hand-eye coordination. Within the confines of the study, this specific twelve weeks CCE programme would have positive impacts on the improvements of two-point shooting accuracy, upper body strength, lower body strength and hand-eye coordination.

Keywords: Two-point shooting accuracy, Basketball, Sabaragamuwa University of Sri Lanka

Influence of Study Habits on Academic Performance of Undergraduates of University of Peradeniya

H.M.U.T. Obesekara* and L.N.A.C. Jayawardena

[1]Department of Agricultural Extension, Faculty of Agriculture, University of Peradeniya, Peradeniya, 20400, Sri Lanka
*uresha.thilakshi94@gmail.com

Study habits of undergraduates play an important role in their academic performance. Examining the study habits of undergraduates and assessing the relationship between study habits and academic performance of students were the objectives of the study. The development of cognitive and practical skills of undergraduates was the expected outcome of the findings. The study focuses on the students of the Faculty of Agriculture, University of Peradeniya, Sri Lanka. A deductive approach was used based on a cross-sectional survey. A sample comprising of 70 final year undergraduates of the Faculty of Agriculture was selected based on stratified random sampling method. Gender, English proficiency, level of academic stress, parental education, engagement in student associations, and other extracurricular activities were also identified as the antecedents influencing the academic performance of undergraduates. Academic performance of undergraduates was estimated using the Grade Point Average (GPA) of the most recent examination performance. Primary data were collected using a self-administered questionnaire. Data were analyzed using descriptive statistics and inferential analyses viz: independent sample t-test, Mann Whitney U test, Spearman's correlation, and multiple regression tests. The mean of overall status of undergraduates' study habits score was 63.01 ± 8.42 from 96 of total study habit scores. Findings revealed differences in the study habits between males and females. There were also differences in the domains of study habits in terms of gender. Academic performance of undergraduates had a positive relationship with the study habits of undergraduates ($p<0.1$). Academic performance of undergraduates were influenced based on engagement in extra-curricular activities, English proficiency and the parental education level ($p<0.1$). Academic performance of undergraduates has been influenced by their study habits and related factors.

Keywords: Study habits, Academic performance, Gender, Undergraduates

Relationship between Adolescents' Self-Concept and School Satisfaction

T.D.S.N. Jayasena* and G. Skrzypiec

Department of Education, College of Education, Psychology and Social Work,
Flinders University, Adelaide 5042, Australia
**jaya0032@flinders.edu.au*

Educational research on social and psychological wellbeing has demonstrated that it is an important determinant of mental health among students. Nonetheless, there is lack of consensus among researchers over how students' mental health should be measured. Identifying this knowledge gap, this study sought to investigate the relationship between self-concept and school satisfaction among students. A secondary data set of 2756 students aged 10-15 years attending 16 schools in Beijing, collected by Askell-Williams et al. (2016) and 3478 students aged 10-15 in 8 South Australian schools, collected by Skrzypiec (2007) were used for this study. In China, data had been collected from eight primary schools and eight secondary schools (all 16 schools were state schools) located in four districts in Beijing. After explaining the purpose, procedure, confidentiality, and anonymity of the questionnaires, the completion of the questionnaires was supervised by Chinese researchers. The sample comprised of 2,756 students from 64 classes in Grades 5-9. In Australia, purposive sampling had been done in eight schools in South Australia, including two Catholic schools, three government schools, and three independent schools, where middle school students were surveyed. The total of 1,983 participants comprised of 25% South Australian government school children, 29.2% Catholic school children, and the others were independent school children. Factor analysis was used to confirm the factors used in the questionnaires. Reliability analysis was done to determine the reliability of each factor. Correlation analysis was then conducted to determine the relationship between the main constructs – school satisfaction and self-concept. Further, comparing scores between the two countries was done by using independent t-test. Results showed that there is a significant moderate positive correlation ($r=0.588$, $p<0.000$, $df=2041$) between school satisfaction and self-concept of the adolescents which revealed that the greater the self-concept of a student, the higher the school satisfaction.

Keywords: Adolescents, Psychological well-being, School satisfaction, Self-concept

Implementing Factors and Criteria That Affect the Increase of Job Satisfaction of Teachers in Government Schools

H.M.N.D. Kumari[1]* and S. Vipularathna[2]

[1]*Hapitigam National College of Education, Mirigama 11200, Sri Lanka*
[2]*Zonal Educational Office, Kothmale 20560, Sri Lanka*
*h.m.n.d.kumari@gmail.com

Many teachers are taking their 'noble' career as a stepping stone to better careers which means they are discontent with teaching as a career. The main objective of this study was to investigate how implementing factors and criteria affect the increase of job satisfaction of teachers in government schools. In order to achieve this, Herzberg's Motivation Theory model, which argued that there are two factors namely Motivating and Hygiene factors that an organization can adjust to influence motivation in the workplace, was used as the theoretical framework. For this study, the descriptive research approach was employed and questionnaires and interviews were used to collect data. For the preparation of questionnaires, five factors from Herzberg's factor theory regarding criteria that affect job satisfaction were taken into consideration. The sample of this study consisted of principals and ninety-six teachers from eight selected Sinhala schools in Minuwangoda Educational Zone of Gampaha District. Data were analyzed and interpreted by means of numbers and percentages. As a whole, the study revealed that the implementation stage of the factors and criteria for the improvement of job satisfaction was unsatisfactory. Particularly, the principals showed fairly satisfactory remarks in terms of teachers allowing to be recognized, yet, in relation to providing opportunities for achievements, assigning responsibilities, chances for teacher development, welfare and other incentives were proved to be unsuccessful. With regard to principals facing problems and challenges, it was revealed that when implementing projects, teachers had negative attitudes towards financial and administrative regulations. As suggestions to enhance job satisfaction, the following were identified: organizing School Based Teacher Development programmes by understanding their needs, improving teacher welfare activities in terms of quality, creating an environment to engage in a satisfactory job by understanding teachers' potentials and capabilities, and giving them due posts and appropriate positions with responsibilities.

Keywords: Job satisfaction, Motivational strategies

Creating an Online Teacher Transfer System for Sri Lankan Education Sector: A Collaborative Action Research Based on *Sipthathu* Education Management Information System (SEMIS)

K.P.A.R. Pathirana[1]*, K.L.E. Kumara[1], H.M.A.S. Herath[2] and M.T.M. Ansaf[1]

[1]*Provincial Department of Education, Sabaragamuwa, Ratnapura 70000, Sri Lanka*
[2] *Department of English Language Teaching, University of Peradeniya, Peradeniya 20400, Sri Lanka*
*anuradharuwan@gmail.com

This collaborative action research study explores the online teacher transfer mechanism developed by the Provincial Department of Education, Sabaragamuwa under the *Sipthathu* Education Management Information System. The study reveals that this online teacher transfer mechanism as a fast, reliable and cost-effective method to manage the human resource in the province, since it benefits students, teachers, principals and education administrators in Sabaragamuwa in multiple ways. Nearly 200 teacher transfers have been successfully completed with the newly developed online teacher transfer system, making it convenient for the teachers to get appointments in the nearest school possible, principals to manage schools effectively, and students to learn from teachers who are stress-free and mentally healthy because of working in a school near their homes. Teacher transfers done under the traditional manual teacher transfer mechanism consume a huge amount of money, time and physical effort. We have provided pragmatic solutions through the online teacher transfer system to address this key limitation by facilitating fast and cost-free teacher transfers within the province using the online teacher database in the *Sipthathu* Education Management Information System. The data were collected by conducting semi-structured interviews with a sample of 30 professionals including teachers, principals, and education administrators in Sabaragamuwa, selected using the purposive sampling method. The findings analyzed thematically revealed that the newly developed online teacher transfer system is highly perceived among the personnel engaged in the educational field and has contributed to manage and distribute the human resource in the education sector of the province conveniently and efficiently. This study will positively impact the Sri Lankan school education sector by encouraging the system developers working in the educational field in the other provinces of the country to ensure accurate and efficient teacher deployment via online mode.

Keywords: Teacher transfers, Education Management Information System, Human resource management, Cost-effective method

Inter-Module Relationship of Student Performance: A Case Study of University of Vocational Technology

D.D.D. Suraweera[1]* and K.G. Alahapperuma[2]

[1]Department of Electrical and Electronics Technology
[2]Department of Manufacturing Technology, University of Vocational Technology
Ratmalana 10390, Sri Lanka
*dimuthusiri@gmail.com

University of Vocational Technology of Sri Lanka offers Bachelor of Technology degrees for National Vocational Qualification holders and students who have passed Advanced Level examination. Engineering Mathematics and Communication Skills are compulsory modules of first semester, since these are identified as modules that provide fundamentals for students to acquire higher level technical content. Those who do well in these two modules are expected to do well in technology modules offered in subsequent semesters. Ex post facto study was conducted among two student groups of the 2017/2018 intake, on their performance in Manufacturing Technology and Mechatronics Technology to investigate the validity of this expectation. It was assumed that both groups had similar entry level of competencies in communication skills and mathematics. Pearson's product momentum correlation coefficient was used as the statistic. Guildford's rule of thumb values were used to interpret the strength of correlations. Student performance in Electrical Technology, Thermodynamics, Strength of Materials and Engineering Mechanics modules of the second semester indicated positive moderate correlations with Engineering Mathematics module of first semester. Student performance in Electrical Technology and Thermodynamics showed similar correlations with Communication Skills module of first semester. These correlations were found as significant with a significance level of 0.01. However, student performance in Strength of Materials and Engineering Mechanics revealed low correlations with Communication Skills. Higher numerical involvements in Strength of Materials and Engineering Mechanics modules could be the reason for these low correlations. Since all other correlations are positive, moderate and significant, findings support the hypothesis. These two modules may have a positive influence on student performance in higher technical modules. Therefore, more attention is required when delivering Engineering Mathematics and Communication Skills modules in the first semester. However, mathematical aptitude and the different entry qualifications of two groups of students may have influenced the observed correlations, which need further investigation.

Keywords: Communication skills, Correlations, Engineering mathematics, Undergraduate student performance

Academics' Perceptions of Adopting OEP for Engineering Education: Peradeniya Perspective

I.P. Ratnapala

Computing Centre, Faculty of Engineering, University of Peradeniya,
Peradeniya 20400, Sri Lanka
iroshinir@pdn.ac.lk

Open Educational Practices (OEP); creation, use, or repurposing Open Educational Resources (OER) mainly with the Creative Commons (CC) licenses is an emerging trend in the education sector to establish inclusive education effectively. Sri Lanka has identified the significance of OER and initiated the development of an OER national policy to adopt OEP for education and included it as a criterion when evaluating higher educational institutions. University academics in Sri Lanka tend to work individually in teaching-related activities. Since possessiveness is a prime concern for Sri Lankan academics in their publications, they do not show a higher tendency on social media usage, sharing contents, open for peer-reviewing, and accepting the use of externally developed teaching materials. Therefore, this study was designed as a case study in the Faculty of Engineering at the University of Peradeniya to analyse university academics' (total-117) perceptions of adopting OEP. Random samples were selected using a proportionate stratified random sampling technique considering eight departments and two units as strata. The total sample size (82) was calculated with a 90% confidence interval and 0.05 error rate. An online questionnaire was emailed to the randomly selected academics, and it was available for three months from December 2019. The questionnaire's overall response rate was 28%, while having more than 25% in 8 strata and 13% in 2 departments. All the respondents use educational web-based materials, but only 52% use OER for their teaching and learning. Also, 87% is willing to encourage students to follow Massive Open Online Courses (MOOCs). However, only 30% is ready to publish their creations as OER with global access, while most prefer to submit them only within the institution. Therefore, more awareness sessions, recognitions and awarding mechanisms are required to popular OAP for the benefit of educational reforms in the field of engineering in Sri Lanka.

Keywords: Open education, OEP, OER, Creative Commons (CC), MOOCs

A Study on the Impact of Training on Employee Performance in a Multi-Purpose Cooperative Society in Sri Lanka

W.D.C.P. Amarasekara

HRcoop Sri Lanka, Digana, 20180, Sri Lanka
research.liyamu@gmail.com

Training and development of employees is crucial for improving performance and productivity. A trained and developed workforce is increasingly important in today's work environment. Training is a crucial method of developing human resources and enhancing knowledge, skills and attitudes in an employee. The problems and challenges the Multi-Purpose Co-operative Societies (MPCSs) in Sri Lanka face today are numerous. The researchers found out that the problems and challenges faced by MPCS include their inability to adapt and make changes to face the challenges posed by the open economy system, under-developed work-force, lack of expertise in the co-operative movement, and not enough emphasis being placed on developing the leaders of tomorrow. To overcome these issues and to face today's competitive business environment with confidence, MPCSs should have a well-trained and a highly motivated workforce. To achieve this objective, MPCSs should provide effective training to their employees. Therefore, this research focused on studying the impact of training on employee performance in a MPCS in Sri Lanka. Both quantitative and qualitative data was collected via a structured questionnaire, formal interviews, observation and analysis by means of Statistical Package for Social Scientist (SPSS), and content analysis. The study was limited to employees of MPCS. The sample of the study was 50 respondents. The Convenient sampling technique was used to select a sample of 50 employees due to the social distancing policy to overcome the risk of the spread of COVID-19. With the findings analyzed, we were able to arrive at the conclusion that training facilities had a direct positive impact on employee performance of the Multi-Purpose Cooperative Society. We also found that the training policy, training methods and the time spent on training had no impact on employee performance.

Keywords: Multi-purpose cooperative society, Training policy, Employee performance, Convenient sampling technique

Promoting Deep Learning among First-Year Undergraduate Medical Students Using Journal Articles

K.N. Nilmini* and K.J. Wijesinghe

*Department of Biochemistry, Faculty of Medicine,
Sabaragamuwa University of Sri Lanka, Hidellana, Ratnapura 70012, Sri Lanka
nadeesha@med.sab.ac.lk

Students who engage in surface learning tries to commit information into memory using rote learning. Deep learning involves comprehension of underlying concepts, patterns, or meanings of a given learning task while promoting development of analytical and critical thinking skills. With surface learning, students' accomplishments are often limited to recalling and reproducing. Hence the objective of this study was to engage students in deep learning. The study was conducted as a cross-sectional survey involving 75 undergraduates from the Faculty of Medicine, Sabaragamuwa University of Sri Lanka. Briefly, the lesson was divided into two sessions and at the first session, students were provided with two journal articles to read and summarize. Summarization required students to participate in deep learning by allowing them to tie new information from the articles to their prior knowledge. In the second session, a discussion among students was facilitated on how this new information can be incorporated to manage health and wellbeing of themselves and their close communities. Data were collected using a self-administrated online questionnaire and simple descriptive analysis was used to analyze data. Fifty six percent students agreed that learning activity demonstrated how the subject concepts are translated into clinical scenarios and 57% have tried to expand on these concepts by adopting lifestyle changes and/or by advising their close communities based on new information they have learned. Fifty eight percent students have agreed that learning activity motivated them to seek an in-depth understanding of the subject than memorizing it. Data suggested that the learning activity was successful in promoting deep learning. Therefore, we intend to continue this learning approach as an effective method. The minority of the negative responses were likely due to student's preference for passive assimilation of information and their reluctance to engage in deep learning due to the belief that it increases their workload.

Keywords: Deep learning, Journal articles, Self-administrated, Surface learning

Assessment of Healthcare Staff Satisfaction with Biochemistry Laboratory Services Provided in Teaching Hospital Anuradhapura

K.M.A.G. Karunatilaka* and H.T.N. Hewageegana

*Department of Chemical Pathology, Teaching Hospital Anuradhapura,
Anuradhapura 50000, Sri Lanka
anjanakaru1990@mail.com

A customer satisfaction survey in clinical biochemistry is a process of review and assessment of laboratory performance. It is a major component of a quality management system. This, in turn, improves staff awareness, education, and training, prepares the laboratory for audits, and sets its own quality goals. The main goal of this study is to measure the level of satisfaction of medical officers and nursing staff who avail the laboratory service at the teaching hospital Anuradhapura, Sri Lanka, and to identify the areas which need improvement. The outcome will ameliorate patient care through corrective actions to improve overall laboratory. A cross-sectional survey was conducted to evaluate the level of the subjective satisfaction of receivers of laboratory service. A whole hospital unit was considered as one sample; hence the sample size was limited to 50. A paper-based self-administered questionnaire was distributed to all the 50 hospital units. The collected data were analyzed using a Microsoft Excel spreadsheet. Out of the 50 questionnaires, the response rate was 90%. The overall satisfaction with the Day-laboratory service was approximately 85%, in contrast to the 60±2% regarding the Night-laboratory. This is a 29.4% declining satisfaction. Respondents were satisfied with the range of tests performed and their accuracy. However, they were dissatisfied with the turnaround time for test results, especially during the night service. The responses in the open-ended section were primarily suggestions to improve the critical value notification and to extend the Day-laboratory service. In conclusion, staff were generally satisfied with the laboratory service provided for them. Turn-around time for results along with the overall functioning of the Night-laboratory received the lowest satisfaction. Therefore, corrective actions are required to meet the needs of the staff and to improve patient care through the overall improvement of the laboratory service.

Keywords: Quality of laboratory, Customer satisfaction, Feedback survey, Biochemistry

ENVIRONMENT AND NATURAL RESOURCES

Development of Evidence-Based Informative and Interactive Database (EBIID) for Vavuniya Solid Waste Management System in Sri Lanka

S. Kayanan[1,3]* and B.F.A. Basnayake[2]

[1]Postgraduate Institute of Science
[2]Department of Agricultural Engineering, Faculty of Agriculture
University of Peradeniya, Peradeniya 20400, Sri Lanka
[3]Department of Bio-Science, University of Jaffna – Vavuniya Campus,
Vavuniya 43000, Sri Lanka
*ksobana6@gmail.com

Solid waste management databases play vital roles in effective waste management in developed countries. In contrast, developing countries having inadequate information create massive problems when planning waste management projects. The objective of this study is collection of relevant and reliable information and development of EBIID.It will be helpful to improve the strategies and policies and design a solid waste management plan for a sustainable solid waste management system.Therefore, data and information were collected from several sources to feed comprehensive information into EBIID. Key personal interviews were done with relevant officials of Local Authorities and secondary information gathered fromhandbooks, documents and published papers. Onsite investigations were madeby observingthe services of disposal site and recyclingoperations. Quantitative and qualitative data related to generation, collection, transportation, recycling and disposal are analyzed and displayed in EBIID in the form of tables or summary sheets to provide the status and know-how of Solid waste management that local authorities are doing in Vavuniya. Researchers, planners, policy makers and public can access Vavuniya District solid waste management information to choose the best options for recycling, treatment and reduce the disposal by recycling and give their feedback to improve the services in future.

Keywords: Database, EBIID, Strategies, Planning, Recycling

iPURSE 2021 – 076   *Environment and Natural Resources*

Assessment of District Inland and Aquaculture Fish Production and Productivity Referring to Major Climatic Zones in Sri Lanka

P.S.S.L. Wickrama*, A.L. Sandika and P.V.S. Harshana

Department of Agricultural Economics, Faculty of Agriculture, University of Ruhuna, Kamburupitiya 81100, Sri Lanka
*shalikalaksan@gmail.com

There is a high number of rivers and reservoirs with a total inland water area of 290,500 ha in Sri Lanka, which is having the highest water bodies: land ratio in the world. However, contribution of the inland fisheries sector for Sri Lankan GDP (0.2%) is insignificant. Per capita consumption of freshwater fish and fresh water dried fish were increased during the last few decades in Sri Lanka with insufficient availability to satisfy the demand. Also, inland fish productivity in Sri Lanka was significantly low (302 kg/ha) compare to other countries e.g. Bangladesh (>1500kg/ha). Also, Sri Lanka imports around 84,463 t of fish and fisheries products by spending around Rs.Mn. 32,726 annually. Therefore, this study explores the potential inland fish productivity of each district under different climate zones for better policy implications.The study follows a quantitative approach drawing secondary data from Ministry of Fisheries & Aquatic Resource Development during 2008-2018 periods by considering both aquacultures/culture based & inland fish production and related inland water areas in each district.The highest annual inland fish production and productivity of dry zone were recorded in Anuradhapura (12,656 t) and Hambantota (460.57 kg/ha) respectively, while the lowest production (86 t) and productivity (8.95 kg/ha) were recorded in Jaffna. The highest annual wet zone inland fish production (2435 t) and productivity (624.48kg/ha) was from Rathnapura while the lowest was from Kegalle district as (20 t production and 25 kg/ha productivity). Further, the highest annual inland fish production (4038 t) and the lowest productivity (210.32 kg/ha) of intermediate zone were recorded in Kurunagala while the lowest production (1074 t) and the highest productivity (315.77 kg/ha) were recorded in Badulla. Accordingly, Sri Lanka can attain more than 181,408 t of possible inland fish yield under the current situation. It revealed that Sri Lankan does not attain its optimum productivity and there were huge fish productivity differences in each district in the same climatic zones. Therefore, rational policies and management of the water bodies with fish productivity mapping, co-management strategies, stock enhancement and fish seed production should be adapted to stop capital flight.

Keywords: Climatic zone, District, Fresh fish, Inland water, Productivity

Sustainability Performance of Urban Rooftop Agriculture:
A Comparative Analysis of South and South East Asia

E.G.I. Sevwandi

Department of Geography, Faculty of Arts, University of Peradeniya,
Peradeniya 20400, Sri Lanka
isurika.sevwandi@arts.pdn.ac.lk

Humanity in the 21st century deliberately evolves as urban species with pressing issue of food security during a time where available fertile land is minimal. Rooftop gardens referring to the cultivation to obtain fresh produce on the top of buildings within the major cities, and are gaining popularity at such pace as they have the potential to meet the growing demand of nutritional needs in cities and to enhance the ecosystem services along with the social capital. Yet, there is no adequate literature available to elaborate how cities can achieve sustainability via urban rooftop agriculture. The primary objective of this study was to conduct an in-depth analysis on how South Asian and South East Asian countries have achieved urban sustainability through rooftop farming interventions. Therefore, three dimensions of sustainability were assessed under thirteen parameters through a systematic review of thirty selected articles from Science direct, Elsevier and Academia Education digital databases. Selected literature comprised of studies from Bangladesh, India and Nepal representing South Asia, and Malaysia, Singapore and Vietnam representing South East Asia. Regardless of the region or the country, findings supports that urban rooftop gardens promotes more environmentalism aspects signifying the reduction of carbon foot print followed by food security cum self-reliance and climate change adaptation. Overall sustainability was best achieved by India showing the highest achievement in all three dimensions. Environmentalism accounted for 43% of overall rooftop sustainability providing a strong sense of environmental security for both human and natural environment. The way forward promoting rooftop farming in cities need outreach programs, capacity development and policy interventions, and nations must foster research partnerships, collaborations and investments. Moreover, it is essential to have a productive mechanism to disseminate the regional success stories and best practices among local urban community to transform their rooftops to more conducive communal spaces.

Keywords: Sustainability performance, Urban rooftop agriculture, Comparative study, South Asia, South East Asia

Current Status and Concerns on Shark and Ray Fishery of Sri Lanka

M.L.I. De Silva*, M.A.S. Ranjula and M.S. Gunasinghe

Department of Fisheries and Marine Science, Faculty of Fisheries and Ocean Sciences, The Ocean University of Sri Lanka, Tangalle 82200, Sri Lanka
*Ninelawlis1@gmail.com

Traditionally, sharks and rays are considered as constant contributors for the marine fishery of Sri Lanka. High consumer demand for fins, gill plates, liver oil and meat influences vulnerability of these species. Unfortunately, accurate quantitative data on shark and ray fishery is scarce to understand the status of these species. The current study aimed to investigate the status of shark and ray fishery exportation, illegal trade and fisher response on conservation measures. From April 2019 to February 2020, the data were collected from Tangalle, Mirissa and Negombo fisheries harbors, interviewing fishers, and exporters. Statistical secondary data on shark and ray trades, collected from National Aquatic Resources Research and Development Agency, Sri Lanka Coast Guard and Sri Lanka Customs were analyzed. During the study period, from 2015 to 2019 shark and ray products were exported to 19 countries while Hong Kong (56%) was the main export destination, followed by Maldives (16%).*Carcharhinus falciformis* (Silky shark)*, Prionace glauca* (Blue shark)*, Mobula mobular* (Spinetail devil ray) and *Mobula tarapacana* (Sicklefin devil ray) were recorded as the main traded shark and ray species. Illegal landing of three shark species was observed during the study period. The highest number of illegal shark cases was reported from Dikowita and Oluwil harbors. According to the illegal shark records, 59% were *Alopias* spp. (Thresher sharks) followed by 20% of *Carcharhinus longimanus* (Oceanic whitetip shark). It was observed that unreported cases to be much higher than the reported cases. Of the interviewed fishers (n= 100), 93% of them reported landing of illegal shark species and 70% of the fishers support the lift of banning *Alopias* spp. This study revealed that there is an urgency to extend protection of these species considering their ecological importance, while addressing the role of shark and ray trade to the countries' economy.

Keywords: Export, Fishery, Fins, Trade, Gills

Relationship between Flame Photometry and ICP-MS Detected Potassium Concentrations Extracted in Calcium Chloride for Paddy Soils Samples

H.M.N.M. Herath[1], N.D.R. Madushan[1], W.M.U.K. Rathnayake[3], D.N. Sirisena[3], M. Ariyaratne[1], B.G.G. Wijesooriya[1], D.A.T. Samarasinghe[1], G.D.D.S. Gamage[2], R. Chandrajith[2], and L.D.B. Suriyagoda[1]*

[1]Department of Crop Science, Faculty of Agriculture
[2]Department of Geology, Faculty of Science
University of Peradeniya, Peradeniya 20400, Sri Lanka
[3]Rice Research and Development Institute, Department of Agriculture,
Batalagoda 60500, Sri Lanka
*lalith.suriyagoda@gmail.com

Ammonium acetate extracted and Flame photometry (FP) detected potassium (K) concentration is widely used to determine the exchangeable K in paddy soils. Recently, inductively coupled plasma mass spectrometry (ICP-MS) is also used widely in analytical purposes as it has capabilities of simultaneous determination of major and trace elements. Moreover, calcium chloride (CC) is used as a universal extractant when determining mineral elements in soil samples. However, the relationship between FP and ICP-MS detected K concentrations in CC extracted paddy soil samples of Sri Lanka is not known. Therefore, a total of 250 soil samples were collected from lowland rice paddy fields in Sri Lanka representing all three climatic zones (wet, dry and intermediate). Potassium in 4 g of soil was extracted into 40 mL of 0.01 M $CaCl_2$ for two hours in an orbital shaker at the ambient temperature and K concentration was determined by FP and ICP-MS methods. The range of K determined by both methods was similar. The concentration of K ranged from 17.84 mg kg^{-1} to 490 mg kg^{-1} in the FP method while it was in the range from 0.00 mg kg^{-1} to 492 mg kg^{-1} in the ICP-MS method. The mean K concentration detected by the FP method was greater (136 ± 5.98 mgkg^{-1}) than that by the ICP-MS method (64.0 ± 3.95 mgkg^{-1}), indicating lower sensitivity of the ICP-MS method than FP. The relationship between the FP and ICP-MS detected K was $K_{(FP)} = 0.52 \times K_{(ICP-MS)} - 6.64$ with a R^2 value of 0.61 ($p<0.000$). Therefore, ICP-MS and FP detected K concentrations are interchangeable when determining K concentration in paddy soils extracted using the CC method. Due to the use of soils from a wide range of soils and concentrations, derived relationships are robust.

Keywords: Calcium chloride, Exchangeable potassium, Flame photometry, ICP-MS, Paddy soils

Possible Replacement of Coco-Peat Substrate with Guinea Grass for Grow-Bag Culture of Capsicum annuum (L.) Var. Muriya

A.W.S. Pushpakumara*, J.M.U.I. Jayasinghe, T.D. Nuwarapaksha, K.L.D.B.P. Liyanage, K.S. Weerasinghe, and B. Gajanayake

Department of Plantation Management, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP) 60170, Sri Lanka
*awspkumara@wyb.ac.lk

Due to high demand for coco-peat as a raw material for grow-bag production, finding viable alternatives would be an economically sound approach to face the future challenges. With this background, a study was conducted with the aim of evaluating different low-cost alternative substrate combinations (through partial substitution of coco-peat) as the growing medium for Capsicum annuum (L.) grown in grow-bags. This experiment was conducted in a greenhouse located in low country intermediate zone - IL1a (7.3225° N, 79.9773° E). Capsicum, cultivar 'Muriya' was tested for seven treatments comprised of T1: 100% base material (BM) (60% coco-chips and 40% coco-peat), T2: 90% BM+ 10% dried Guinea grass (DGG), T3: 80% BM+ 20% DGG, T4: 97% BM+ 3% Guinea grass biochar (GGB), T5: 95% BM+ 5% GGB, T6: 87% BM+ 10% DGG + 3% GGB, T7: 75% BM+ 20% DGG + 5% GGB with three blocks in a Randomized Complete Block Design. The DGG was prepared by drying 1 cm chopped Guinea grass shoots and GGB was prepared by pyrolyzing dried non-chopped Guinea grass shoots (conversion ratio 6:1). Growth, development and yield performances of Capsicum were measured. There were no significant differences in plant height, leaf length, and pod weight among the treatments. However, significantly high number of leaves, leaf area, root volume, shoot dry weight, number of pods and total yield were recorded in treatments containing BM with 10% and 20% DGG. Results indicated that the media containing BM with 10% and 20% DGG showed a significantly higher crop growth, development and yield than the other growing media tested. Hence, incorporation of DGG at a rate of 10% to 20% with BM can be recommended as a low-cost and viable alternative to coco-peat grow-bag media for the cultivation of Capsicum under tropical greenhouse conditions.

Keywords: Biochar, Coco-peat, Grow-bags, Guinea grass, Greenhouse culture

Phosphorus Reserves in a Tropical Ultisol under Vegetable Cultivation and Tropical Forests

D.M.M.R. Dissanayake[1], C.P. Attanayake[1]*,
U.W.A. Vitharana[1] and D.D.A.E. Hemamali[2]

[1]Department of Soil Science, Faculty of Agriculture
[2]Postgraduate Institute of Science
University of Peradeniya, Peradeniya 20400, Sri Lanka
*chammiatt@pdn.ac.lk

Land use causes a considerable impact on the composition of Phosphorus reserves in Soil. Understanding on forms and abundance of soil P is essential to make them available for crop production. This study was conducted to determine soil P fractions in a vegetable grown land in comparison to a natural forest in Nuwaraeliya, Sri Lanka. Both soils belonged to Ultisols soil order. Based on a primary data set, 28 sampling points were selected by conditioned Latin hypercube sampling method. Phosphorus fractions of topsoil (0-30 cm) and subsoil (30-60 cm) were determined using Hedley sequential P fractionation procedure. Readily available P, loosely and tightly bound P to Fe, Al and Ca bound P were extracted using distilled water, 0.5 M $NaHCO_3$, 0.1 M NaOH and 0.1 M HCl, respectively. Total and inorganic P in extractants were determined and the difference was taken as organic P. Finally residual P was determined. The total P concentration was significantly higher in vegetable soil (2423 mg/kg) than forest soil (345 mg/kg). In both land uses, total P concentration in the subsoil was more than 55% of that in the topsoil, indicating a significant P reserve in subsoil. Organic P fraction was 43% (of the total P) in forest soil whereas inorganic P fraction was 49% in vegetable soil There was no significant difference in residual P fraction in both land uses. Readily available P and the P fraction loosely bound to Al or Fe were 17% and 25% in vegetableand forest soils, respectively. Majority of P in both land uses were in NaOH extractable form (50 - 43%) either in organic or inorganic formsthat tightly bound to Al or Fe components, plant cannot access. This study revealed that intensive vegetable cultivation has altered total soil P by increasing the unavailable pool. Thus, technologies need to be developed to utilize this fraction effectively.

Keywords: Phosphorus fractions, Phosphorus availability, Forest soil, Vegetable grown soil

Solid Waste Management Process and Related Issues in Halls of Residence in University of Peradeniya

D.M.L. Dissanayake*, C.S. Arambegedara and W.M.S.S. Dias

Department of Geography, Faculty of Arts, University of Peradeniya, Peradeniya 20400, Sri Lanka
*dissanayakedml2011@gmail.com

The University of Peradeniya is the most prestigious, top-ranked, and the first and largest residential university of Sri Lanka, with twenty-one (21) permanent halls of residence. With the abundant beauty of Mother Nature, the university has become one of the richest universities with lush green landscapes. However, malpractices related to Solid Waste Management (SWM), among other things, pose a major threat to this landscape. The study was aimed at proposing an efficient SWM system for residential halls by examining the existing SWM process and its related issues. Data were collected from field research which involved a questionnaire survey, stakeholder discussion circle, stakeholder interviews, and observation about the key stages of the SWM process. A high proportion of the data was analysed by using quantitative analysis with the support of data analysis tools such as MS Excel and ArcGIS. The research has generated statistics by considering the number of residents with per person waste generation per day (Student; 90g food, 35g polythene, 25g paper, 10g other), per canteen waste generation rate per day (E.g. Marrs Hall; 4500g food, 400g polythene, 400g paper, 750g other), temporal changes in waste generation rate throughout the year (examination, vacation, hall leaving periods, etc.). The appropriate separation of waste has been determined by the gender and the faculty of the residents. The waste collection is being done at different levels in halls, namely, Room, Bin, and Central Point. Yet, these collection stations are always disturbed by monkeys and dogs due to the structural failures of the stations. The university health administration is responsible for the waste transfer to the final disposal. According to the stakeholder interviews, the inability to follow a proper waste collection timetable, the distance of the halls from the SWM centre, and the mixing of separated waste during transfer in the waste truck have created problems. Hall management has requested an incinerator regarding the critical issue of disposal of sanitary pads and plastics. Also, relocating the disposal station away from the sensitive area of right bank of river Mahaweli is essential.

Keywords: SWM process, SWM issues, Students' residence, University of Peradeniya

A Social-Ecological Study on Urban Wetland Parks with Special Reference to Nugegoda Urban Wetland Park

V.A.V. De Silva

Department of Sociology, Faculty of Arts, University of Colombo,
Colombo 3, 00700, Sri Lanka
vidudesilva77@gmail.com

With the rapid urbanisation, the human ability to access the natural environment has been curtailed. When it comes to modern urban designing, special attentiveness is given to green covers as the inseparable link between humans and the environment. At present, urban parks are being developed in several areas of Sri Lanka in line with urban development. The Nugegoda Wetland Park is designed with the aim of building a pleasant environment, as well as a stress-free and healthy nation. Therefore, the main objective of this study was to explore the social and ecological benefits of the Nugegoda Wetland Park and its trends. As the methodology, 20 visitors to the Nugegoda Wetland Park were selected by using purposive sampling for primary data collection respectively. Both secondary and primary data were gathered. Data was collected through interview schedules, in-depth interviews, and observations. The results revealed that there were benefits of urban Wetland Parks in environmental, social, physical, and spiritual aspects which include pollution control, nature conservation, reducing criminal activities, flood mitigation, and developing social interactions, energy savings, water management, and environmental sustainability, increasing physical and spiritual well-being of individuals and reducing stress. The socio-economic profile shows that 60% of respondents were male, belonging to the upper-middle class, having higher education qualifications and a high-income level. In urban development, the establishment of green-covered urban parks provides an opportunity to build a direct relationship between human beings and the environment. This also provides beneficial functions. Suggestions include building an outdoor gym in the Nugegoda Urban Wetland Park, creating a cycling track, and establishing a green zone to provide a habitat for non-harmful species such as deer and geese in the park.

Keywords: Urbanisation, Urban wetland park, Environment, Environmental sustainability, Green zone

State-of-the-Art Literature of Global Heavy Minerals

H.C.S. Subasinghe*, A.S. Ratnayake and T.D.U. Wijewardhana

*Department of Applied Earth Sciences, Faculty of Applied Sciences,
Uva Wellassa University, Badulla 90000, Sri Lanka
chandimasubasinghe00@gmail.com

Minerals having specific gravities greater than common minerals such as quartz and feldspars (i.e., <2.65 g/cm^3) are known as heavy minerals (HMs). Titanium, zirconium, and rare earth elements (REEs) containing minerals are key players in the global HMs industry that have diversified industrial applications. This study aims to discuss the global distribution, genesis, exploration, and processing of HMs to understand and summarise the status of the global heavy minerals. Over 400 research articles of different disciplines such as geology, geochemistry, geophysics, mineral processing and engineering, mining and metallurgy, mineral economics, and policy studies were referred to compile this review. Heavy mineral deposits are distributed in more than 45 countries in the world. The major HMs deposits are located in Australia, Asia, and Africa, as secondary coastal places neighbouring the Indian Ocean. Onshore and offshore HMs deposits in America and Europe also considerably contribute to the global market. The HMs deposits are categorised as primary (magmatic, hydrothermal, metamorphic are endogenous processes) and secondary (weathered, eroded, and transported sediments are exogenous processes) deposits. The combination of traditional and sophisticated geological, geophysical, and geochemical techniques is currently used in HMs exploration. However, there is a lack of exploration and discovery of new HMs deposits. Therefore, the global mining industry has gradually downgraded. Physical separation followed by chemical treatments is commonly used to process HMs and extract valuable components. For example, the heavy minerals are initially concentrated using gravity, magnetic and electrical separation techniques. The separated HMs are then transferred to reduction, smelting, and acid leaching processes. However, HMs require limited chemicals in upgrading and processing compared to other mineral industries. Stockpiling, legacy contracts, and government policies preside the production, supply, and market balance of the HMs industry. Mining and utilisation planning followed by the United Nations Sustainable Development Goals are a timely requirement for the sustainability of HMs industry and to overcome challenges such as environmental, health issues, and social resistance. Consequently, the mining and processing industry should strengthen prospective new resources, adopt environmentally friendly processing methods, and recycle waste materials wherever possible to overcome supply risks and environmental impacts in the future.

Keywords: Heavy minerals distribution, Primary deposits, Secondary deposits, Exploration and production, Supply drivers

An Evaluation of Avitourism Potential in Jaffna District, Sri Lanka

P. Rajkumar[1]* and C.S. Wijesundara[2]

[1]*Wetland Conservation Society, Jaffna 40000, Sri Lanka*
[2]*Department of Zoology, Faculty of Science, University of Peradeniya,*
Peradeniya 20400, Sri Lanka
*vpkuma82@gmail.com

Avitourism ("bird-tourism") is a growing sector in the broader nature-based tourism industry in the world. Jaffna District, one of the four richest water bird areas in Sri Lanka, has great potential for the promotion of avitourism. The area provides suitable habitats for a large number of bird species both migrant and resident, but its avitourism potential has not been evaluated previously, probably due to the three decade long civil war. Thus, the present study was designed to evaluate its avitourism potential using Geographic Information System (GIS). Potential analysis was carried out based on studies undertaken from 2013 to 2018 in the Jaffna peninsula. Multi Criteria Decision Method and criteria ranking method in GIS were used for suitability analysis. The evaluation process for avitourism sites was conducted based on six criteria *viz.* bird species diversity, tourist preferences, proximity to residential areas, proximity to tourists' accommodation, distance from main roads, and scenic beauty (factors selected according to expert opinion). The ranking levels were applied within the criterion and between criteria. A suitability map was produced by overlaying six thematic maps. Based on multi criteria analysis, fifteen places among the thirty-eight birding places of Jaffna District were identified including Chundikkulam National Park, Mamunai, Vallai, Thondamanaru, Sarasalai, Anthanathidal, Avarankal East, Arali Baradge, Mandaitivu, Allaipiday, Mankumban, Chavakachcheri, Kopay, Putur and Navatkuli, as high avitourism potential areas; a further fourteen places as moderate potential areas; and the rest of the nine places as representing the lowest potential. The present study showed that several wetland areas in the Jaffna peninsula harbour many waterbird species, including the Greater Flamingo (*Phoenicopterus roseus*), an uncommon migrant but a major attraction among avitourists. Based on the analysis, the potential statuses of bird sites were identified. Hence, the researchers recommend that these wetland areas should be considered for the promotion of avitourism, which will eventually aid in the conservation of these sites as well as the species.

Keywords: Geographic information system, Avitourism, Jaffna district, Multi criteria analysis, Suitability analysis

An Assessment of Delft Eco-Village Tourism Potential as a Model for Sustainable Ecotourism in Jaffna District, Sri Lanka

P. Rajkumar[1]* and C.S. Wijesundara[2]

[1]Wetland Conservation Society, Jaffna 40000, Sri Lanka
[2]Department of Zoology, Faculty of Science, University of Peradeniya, Peradeniya 20400, Sri Lanka
*vpkuma82@gmail.com

Ecotourism is travelling to relatively undisturbed natural areas with the objective of studying, admiring, and enjoying the scenery and its wild plants and animals. The Delft Island is one of the seven islands of Jaffna District and is a great destination for the promotion of ecotourism. The present study was carried out to explore the potential of ecotourism and eco-village tourism as a model for sustainable development in the Delft Island. Eco-village is a living model of sustainable ecotourism and traditional or intentional community with the goal of becoming more socially, culturally, economically, and ecologically sustainable. The research methodology employed both quantitative and qualitative data collection techniques. Secondary data related to resource potentials were collected from the Delft Divisional Secretariat and focus group discussions with relevant stakeholders were held to identify the potentials and gaps. Additionally, as a natural resource, bird species were studied from September 2016 to 2017 June. A total of 37 species of birds were recorded from Delft during the study period. Among them were uncommon breeding residents including the Indian courser (*Cursorius coromandelicus*) and uncommon winter migrants including the Greater Flamingo (*Phoenicopterus roseus*), both holding high ecotourism potential given their rarity. Other natural resources include Sri Lanka's only population of feral ponies (*Equus caballus*), Palmyra resources, beach, exotic baobab trees, and rich marine life. In addition, the colonial-era fort, buildings, other archaeological monuments, lifestyle of the Delft community, farming, fishing activities, sea food and the fen system are the best culture-based potentials for promoting ecotourism. The Fen system is made from corals which are available in the island. The architecture of the houses is mostly uniform and major foods are sea and traditional food. Art, including folk drama, is being practised with same traditions. The local people of the Delft Island have never been displaced from Delft to anywhere due to civil war or any natural disasters. The lifestyle of the local people is socially, culturally, economically, and ecologically unique. Hence this island may be considered as an eco-village. The lack of infrastructure facilities, accessibility and lack of promotional activities negatively impact on tourism development and economic development.

Keywords: Eco-village, Ecotourism, Natural and cultural resources, Sustainability, Jaffna District

Preferences towards Energy Sustainability: Different Effects of Gender on Knowledge and Importance

S. Managi* and I.A.J. Imbulana Arachchi

[1]*Department of Urban and Environmental Engineering, Faculty of Engineering, Kyushu University, 744 Motooka, Nishi-ku, Fukuoka, 819-0395, Japan*
*managi@doc.kyushu-u.ac.jp

A widely recognized reason for climate change was the emission of carbon dioxide (CO_2). Therefore, there is an increasing interest in investigating the sustainable energy sources to mitigate CO_2 emissions and promote energy sustainability. We contribute to the existing literature by studying energy where peoples' knowledge of energy sustainability and concern on the importance of energy sustainability. This study aims at investigating the linkage between self-reported knowledge and concerns of energy sustainability and the by identifying role of gender with concepts of holistic associations and cause-effect logic which rely on the role of gender. To examine these linkages, we developed a hypothesis: that males are more knowledgeable about energy sustainability, while females are more concerned about its importance. This hypothesis relies on existing literatures of different disciplines, namely, such as environment, energy, neuroscience, business administration, medicine and psychology. For that purpose, this study uses both binary and ordered logistic regression models for analysis. We utilize a large-scale survey of 100,956 respondents across 37 countries, showing the contrasts in individual and both binary and ordered logistic regression models to analyze the marginal effect of gender with some other control variables. The model specifications depend on the categorical dependent variables and use two estimation models to test the robustness of the results. The results reveal that the marginal effect of males have more knowledge about energy sustainability is higher than females in terms of knowledge about energy sustainability, while the marginal effect of females is higher than males on concerns regarding the importance of energy sustainability, within-country and across countries. Furthermore, compared to low-income and middle-income countries, high-income countries show a substantial difference with regard to the above-mentioned effects of gender. Therefore, it can be concluded that when it comes to energy sustainability, males are more knowledgeable about it while females are more concerned about it. This is consistent with the evidence provided by some empirical studies which show that males are stronger in cause-effect logic and females are stronger in holistic associations. Thus, it would be beneficial if both concepts are involved in the decision-making process concerning energy sustainability and energy conservation practices. These facts highlight the need for further research to uncover how to integrate both the concepts among gender groups to make better decisions about sustainable energy.

Keywords: Energy sustainability, Gender difference, Knowledge, Importance, Holistic associations, Cause-effect logic

Potentials and Constraints of Natural Resource Utilization in Etanwala Isolated Village

G.V.H.M. Madhumali[1]*, D.C.V. Fernando[2],
M.M.S.B. Manamperi[2] and D.S.A. Munasinghe[3]

[1]Department of Geography and Environmental Management, Faculty of Social Sciences and Languages, Sabaragamuwa University of Sri Lanka, Belihuloya 70140, Sri Lanka
[2]Department of Fine Arts, Faculty of Humanities
[3]Department of Archaeology, Faculty of Social Sciences
University of Kelaniya, Kelaniya 11600, Sri Lanka
*maheshikausjp@gmail.com

Nature is the most powerful and the closest natural entity that is inherently yoked with the rural community and the development of the village. It is prominent in sustainable development in rural villages. Etanwala in Matale district is an isolated and rural village due to the natural environment and natural resources available in the development process. Even in present, Etanwala is considered a traditional village. The purpose of the study is to identify the ways in which natural resources are used by the villagers and identify potentials and constraints related to the natural resource utilization in Etanwala. Accordingly, the research questions seek answers for questions such as, what are the natural resources used by people, how they access said natural resources and issues regarding the utilization of natural resources. Under methodology, primary data that belong to both the qualitative and quantitative categories have been collected by using observation, questioners, and informal discussions. Because most collected data are qualitative, descriptive data analytical method has been used for data analysis. The result revealed that the forest is the most significant feature in the area as it facilitates several functions of the villagers. Likewise, firewood is the most utilized natural resource because of its high accessibility and because it is costless. Due to the prohibition of using forest areas by government regulations, people have to fulfill only their primary requirement from the forest and that is the major issue that has been identified regarding the natural resource utilization in Etanwala. Finally, it can be concluded that natural resources are still widely used in developing countries like Sri Lanka. Therefore, it requires proper management procedure and conservation mechanisms for natural resource utilization in Sri Lanka.

Keywords: Constrains, Natural resources, Potentials, Utilization, Etanwala

A Descriptive Analysis on Corporate Environmental Reporting Practices of Sri Lankan Firms

R.N.K. Soysa[1]*, A. Pallegedara[1], A.S. Kumara[2], D.M. Jayasena[1],
K.M. Dissanayake[3] and M.K.S.M. Samaranayake[3]

[1]Department of Industrial Management, Faculty of Applied Sciences, Wayamba University of Sri Lanka, Kuliyapitiya 60200, Sri Lanka
[2]Department of Public Administration, Faculty of Management Studies and Commerce University of Sri Jayewardenepura, Nugegoda 10250, Sri Lanka
[3]Department of English Language Teaching, Faculty of Business Studies & Finance, Wayamba University of Sri Lanka, Kuliyapitiya 60200, Sri Lanka
*nimshasoysa@yahoo.com

Corporate environmental reporting has gained significant international importance with the rising environmental risks and concerns that will be a threat to global economic growth and prosperity. Typically, the nature of reporting and the quality of environmental reports may differ from one country to another depending on diverse stakeholder pressure and other institutional requirements. Against this backdrop, this study examines the nature of existing environmental disclosure practices of Sri Lankan firms. The selected sample comprised of annual reports from 2015-2019 of the top 25 companies listed in the Colombo Stock Exchange with the highest market capitalization, and descriptive statistics were used to determine the behavior of the environmental disclosures. The results show that eighty percent (80%) of firms tend to report their environmental performance through their annual reports and a larger proportion of these firm disclosures have shown to include both quantifiable and descriptive information while smaller number of the firms solely disclose their performance descriptively. Carbon Footprint, total energy consumption and water consumption were commonly identified as quantifiable environment performance indicators in the disclosures. Furthermore, it was revealed that, the indicators with the least environmental impact were reported by firms in the services sector and the most commonly reported indicator was the carbon footprint information. More than one-quarter of the top market capitalized companies have obtained environmental certification for their business processes while some firms have disclosed their environmental performance through achievements and awards. Thus it can be concluded that in Sri Lanka, most of the firms having higher market exposure tend to disclose their environmental performance through environmental reporting. Moreover, with the rising awareness and concern of major stakeholders and general public on environment related issues, environmental reporting will act as an effective business opportunity and legitimization technique for firms' current business process to progress towards firms' sustainable growth.

Keywords: Environmental reporting, Quantifiable environmental performance indicators, Carbon footprint

Role of the Judiciary in Balancing Developmental Rights and Environmental Rights in Sri Lanka: A 'Band-aid' or A 'Cure'?

R.A.P. Panchali* and A. Gunawardana

*Department of Law, Faculty of Arts, University of Peradeniya,
Peradeniya 20400, Sri Lanka*
*piyumaniranasinghe@gmail.com

The 'development discourse' in Sri Lanka perceives developmental rights in juxtaposition to environmental rights, which results in environmental externalities. Environmental rights are becoming harder to ignore due to calamities arising from climate change. Nevertheless, being a developing country, with pressing economic challenges affecting the quality of life, developmental rights cannot be undermined either. This study engaged in a critical analysis of qualitative data collected through a library research embodying primary (case law and legislation) and secondary sources (books, journal articles, reports) in order to determine the existing jurisprudence on the two rights. Accordingly, it was found that the judiciary reviews both rights as a 'public trustee' and does not favour one over the other. Therefore, albeit competitive at times, they are not viewed as mutually exclusive rights. In striking a balance between the two rights, the judiciary, deriving jurisdiction and power from the Fundamental Rights Chapter, State Directive Principles and Article 126 of the Constitution of Sri Lanka, has adopted creative interpretations utilizing international environmental law principles such as 'precautionary principle', 'polluter-pays principle', 'sustainable development' and 'inter-generational equity'. However, the aptness in relying solely on the judiciary to make such a balance is contentious. As judicial review adopts a case-by-case approach, the outcome is unpredictable and uncertain. More importantly, it could be regressive in the realization of sustainable development in the country, as the judiciary intervenes only after a dispute transpires. Further, judicial power could only be exercised within the four corners of the law respecting democratic values of 'Separation of Powers' and 'Checks and Balances'. Judicial activism in this regard is proven to be a band-aid rather than a cure to the problem. Therefore, there is a real need to provide a comprehensive solution by enacting progressive legislation seeking to balance the two rights.

Keywords: Developmental rights, Environmental rights, Balance, Judicial activism, Sustainable development

Social Media Platforms – An Emerging Threat to Biodiversity of Sri Lanka

M.L.I. De Silva[1]*, N.P. Abeyrathne[2] and H.M.H.I. Herath[2]

[1]Department of Fisheries and Marine Sciences, Faculty of Fisheries and Ocean Sciences, Ocean University of Sri Lanka, Tangalle 82200, Sri Lanka
[2]Department of Veterinary Pathobiology, Faculty of Veterinary Medicine and Animal Sciences, University of Peradeniya, Peradeniya 20400, Sri Lanka
*Ninelawlis1@gmail.com

With the topographic and climatic heterogeneity, Sri Lanka is considered a biodiversity hotspot in the world. Since recent years, a growing demand and enthusiasm can be observed in pet trade in Sri Lanka with the development of technology and communication. With this trend, social media can be considered a major platform for illegal pet trade in Sri Lanka. The current study aimed to investigate the extent of illegal wildlife trade carried out through social media platforms and local websites. Pet trade can cause immense destructive effects to our biodiversity mainly by means of illegal wildlife trade, exotic species invasion and indirect destruction by exotic animals to the local biodiversity. In this study, data was collected from social media platforms and direct interviews. Traders who have posted advertisements were interviewed regarding the movements in the pet trade, traded species, their price ranges, and the role of competent authorities and interested parties from January 2019 to January 2021. All collected data was analyzed for species, location, protected status of the species and frequency of illegal wildlife trade postings with the activity of Department of Wildlife and Conservation (DWC) in social media platforms. Many bird species such as all species of parrots, birds of prey, small to medium sized mammals such as giant squirrels and palm squirrels, freshwater fish species and native and endemic plant species were observed to be frequently traded in these platforms. Here, a total of 290 social media posts and advertisements including 12 species of birds (155 posts), 7 species of fish (23 posts), 12 species of mammals/ parts of mammals (47 posts), 4 species of reptiles (14 posts) and 9 species of plants (51 posts) were observed. Though the implementation of law and reinforcements were observed to be in a debatable situation regarding the illegal trade, a clear relationship was observed with respect to the actions of competent authorities and illegal dealers. Proper awareness programmes, equipping DWC with information technology and introducing alternative commercial varieties to highly demanded species are observed as timely needs in addressing these issues. The highest possible practical answers are important to protect the biodiversity of Sri Lanka.

Keywords: Demand, Illegal, Pets, Social media, Trade

Relationship between FDI, Trade Openness and Environmental Degradation: With Special Reference to Sri Lanka

P.M.G.S. Nipunika

Department of Economics, Humanities and Social Sciences,
University of Ruhuna, Matara 81000, Sri Lanka
pmgsnipunika95@gmail.com

Environmental degradation (ED) is a global crisis and an influencing factor of climate change. To bring forth sound policy implications, it is essential to identify the determinants of ED. In Sri Lanka, several studies have been conducted on the relationship between economic growth and ED. Yet, there is little to find the direct relationship among macroeconomic variables such as Foreign Direct Investments (FDI) and Trade Openness (TO) in terms of ED. Filling this gap, the present study investigates the long run and causality relationship among these variables employing the ARDL Bound Testing approach and Granger Causality respectively. The annual time series data from 1980 to 2019 has been used for the variables ED, TO and FDI. Here, the variable TO is used as the ratio of total trade to Gross Domestic Product and ED is used as the annual amount of CO_2 emissions. As a developing country, Sri Lanka escalates to attract more FDI and engages in more trade agreements. In this context, the results of the study are important to make the future trade and investment decisions more sustainable. According to the ARDL bound test results, there is a long-run relationship among the variables FDI, TO, and CO_2 emissions in Sri Lanka in terms of FDI. The coefficient value (1.3238) of one-year lagged CO_2 has a positive and significant impact on FDI in the long run. The cointegration equation is negative with a coefficient estimate of -1.3238 which is highly significant (0.00015). This implies that the speed of adjustment towards long run equilibrium is 132% within one period of disequilibrium. The Granger Causality test indicates that there is a bidirectional relationship between FDI and CO_2. Finally, the study concludes that concentrating on the environmental quality of the country is crucial when implementing policies to develop FDI and international trade.

Keywords: Environmental degradation, FDI, Trade openness, ARDL bound test, Granger causality

Exploring the Impact of Responsible Tourism on Stakeholders in Dambulla Tourism Destination

G.R.S.D. Gamage* and P.S.K. Rajapakshe

Department of Environmental Management, Faculty of Social Sciences and Humanities, Rajarata University of Sri Lanka, Mihintale 50300, Sri Lanka
*grsdgamage@gmail.com

According to the 2002 Cape Town declaration, tourism is defined as 'which creates better places for people to live in, and better places to visit'. Responsible tourism considers economic, social and environmental aspects as the three pillars of tourism initiatives in the destinations, thus contributing to achieving the Sustainable Development Goals. This study attempts to explore the impact of responsible tourism on stakeholders in the Dambulla tourism destination. There have been few studies carried out on this issue in Sri Lanka. The researcher identified environmental protection, risk awareness and environmental policies as independent variables and stakeholders as the dependent variable. Environment protection entails aspects of biodiversity management, waste management, and reduction of ecological stress, while risk awareness follows environmental risk, economical risk and social risk. Environmental policies are associated with environmental policies, standards and rules and regulations. Stakeholders espouse quality of life, support local economy and increasing reputation. Both primary and secondary data were used in this study. Primary data were collected by key persons' interviews and questionnaire-based surveys. This study is based on data collected from 60 dwellers, 15 hotels and 5 government agencies. SPSS version 21 was used for the analysis, and descriptive analysis, multiple regression analysis, correlation analysis and were employed. The correlation analysis revealed the positive significant relationship among the variables. The multiple regression analysis indicated that environmental protection (Sig = 0.000) and Risk Awareness (Sig = 0.008) have positive and significant impact on stakeholders in Dambulla. Environmental Policies (Sig = 0.113) have an insignificant influence on stakeholders and this may be because of most stakeholders have low knowledge and awareness levels about environmental policies. This study will contribute to society in general, the tourism sector, decision-makers and policy makers to identify how responsible tourism impacts upon stakeholders with heterogeneous preferences.

Keywords: Environmental protection, Risk awareness, Environmental policies, Responsible tourism, Stakeholders

Assessment of Human-Leopard Conflict in Selected Tea Plantation Ecosystems in Hill Country of Sri Lanka

K. Vinojkumar[1]* and C.S. Wijesundara[2]

[1]Postgraduate Institute of Science
[2]Department of Zoology, Faculty of Science,
University of Peradeniya, Peradeniya 20400, Sri Lanka
*vinojkvk@gmail.com

Human-leopard conflict is a rising issue in the upcountry of Sri Lanka, especially where tea fields are the dominant ecosystem. The Sri Lankan Leopard (*Panthera pardus kotiya*) is an endangered species, and most conflicts result in human-caused deaths of leopards. Hence the objective of this research was to assess the human-leopard conflict in selected tea estates in the upcountry wet zone. The study was conducted from January 2016 to February 2019 focusing on 15 estates. Data were collected through questionnaires and personal interviews from 225 respondents, and were processed to generate information on trends and patterns of the conflict. A regression analysis was performed to check the relationship between attack frequency and distance to the nearest forest. The results indicate a rise in the conflict. Most attacks were on dogs. Attacks on humans were recorded from Panmoor, and Rosita estates. These were sudden attacks, with no particular time. There was no significant correlation between distance to the nearest forest and the attack frequency ($p > 0.05$). Majority of leopard deaths were due to snares targeted at wild boar (*Sus scrofa*). Incorrect identification of leopard by estate community leads to illegal killing of fishing cats (*Prionailurus viverrinus*), another endangered species. Dogs act as an attractant for leopards. Negative attitudes of locals (84% of respondents) towards leopard conservation was observed due to fear and lack of awareness on their role in the ecosystems. It is recommended that locals avoid bringing their dogs into the forest. Disturbances to leopards outside their habitats must be avoided as much as possible to alleviate attacks on humans. Habitat destruction and interference reduce the natural prey of leopards. Therefore, avoiding deforestation and planting new trees may help in reducing conflict rates in the long run. Awareness programs for plantation community may help in conserving not only leopards but also fishing cats.

Keywords: Human-leopard conflict, Leopard, Fishing cat, Panmoor, Rosita

Solid Waste Management in Wattala-Mabole Urban Council

K. Nishathi

Sri Lanka Land Development Corporation, Rajagiriya 10107, Sri Lanka
nishanthi@sllrdc.lk

Solid waste is a growing problem in urban areas in Sri Lanka. Waste generations due to urbanization and economic development have had adverse effects on the environment and socio-economic development. This study examined the status of solid waste management at the Wattala-Mabole urban council in the Gampaha district. A questionnaire and published statistical information were used to carry out the research. 68 Questionnaires were issued based on a random sampling method with a 90% confidence level and 10% margin of error. The study covered six Grama Niladari (GN) divisions of the study area. The urban council collects both household and industrial waste. As per the survey, 56.66% population of the study area, including Wattala, Galvetiya, Mabola, and Welikadamulla grama niladhari divisions have aceess to regular waste collection with a perfect routine of waste collection. Thelangapatha and Averiwatta GN division used to skip regular waste collection because of the local authority's lack of machinery and labor facility. 70% of people of the area categorize waste into organic, plastic, and paper. However, 30% of the people do not categorize the waste for disposal. The surveys revealed that improper waste disposal practices cause social impacts such as odour, breeding of pests, and loss of property values. Another main issue is dumping waste into drainage lines creating major blocks in water flow. These problems can be overcome through public awareness about waste reduction methods and proper waste categorization practice in their daily routine. However, the government has the responsibility to provide the requirements of the local authority, including the labor force and machinery to carry out an efficient solid waste management process. In addition, the collected waste can be either recycle or reduced to ashes to minimize contaminants, and the Plasma gasification method can be used to break the bonds of elemental components of waste to improve solid waste management.

Keywords: Solid waste, Waste management, Urbanization, Plasma gasification

Waste Segregation in Household Sector in Sri Lanka: An Empirical Analysis of Ambalangoda Divisional Secretariat Division

H.W.H. Sandaruwani* and N.P.D. Padmakanthi

Department of Economics, Faculty of Social Sciences, University of Kelaniya, Kelaniya 11600, Sri Lanka
**hareeshasandaruwani186@gmail.com*

Waste is a global issue that needs to be paid attention to in order to create a sustainable world. Waste segregation is an integral part of waste management. There is no proper mechanism for household waste segregation and management in most areas in Sri Lanka. Households generate every type of waste in different amounts and rarely separate in a proper way. Hence, it is important to investigate why people do not segregate waste that is generated in their houses. The main objectives of this study are determining the factors that affect waste segregation, identifying people's awareness about waste segregation, and identifying factors that contribute to people's willingness to segregate waste. Data were collected from 204 households in Ambalangoda divisional secretariat division using systematic random sampling method which includes both waste collection and non-collection areas by the local Government Authority. Factor Analysis and Logit model were carried out to analyze the data. Out of the total sample, 32.9 per cent of households segregate waste before disposal while 67.1 per cent of households do not. Lack of awareness, negative attitudes, difficulties of disposal, lack of personal norms and habits are the main reasons for improper waste disposal. However, the results indicated that out of total households that do not segregate waste, 67.6 per cent of households are willing to segregate waste if the necessary facilities are provided. Survey data indicated that people's awareness about waste segregation is low. Factors that affect waste segregation such as awareness factor, difficulties of disposal factor, positive attitudes factor and practices factor were identified from the factor analysis. According to the logit model, age, gender, education level, income, attitudes, awareness, family size, land size, practice factors, and disposable difficulties are the most significant factors that affect waste segregation. Hence, it is essential to increase peoples' awareness, change attitudes, and provide necessary initial facilities to increase waste segregation.

Keywords: Waste segregation, Awareness, Factor analysis, Logit model

Waste Management Measures within Kandy Municipal Council Limits and Challenges Faced by Authorities and General Public

A.M.P.E.K. Atapattu* and U. Edirisinghe

Postgraduate Institute of Science, University of Peradeniya,
Peradeniya 20400, Sri Lanka
*prabashia@yahoo.com

Municipal Solid Waste Management is one of the major challenges in Sri Lanka. The objective of this study was to identify the waste management measures in the Kandy Municipal Council area. Primary data were collected through direct observations and group discussions held with the government officials of Kandy Municipal Council and the general public, while secondary data were gathered from available literature from 2019 to 2020. Collected data revealed, daily waste generation in municipal area was about 176 tons per day, which consisted 75% kitchen wastes, 8% paper wastes, 5% plastics, while other categories were 12%. Among the total waste generated, 88% was collected and only 11% was used for recycling, where a major portion was dumped at Gohagoda dumping site causing many problems to general public. Since 2011, a common bin system has been used, which consisted of 30 official dumping bins built as concrete boxes. According to the ten-year action plan introduced in 2013, a garbage fee was charged   monthly from the general public in the municipal area and a fund of Rs.10,000/- was allocated for each Environmental Committee. Sampath Piyasa centers in Gohagoda, Ranawana, and Kandy Car Park were started in 2012. A plastic recycling center was established in 2015 in Gohagoda, which produce plastic chips and pebbles. Further, 20 tons of decaying waste per day was used in the windrow method to produce 1-2 tons of compost fertilizer and sold to the public. Flee market concept and biogas plants were introduced to hotels and hospitals respectively. Public awareness campaigns were organized through schools, Environmental Committees, Shramadana campaigns, dengue programs, workshops and distribution of garbage bins and compost bins were done. Kandy, being a tourist, commercial and a cultural center, waste generation is very high. Lack of support from the floating population is a major challenge in implementing proper waste management.

Keywords: Gohagoda, Kandy, Waste management measures

Covid-19 Implications on Achieving SDG 6 Targets in Sri Lanka under Global Water Agenda

D. Gamage[1]*, M.G.P.N. Chandrasena[2] and H.A.H. Jayasena[1]

[1]Department of Geology, Faculty of Science
[2]Postgraduate Institute of Science
University of Peradeniya, Peradeniya 20400, Sri Lanka
*cjayasena@pdn.ac.lk

Sri Lanka achieved SDG 6.1 by 89.4% and 6.2 by 95.8%, respectively, considering the percentages accessing drinking water and sanitation services. Since Covid-19 infused government revenues have declined below the threshold expenditure (18.6% GDP), efficient public service inputs are expected to avert an overall economic crisis. A structured questionnaire survey was conducted in the dry zone to test the SDG targets. The output compares rural households (RH) and township dwellers (TD) while it analyses the interferences under a quasi-cultural context. SDG 6.1 implies 45% of the TD have access to safely managed drinking water but only 4% for RH. For target 6.2, 45% of the TD have access to safely managed sanitation services, whereas RH has 4%. Basic sanitation services are unavailable to 31% of women. The income and educational levels show positive correlations; R^2=0.97 and 0.99 with SDG 6.1 and R^2=0.98 and 0.81 with SDG 6.2, respectively. SDG 6.3 indicates that 32% of TD are disposing of their wastewater through methodical purifications, whereas RH covers only 7%. However, 65% of TD dispose wastewater into drains, contrary to 97% of RH into plants. For SDG 6.4, the domestic per capita water requirement varies from 80-110 L/day. Though the social water stress index ensures water sufficiency for the country by 2030, Covid-19 has negatively affected all aspects of HDI; income, health, and education, which indirectly lead to unsustainability and water stress. In addition, the ratio of withdrawal to availability exceeds 40% in the dry zone implying severe scarcity. SDG 6.5 and 6.6 highlighted the importance of indigenous water management systems to achieve sustainability. With the expected climatic change, authorities should ensure safe water and hygienic sanitation services to minimize diseases. The vulnerable communities faced with diversified water issues under Covid-19, need a socio-technically adapted efficient framework to achieve SDG 6.

Keywords: SDG 6, Covid-19, Water stress index, Dry zone, Climate change

Study on the Viability of Increasing Renewable Energy-Based Power Generation through Energy Democratization

M.R.C. Moraes[1]*, L. Manawadu[2] and S.P. Premaratne[3]

[1]Faculty of Graduate Studies
[2]Department of Geography, Faculty of Arts
[3]Department of Economics, Faculty of Arts
University of Colombo, Colombo 00700, Sri Lanka
*rozannemoraes@gmail.com

Long term policies of Sri Lanka indicate a goal to increase renewable energy based power generation, in line with global mandates of reducing greenhouse gas emissions and curbing climate change. In this context, the Energy Democracy concept is gaining popularity for increasing public participation and decentralisation of the energy systems which promotes the increase of renewable energy plants. This is followed in Sri Lanka too with rooftop solar schemes and tenders for small-scale wind and solar power plants. However, recent research on the similar Energiewende concept in Germany shows that there has been a significant cost overrun in the program, and the efficacy of the conversion from nuclear and coal power to renewables based power has been questioned. In Sri Lanka, the increasing disparity between the selling price and the cost at sale point of electricity has led to financial losses. Energy democracy promotes shared ownership, decentralization, and energy sovereignty. It is also promoted as an outcome to increase renewable energy. This outline was used to develop the conceptual framework of the study. The objective was to study countries that followed the principles of energy democracy with lessons that could be drawn for Sri Lanka to see a viable increase of renewable energy. This is a case study of the Sri Lankan power sector with secondary literature from countries transitioning to renewable energy. Based on the research, it is evident that the increase of renewable energy requires large scale systemic changes and introduction of newer technologies such as energy storage and smart grid systems with demand management, which are currently not available in Sri Lanka. As a fossil fuel non-producer, Sri Lanka requires holistic development initiatives to strike a balance between rationalising the imports of cheaper fuel sources and managing the cost of electricity by increasing renewable energy sources.

Keywords: Renewable energy, Electricity, Energy democracy, Sustainability

Strategies for Sustainable Solid Waste Disposal Process for Sub Urban DSD in Gampaha

K.B.I.S. Ranwella[1]* and W.A.L.P. Jayasinghe[2]

[1]*Department of Geography, Faculty of Social Sciences, University of Kelaniya, Dalugama, 11600, Sri Lanka*
[2]*Department of Geography, Faculty of Arts, University of Colombo, Colombo 00300, Sri Lanka*
indunilranwella@gmail.com

Waste management, particularly solid waste management, is a major problem in Sri Lanka. Every person in the world disposes garbage into the environment daily. The amount of waste disposed depends on people's income, human perception or ethics and institutional facilities. Sri Lanka generates around 7,500 metric tons of waste per day and the 3,500 metric tons are produced in the Western province. About 261 governments and communities based open garbage dumps have been created in Sri Lanka. The amount of waste disposed from houses (household waste) in suburban areas can be reduced from reaching an open garbage dump by practicing sustainable waste management process. The objective of this study is to identify the waste management strategy in a suburban area in a sustainable manner. For this study, Oruthota South GN Division of the Divisional secretary area of Gampaha district has been selected a sample of 10% of the population. Data were collected using questionnaires, interviews, and direct observations. The study examines the sustainable use of waste disposed process in the suburban area as decaying and non-decaying garbage. That was to study whether waste disposal were used to recycle, reuse, or compost fertilizer. It was recognized that 88% of households did not manage the garbage within their own premises. 80% of them are accustomed to putting garbage into the Pradeshiya Sabha tractor. As a result, the garbage dump lands will be increased. Thus, suburban areas require sustainable strategies to waste management. People's attitudes must be changed to fulfill this purpose. Until now, it has not established sustainable waste management practice by laws in Sri Lanka. Therefore, the disposable waste should be valued and tax should be imposed on the quantity of garbage. That can be a good solution to the reduced open garbage dumps in Sri Lanka.

Keywords: Sustainable waste management, Waste management strategies, Open garbage dumps, Waste disposal

Comparison of Exposure to Particulate Matter and Volatile Organic Compounds while Commuting in Kandy City Using Different Transportation Modes

K.K.V. Dulmini*, M.A. Elangasinghe and D.G.G.P. Karunarathne

*Department of Chemical and Process Engineering, Faculty of Engineering,
University of Peradeniya, Peradeniya 20400, Sri Lanka
kkvd92@gmail.com

The main objective of the work is to understand the exposure level of inhalable suspended Particulate Matter less than 10 µm and 2.5 µm (PM_{10} and $PM_{2.5}$) and Volatile Organic Compounds (VOC) while commuting in different transport modes (bus, car, three-wheeler, motor bicycle). A fixed route- multi transport study was carried out along Kandy-Panideniya route. The aforementioned pollution levels were measured by a commuter travelling in each of these travel modes with a portable monitor that records 1-minute average pollutant concentrations. Moreover, Time Weighted Average Exposure Concentrations (TWAEC) and inhalation doses for different travel modes were compared. No statistical relationship or difference between the four modes was found for temperature (one-way ANOVA, p=0.75 R^2=0.003) and relative humidity (one-way ANOVA, p=0.82, R^2=0.002). Observed concentration levels of PM_{10} and $PM_{2.5}$ seemed to be substantially lower than those found in previous studies conducted in different locations in Kandy, as this study was carried out in the rainy season and also in the morning. However, in some instances, exposure concentrations exceeded the National Ambient Air Quality Standards when traffic congestion is high and queuing in roads for longer time periods. Three-wheeler (on average $PM_{10} = 71\pm31$ µg/m^3, $PM_{2.5} = 31\pm12$ µg/m^3) and bus (on average $PM_{10} = 61\pm10$ µg/m^3, $PM_{2.5} = 28 \pm 3$ µg/m^3) commuters had the highest level of TWAEC to PM_{10} and $PM_{2.5}$. While motor bicycle (on average 5.3±0.5 mg/m^3) and car (on average 3.8±2.5 mg/m^3) commuters had the highest level of TWAEC to VOC. Combination of exposure concentration, travel time, and inhalation rates led to a different inter-mode comparison with inhalation dose. Hence inhalation dose of PM_{10} and $PM_{2.5}$ for bus commuters were high as the trip time was comparatively high, while inhalation dose of VOC for motor bicycle commuters was high as the exposure concentration was comparatively high.

Keywords: PM_{10}, $PM_{2.5}$, VOC, Kandy, Inhalation dose

Real-Time Air Pollution Monitoring System and Tracking Mobile App

S. Mathitheepan[1]* and M. Kukapalini[2]

[1]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya 20400, Sri Lanka*
[2]*Lansing Community College, Lansing, Michigan 48912, USA*
*mathitheepan@gmail.com

Air pollution is a major environmental health issue in urban areas of Sri Lanka due to industrialization, urbanization, growing population rate, and increasing vehicle usage. The people who live in urban areas, face various harmful allergies and diseases due to poor air quality; the quality goes down beyond a certain level. Air pollutants have a negative impact on human health, stroke and lung cancer, for example, and harm the earth's ecosystem. The existing systems for pollution testing and real time updates in Sri Lanka are not efficient and also they are only installed in certain places that can cover a small area. Further, because these systems are fixed in a permanent place, the air quality alerts do not easily reach all the people who live in the surrounding area. To overcome these issues, this study suggests a new system that monitors the current pollution status of a particular location and gives updates through a mobile application to create self-awareness for the people to protect themselves. The system uses different sensor nodes designed in a mobile wireless sensor network (WSN) based on a mesh topology, to monitor temperature, humidity, particulate matter (PM) 2.5, PM 10, ozone, carbon mono-oxide, nitrogen dioxide, and sulphur dioxide concentrations in the atmosphere. Then it transfers these parameters to the cloud server by using Global System for Mobile communication (GSM) module and General Packet Radio Service (GPRS) module, which is an architectural design used for mobile communication between a mobile phone and GSM system. GSM/GPS modules work with any mobile network coverage. The Air Pollution Monitoring system mobile App (APMAP) calculates the air quality index (AQI) of the collected data and generates the warning alert when AQI has passed the permitted threshold. This portable mobile app APMAP has been designed using cross-platform mobile app development tools that can be used over different mobile platforms easily.

Keywords: Air quality index, Particular matter, Portable tracking mobile app, GSM/GPS based real-time system. Mesh topology, Wireless sensor network

Environmental Management Accounting Practices: A Case Study Analysis with Special Reference to Food and Beverage Industry in Sri Lanka

J.P.S.N. Samaranayake, D.H.S.W. Dissanayake and M.O.S. Mendis*

Department of Accountancy, Faculty of Business Studies and Finance, Wayamba University of Sri Lanka, Kuliyapitiya 60200, Sri Lanka
*oshanimendis33@gmail.com

Environmental Management Accounting (EMA) is acknowledged as a key element to promote organizational sustainability. EMA practices benefit the industries in both financial & non-financial terms such as cost efficiencies, transparency of environmental reporting and legal compliance. This study aims to find the drivers of EMA implementation, EMA practices, and challenges or barriers of EMA implementation in the Food & Beverage Industry in Sri Lanka. The growing rate of solid wastewater and energy consumption reported in the Food & Beverage Industry in Sri Lanka indicated the importance of EMA practices in the sector. A comparative multiple case study approach which is related to two different food and beverage manufacturing companies is utilized for this study. Data triangulation approach is adopted including interviews, observations, and document survey. This study encompasses the qualitative method in data analysis and interpretation of the results. The findings show that both companies practice their EMA practices in accordance with their strategic plan. However, the extent of priority of the EMA concerns is lower because of the inherent complexity that every company has to face in the practical implementation of the EMA. Company A is led by its group policy to comply with EMA practices, while company B appreciates its image achieved via EMA practices. Furthermore, in respect of solid waste, water & energy consumption, both companies have similar treatments where the quality of the treatment is different based on the companies' ability to cater to required resources. In terms of challenges, both companies have suffered from a lack of skilled and committed workforce. Moreover, one case company emphasizes financial issues related to their EMA practices. These findings suggest that companies should find technology solutions to overcome issues related to EMA practices rather than conventional methodologies. Finally, this study will provide practical implications relating to EMA practices.

Keywords: Environment management accounting, Water consumption, Energy consumption, Food and beverage industry

Adoption of Green Practices in Supply Chain Management among Manufacturing SMEs: Awareness, Willingness and Challenges

A.N. Fernando[1]*, R.Y.H. de A. Seneviratne[2], N. Melegoda[3], S.P. Premaratne[4], K. Dissanayake[5] and S.M.W. Ranawala[6]

*[1,2,4]Department of Economics, Faculty of Arts [3]Faculty of Graduate Studies [5]Department of Management and Organization Studies, Faculty of Management and Finance [6]Department of Plant Science, Faculty of Science University of Colombo 00300, Sri Lanka *ashani@econ.cmb.ac.lk*

Green Supply Chain Management (GSCM) is an emerging concept that attempts to incorporate principles of sustainability into SCM. Although the current global community has recognized the proactive need for ecological management, adoption of GSCM practices in Sri Lankan is still in its infant stages. Given that Small and Medium Scale Enterprises (SMEs) in the manufacturing sector account for about 20% of industrial establishments in the country it is inevitable that they would have a considerable impact on the environmental quality. Therefore, the paper aims to explore the efforts made by manufacturing SMEs in the Western Province, Sri Lanka to adopt green practices in SCM. Data were collected using a questionnaire survey responded by 342 manufacturing SMEs in the Western Province, Sri Lanka. Data reflected the degree to which their organizations work with suppliers and customers to improve environmental sustainability of the supply chain. A descriptive statistical analysis was conducted to examine the steps taken by the selected manufacturing firms to adopt green practices in SCM. The findings of the study revealed that 97% of the SMEs did not have a written policy on GSCM, while 65% confirmed that the firm has a GSCM scheme in place. Majority of the firms were identified to have adopted green practices to comply with regulations while contradicting to literature; pressure from customers, suppliers and competitors played an insignificant role. Green initiatives were highlighted in terms of efficient use of resources, occupational health and safety and labourforce welfare. The primitive nature of the manufacturing SMEs in GSCM was identical in terms of the limited scope of application and adoption of green practices. It further revealed the need for education in terms of green practices which led to the development of a GSCM manual for manufacturing SMEs in the Western province of Sri Lanka.

Keywords: Green practices, Green Supply Chain Management (GSCM), Manufacturing sector, Small and Medium Enterprises (SMEs)

Identification and Quantification of Camptothecin and Camptothecin Analogues in *Ophiorriza Mungos* Grown in Bibile Area in Sri Lanka

K.M.T.D. Weerasekara[1], N. Salim[2] and U.G. Chandrika[1]*

[1]*Department of Biochemistry, Faculty of Medical Sciences*
[2]*Department of Botany, Faculty of Applied Sciences*
University of Sri Jayewardenepura, Gangodawila, Nugegoda 10250, Sri Lanka
*chandri@sjp.ac.lk

Camptothecin (CPT), and camptothecin analogues are essential precursors of semisynthetic chemotherapeutic agents in cancer treatment. *Ophiorrhiza mungos* (*Dathketiya*) are used for the treatment of snake bites, ulcers, leprosy, and cancers in traditional and folk medicine. Hence the present study was focused on the identification and quantification of CPT and its analogues in *O. mungos* found in Bibile area. CPT and their analogues in roots, stem, leaves, and fruits were identified and quantified using thin-layer chromatography (TLC) and high-performance liquid chromatography (HPLC-DAD) techniques. The HPLC method was validated as per the ICH (International Council on Harmonisation) guidelines. The results showed that CPT, 9-methoxy CPT, and 10-methoxy CPT were present in all parts of the *O. mungos* plant. The root of *O. mungos* possessed the highest mean yield of CPT (780.59±78.29 μg/g, dr. wt) and 10-methoxy CPT (27.25±4.09 μg/g, dr. wt) and lower content of 9-methoxy CPT. The leaves contained the lowest CPT (283.79±19.08 μg/g, dr. wt) and 10-methoxy CPT (2.78±0.32 μg/g, dr. wt). The CPT and 10-methoxy CPT accumulation patterns remained as highest in root followed by fruits, stem, and leaves, respectively while that of 9-methoxy CPT was fruits > leaves > stem > root. In conclusion, the CPT content of *O. mungos* from Bibile location is two-fold more than what has been reported hitherto in the literature for the same species in the Western Ghats, suggesting that it can contribute partially to fulfil the current global demand to some extent, as the shrub has shorter productive time compared to tree sources of CPT.

Keywords: Camptothecin, *Ophiorriza mungos*, 9-methoxycamptothecin, 10-methoxycamptothecin

Isolation and Selection of Beneficial Fungi from Rubber-Growing Soils with Special Reference to Wood Degradability

A.H.M.N.R. Aberathne and T.H.P.S. Fernando*

Plant Pathology and Microbiology Department, Rubber Research Institute, Agalawatta 12200, Sri Lanka
*sarojinifernando787@gmail.com

In rubber, continuous cultivation is known to deplete soil nutrients, thus leading to soil degradation. Green matter and litter production of cover crops increase organic matter content in rubber growing soils leading to better soil fertility. The activity of decomposing fungi plays an important role in the process of enhancing soil fertility status. An attempt was taken to isolate and evaluate effective fungal decomposers in rubber-growing soils that could improve soil fertility in rubber plantations. The isolates were obtained from decaying rubber wood samples in five rubber plantations in Kalutara district. Pure cultures of seven morphologically different isolates (numbered as F1, F2, F3, F13, F16, F18 and F19) were selected and grown on Potato Dextrose Agar. To compare the wood degradability, rubber root pieces with pencil thickness and 5 cm length were cut and oven dried until a constant dry weight was obtained. Two feeder root pieces were inoculated with a 4 cm^2 mycelium plug of each isolate in a conical flask. After 20 days, another two root pieces were added into each flask as testing strips. After 12 weeks, loss of percentage dry weight loss of the testing strips was calculated after removing the growing mycelium carefully in each wood block. Isolates F1 and F2 showed the highest percentage weight loss (45.7% and 40.0%, respectively) indicating their higher potential in wood degradability. Isolates F3, F13, F16, F18 and F19 showed 11.3%, 15.7%, 12.8%, 13.1% and 21.5%, respectively. As the saprophytic fungi causing more than 30% weight loss are considered as good decomposers under prescribed experimental conditions, isolates F1 and F2 can be identified as beneficial decomposers which degrade organic materials fast and convert them into nutrients. We recommend mass production of these two fungi and introduction to the rubber plantations as effective decomposers. Further, molecular identification of these isolates are recommended.

Keywords: Rubber plantations, Wood degradability, Saprophytic fungi, Mass production

Identification of Meteorological Drought Using SPI Index in Kurunegala District, Sri Lanka

W.D.N. Asangika

Institute of Human Resource Advancement, University of Colombo,
Colombo 00700, Sri Lanka
nipuli@ihra.cmb.ac.lk

As Sri Lanka is an island located near the equator, it has felt the full impact of climate change. Unlike other natural disasters, droughts are difficult to identify as they can continue for longer periods of time. One of the most serious issues related to climate change has been the droughts which have severely made a damaging impact on the livelihood of the people living especially the dry and intermediate zone. In Sri Lanka droughts mainly occur due to prolonged periods of dry weather and lack of proper rainfall for a certain period. Therefore, this study was conducted in order to identify the temporal patterns of the meteorological drought conditions from 1987 to 2018 covering a period of 31 years and to identify the spatial distribution of meteorological drought conditions in Kurunegala district which is the most affected intermediate zone in the country from droughts. The study used the Standardized Precipitation Index (SPI) to identify the temporal patterns and the spatial distribution of meteorological drought conditions in Kurunegala district. The study used the inverse distance weighted interpolation method of ArcGIS for indicating the drought-impacted areas in the maps through the data gathered from SPI. The results showed that in the mid-term (six-month period) there has been a gradual increase of the drought incidents of the study area where from 1988-1997 had a drought occurrence of 26.2% and from 1998-2007 30.9% and from 2008-2018 42.0.%. In considering the spatial distribution of meteorological drought conditions in Kurunegala district it was observed that drought conditions have occurred more frequently in the south-western part of the district. Findings also revealed that the intermediate zone suffered from high meteorological droughts than the dry zone in the district.

Keywords: Climate change, Meteorological drought, Standardized precipitation index

Environment and Natural Resources

Evaluation of the Level of Groundwater Contamination Using Numerical Indices: A Case Study of CKDu Prevalence Area, Sri Lanka

H.T.D.R. Karunadasa[1]* and J.A. Liyanage[2]

[1]Institute of Chemistry Ceylon, Adamantane House, Rajagiriya 10100, Sri Lanka
[2]Department of Chemistry, Faculty of Science, University of Kelaniya,
Kelaniya 11600, Sri Lanka
*dilu.ruwangika@gmail.com

Chronic Kidney Disease of unetiology (CKDu) has been emerging as a pressing health crisis in Sri Lanka. The most vulnerable age group for this disease has been identified as 40-60 years of age. It is not associated with identified factors such as hypertension, diabetes, and illegal drug abuse. Therefore, this study was carried out to assess the toxic element contaminants associated with drinking water resources in a newly emerged CKDu prevalence area, Rideemaliyadda-South Grama Niladhari Division in Badulla district in Sri Lanka. Thirty groundwater samples were collected from the study area, and Dissolved Oxygen (DO), pH, Electrical Conductivity (EC), and Fluoride level (F^-) were analyzed using multipara-meter and Fluoride meter. Ca, Mg, Al, Mn, Fe, Ni, Zn, Cr, As, Cd, and Pb were analyzed using Inductively Coupled Plasma Mass Spectrometry (ICP-MS-Agilent-7800). Water hardness values were calculated based on Ca and Mg concentrations. The Pollution Index of Groundwater (PIG), Synthetic Pollution Index (SPI), and Overall Pollution Index (OPI) were computed to classify the groundwater in the sampling area. Results were statistically analyzed using MINITAB 17 software. According to the results, the mean values of selected nephrotoxic and trace element concentrations (in µg/L) Al (41.8±16.33), Mn (63.4±19.75), Fe (239.9±62.47), Zn (152.9±41.51), Cr (0.1587±0.046), As (0.242±0.058), Cd (0.113±0.024), Pb (0.449±1.174) and Ni (0.314±0.115) are complied with WHO standard limits -2004, except Fe. Mean water hardness (75.10±5.60 mg/L) indicated 'moderately hard water' (60 to 120 mg/L). The PIG (0.2031±0.0060) showed insignificant pollution (PIG<1.0), the SPI (0.0402±0.0080), indicated suitable drinking water (SPI<0.5), and the OPI (0.2831±0.0021) meant excellent water quality (OPI = 0-1). Based on the results, it can be concluded that the water hardness and long-term exposure to nephrotoxic metals may lead to the occurrence of CKDu in the study area. Proper treatment of water before consumption and responsiveness on handling agrochemicals can be recommended as a preventive measure of CKDu in the study area.

Keywords: CKDu, Water hardness, Nephrotoxic heavy metals, Pollution indices

iPURSE 2021 – 109   *Environment and Natural Resources*

Characterization and Authentication of Isolated Rhizobia from Some Selected Host Plants

G.G.C.G. Thennakoon[1]*, R.G.U. Jayalal[1]* and S.A. Kulasooriya[2]

[1]Department of Natural Resources, Faculty of Applied Sciences,
Sabaragamuwa University of Sri Lanka, Belihuloya 70140, Sri Lanka
[2]National Institute of Fundamental Studies, Hantana Road, Kandy 20000, Sri Lanka
*gayanithennakoon93@gmail.com

Rhizobia are naturally occurring soil bacteria, of them plant growth-promoting Rhizobacteria (PGPR) have an ability to fix atmospheric inert nitrogen into plant utilizable forms like ammonia and amino acids. They accomplish biological nitrogen fixation through symbiotic associations with legume plants. In the present study, Rhizobia strains isolated from soybean (*Glycine max*), groundnut (*Arachis hypogaea*), mung bean (*Vigna radiata*), cowpea (*Vigna unguiculata*), common bean (*Phaseolus vulgaris*), and white clover (*Trifolium repens*) were purified and characterized morphologically, biochemically and physiologically. According to morphological characterizations, Rhizobia were found to be gram-negative and rod-shaped/ roughly rounded bacteria. The colony appearance was gummy, white, opaque, or immersed. Biochemical characteristics were tested against five different antibiotics (Tetracycline, Cloxacillin, Ampicillin, Ciprofloxacin, and Metronidazole), five different amino acids (L-tryptophan, Urea, Glycine, Cysteine, and L-tyrosine) and six different carbohydrates (D-glucose, Galactose, Fructose, Lactose, Mannitol, and Sucrose). Tetracycline was given solitary observation for the resistance of selected strains. Sucrose and dextrose were optimally utilized by Rhizobia besides mannitol. Utilization of amino acids by many strains was restricted to Cysteine and L-tyrosine. Green gram and cowpea strains were fast growers with acid-production in BTB and BRYMA. Similar results were obtained in UV absorbance of Rhizobial culture densities at 254 nm wavelength for their growth rate. Following the physiological characteristics, many strains were restricted to the 6.5-9.5 pH range and 0.5% -1% salinity levels. There was optimized growth of all strains at 32 ^{0}C and 35 ^{0}C temperatures incubation. Groundnut, cowpea, and green gram obtained excellent potential to nodulation out of other Rhizobia inoculated legumes with authentication. The study implies the importance of selecting the most effective and efficient Rhizobial strain for a particular physical and biochemical conditions of the host plant and rhizosphere. The recorded properties potential to implement sustainable agriculture by promoting them as biofertilizers to replace chemical N fertilizer.

Keywords: *Rhizobium* Spp., *Rhizobium* characterization, Authentication of Rhizobia, Nodulation, Nitrogen fixation

Environment and Natural Resources

Degradation of Bisphenol-A (BPA) in Drinking Water Using a Newly Synthesized Graphene-Based Photocatalyst

T.A.K.A. Thennakoon[1], B.E.P. Mendis[1]*, M. Gunawardena[2] and R. De Silva[2]

[1]*Department of Food Science and Technology, Faculty of Agriculture, University of Peradeniya, Peradeniya 20400, Sri Lanka*
[2]*Sri Lanka Institute of Nanotechnology, Pitipana, Homagama 10206, Sri Lanka*
*ereshamendis@yahoo.com

Drinking water sources contain various types of micro-pollutants leading to significant health conditions in humans and animals. Bisphenol-A (BPA) is one of the micro-pollutants present in drinking water sources due to leaching from polycarbonate sources. Different mechanisms have been used to remove BPA from water and photocatalytic degradation is one of the methods. A photocatalytic material incorporated graphene has been developed to study its effectiveness in removing BPA from drinking water under different conditions as pH of the water (5.4, 6.5, 7.3 and 8.2), initial BPA concentration (5 mg/L, 10 mg/L, 20 mg/L and 25 mg/L), photocatalytic material concentration (0.8 g/L, 1.0 g/L and 2.0 g/L) and the light source (halogen light, UV light and 11.00 a.m.-2.00 p.m. sunlight). Photocatalytic material was added to drinking water samples with BPA, stirred to ensure even dispersion of material and the unit was exposed to the light source. Degradation of BPA was analysed with irradiation time. The absorbance of BPA was measured using a UV-VIS-NIR spectrophotometer for the calculation of concentration reduction over time. A simple kinetic study was performed using pseudo 1st order kinetic model to study the relationship between degradation and irradiation time of BPA. The highest degradation efficiency for BPA was achieved with 2.0 g/L catalyst concentration, 10 mg/L initial BPA concentration, pH 8.2 and visible light sources. The degradation efficiencies are 95.5±0.20 %, 95.70±0.73 %, 92.60±2.85 % and 95.7±0.73 %, respectively. Degradation of BPA with time showed a linear relationship under UV light and pH conditions 5.4, 7.3, and 8.2 resulting in squared correlation as 0.9523, 0.9797, 0.9515, and 0.9358 respectively. Based on the kinetics, degradation of BPA does not follow 1st order kinetics when resulting in the higher degradation efficiencies. The material is effective in degrading BPA in drinking water sources under visible light compared to UV light and above 95 % degradation efficiency was achieved.

Keywords: Bisphenol-A, Photocatalytic degradation, Drinking water, Graphene-based photocatalyst, Irradiation time

In-Vitro Antioxidant and Phytotoxic Properties of Lichen Species *Heterodermia obscurata* Locally Common in Belihuloya, Sri Lanka

L.V. Perera*, R.G.U. Jayalal and S.J. Perera

Department of Natural Resources, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya 70140, Sri Lanka
*lasithviduranga120@gmail.com

Synthetic medicinal drugs and weedicides are causing adverse side effects. Natural bioactive compounds are the best solution to reduce such effects. We investigated antioxidant and phytotoxic properties of the lichen species *Heterodermia obscurata* identified using standard keys from Belihuloya. Methanol, acetone and hexane extracts of fresh lichen samples were prepared and their antioxidant activity was measured using 2,2-diphenyl-1-picryl hydrazyl (DPPH), while the reducing ability was observed using ferric reducing antioxidant potential (FRAP) test using Ascorbic acid as the positive controller for both tests. The total phenolic content (TPC) was evaluated using the Folin–Ciocalteu reagent assay and calculated as gallic acid equivalents for the dry weight of lichen. Further, seed germination and the root length inhibition assays were performed using radish seeds (*Raphanus sativus* L.) to evaluate the phytotoxicity of the extracts using relevant solvents as the negative controllers. Three replicates were used for each and every test. Methanol extract showed the highest antioxidant activity in DPPH assay (IC_{50} = 273.4 ppm, R^2 = 0.927, p-value= 0.009, n=3) and the highest absorbance in FRAP assay (0.277±0.051) compared with Ascorbic acid. TPC of the same extract was significantly higher (16.451±3.802) compared to all the other extracts (p-value < 0.05). TPC of the extracts showed a strong positive correlation with radical scavenging activity (0.806, p-value < 0.2) and the reducing potential (0.949, p-value < 0.1). Inhibition of radish seed germination was significantly high in methanol extract of *H. obscurata* compared to the negative controller after 24 h and 72 h of exposure (p-value < 0.05). Similarly, the methanol extract of the lichen had the highest root inhibition activity after exposure for five days. Hexane extract did not show any bioactivity. Hence, we propose the methanol extract of the *H. obscurata* for further studies on applications of its bioactivity.

Keywords: Antioxidant, Bioactivity, *Heterodermia obscurata*, Lichens, Phytotoxicity

iPURSE 2021 – 112   *Environment and Natural Resources*

Variation of Tree Diversity and Above-Ground Biomass of Homegardens in Matale District, Sri Lanka

W.A.M. Lowe[1]*, G.L.L.P. Silva[2] and D.K.N.G. Pushpakumara[3]

[1]*Postgraduate Institute of Agriculture*
[2]*Department of Animal Science, Faculty of Agriculture*
[3]*Department of Crop Science, Faculty of Agriculture*
University of Peradeniya, Peradeniya 20400, Sri Lanka
*ayeshlowe@gmail.com

Homegardens are known as integrated man-made ecosystems with annuals and perennials where trees play a significant role in storing atmospheric carbon. Homegardens are agroforestry systems that have been identified as a favorable approach in mitigating climate change, by easing the pressure on natural forests in reducing greenhouse gas accumulation (CO_2) in the atmosphere via fixing carbon in the vegetation as above-ground biomass (AGB). A study was conducted to assess the tree diversity and AGB carbon stock of homegardens in Matale, Sri Lanka. A total of 122 homegardens were surveyed, capturing a vast diversity. Homegardens surveyed were ranging from urban dwellings to sub-urban and close to natural eco-systems under five agro-ecological regions (AER). A total of 5,140 woody trees were recorded under 100 genera and 45 families, covering 16.67 ha of homegardens. Six and three species were identified as vulnerable and near threatened, respectively, in terms of national level conservation status. Shannon-Wiener index (SWI) was computed with a mean of 1.90±0.49 and a range of 0.49-2.83, owing to the multiplicity and composition of tree species. Using allometric equations, mean AGB was calculated to be as 36.5±27.4 Mg C/ha (0.8-139.4 Mg C/ha). AGB and SWI were higher in small scale (38.8±29.7 Mg C/ha and 1.91±0.50) than medium scale (28.0±14.9 Mg C/ha and 1.86±0.50) homegardens. A high species richness and species/ha was observed in small yet well managed homegardens. No large scale homegardens were found during the survey (Small=<0.2ha, Medium=0.2-0.8ha, Large=1.0-1.2ha). A notable variation was observed in tree diversity and AGB among the homegardens in different AERs. The variation of AGB was primarily governed by trees/ha and species diversity. Optimization of potential homegardens in the study area in favor of enhanced carbon sequestration and food security could be used as a timely remedy to mitigate climate change, via storing atmospheric carbon as above-ground biomass.

Keywords: Homegarden, Trees, Diversity, Aboveground biomass, Carbon

Distribution and Probable Sources of Faecal Indicator Bacteria along Rawan-Oya Tributary of Mahaweli River in Kandy District

R.W.M.G.K. Kapukotuwa[1]*, C.L. Abayasekara[2], K.C. Weerakoon[4] and R.S. Rajakaruna[3]

[1]*Postgraduate Institute of Science*
[2]*Department of Botany, Faculty of Science*
[3]*Department of Zoology, Faculty of Science*
University of Peradeniya, Peradeniya, 20400, Sri Lanka
[4]*Department of Zoology, The Open University of Sri Lanka,*
Nugegoda10250, Sri Lanka
*kapukotuwag@gmail.com

Faecal indicator bacteria (FIB) count reflects the level of faecal contamination of water. This study investigated faecal contamination levels along the Rawan-Oya tributary of Mahaweli River by analysing the total-coliform (TC), faecal-coliform (FC), *Escherichia coli* and faecal-streptococci (FS) levels. Water samples (1 L) were collected monthly from five different habitats: pristine, rural, agricultural, urban and semi-urban areas from June 2020 to January 2021. Subsequently, water was filtered through membrane-filters (0.45µm pore-size), and placed on Petri-dishes, containing M-Endo, M-FC and KF-streptococcus agar. M-Endo and M-FC plates were incubated for 36 hr at 35 °C and at 44.5 °C, respectively. KF-streptococcus agar plates were incubated for 48 hr at 35 ºC. Confirmation tests were performed using brilliant-green bile broth for TC and FC, Indole test was done for *E. coli*. FS was confirmed by the growth in BHI broth and the colour change of BEA slant. Sources of FIB were analysed using FC: FS ratio. The lowest mean values cfu/100 mL were noted in the pristine area: TC 270 (±20), FC 16 (±1) FS 196 (±3) and the highest values were obtained from the Madawala urban site: TC 209,000 (±7,000), FC 22100 (±100), FS 96,500 (±2,500). There were significant differences in the distribution of TC, FC and FS counts among the five habitats (ANOVA, p< 0.05). The source of contamination in the pristine area was mainly wild animals (FC:FS= 0.07) and in all other sites, it was domestic animals (FC:FS= 0.1– 4.0). A public toilet on the river-bank and disposing animal wastes into the stream from meat-shops at the Madawala site may have had a significant contribution to the increased FIB counts. The results indicated that the distribution of FIB varied among the sites and the sources were related to the anthropogenic interventions, and the domestic animal density of the area.

Keywords: Faecal indicator bacteria, Coliforms, Faecal-streptococcus, River water, Pollution

Preliminary Analysis of Functional Diversity of Bacterial Communities Associated with Mangrove Ecosystems Located Within Puttalam Lagoon, Sri Lanka

B.W.M.K.E. Weerasinghe and A.P. Halmillawewa*

Department of Microbiology, University of Kelaniya, Kelaniya 11600, Sri Lanka
*anupama@kln.ac.lk

Mangroves are composed of a broad range of well-adapted vegetations associated with macro and microorganisms. As a tropical country, Sri Lankan mangroves provide habitats to a microbial population rich in compositional and functional diversity. The present study aimed at exploring the functional diversity of the bacterial isolates associated with sediments from mangrove ecosystems located in the Puttalam lagoon, Sri Lanka. Bacteria were isolated based on the cultural techniques using sea water (50% v/v)- nutrient agar medium. Extracellular enzyme production including amylase, protease, cellulase and lipase, phosphate solubilization and antimicrobial activities of bacterial isolates were evaluated through culture-based screening techniques. The ratio of clear zone diameter (z) to colony diameter (n) was used to identify the highest amylase, protease, and cellulose producers among the isolates. Out of eighteen isolates, eight (44% of total isolates) exhibited amylase activity, while 50% of total isolates exhibited protease and cellulase activities. The highest activities of amylase, protease and cellulase were observed in bacterial isolates PUTS2_7 (3.00 z/n), PUTS1_6 (3.93 z/n) and PUTS1_1 (3.33 z/n), respectively. Six isolates (33% of total isolates) showed lipase activity by creating a yellowish zone around the colony. Five isolates produced yellow coloration around the colonies when grown on modified Pikovskaya medium indicating their phosphate solubilization ability. The preliminary screening for antimicrobial activity was performed using the cross-streak method against *Staphylococcus aureus* (ATCC 25923), *Escherichia coli* (ATCC 25922) and *Pseudomonas aeruginosa* (ATCC 27853). None of the isolates exhibited antimicrobial activity against pathogens tested. Further studies are necessary to evaluate the potential use of extracellular enzymes produced by those bacterial isolates in various large scale industrial applications.

Keywords: Mangroves, Bacteria, Extracellular enzymes, Antimicrobial activity, Phosphate solubilization

Evaluation of Microbiological Quality of Commercially Available Bottled Drinking Water in Colombo District, Sri Lanka

D.D.N. Perera[1]*, A.T. Herath[3], J.L.P.C. Randika[1],
H.A.D. Ruwandeepika[2] and R.G.U. Jayalal[1]

[1]Department of Natural Resources, Faculty of Applied Sciences
[2]Department of Livestock Production, Faculty of Agricultural Sciences
Sabaragamuwa University of Sri Lanka, Belihuloya 70140, Sri Lanka
[3]Department of Botany, Faculty of Natural Sciences, The Open University of Sri Lanka,
Nawala, Nugegoda 10250, Sri Lanka
*devanginethmani@gmail.com

Recently, the consumption of bottled drinking water has dramatically increased globally and also in Sri Lanka. However, compliance by the manufacturers with the regulations regarding bottled water is debatable. Currently, there is a rising concern regarding the quality of Bottled water. The objective of the current study was to investigate the microbiological quality of bottled water in Colombo district, Sri Lanka. Three bottles each from Twenty-six brands of bottled water were randomly collected from the local market in the Colombo district. Total coliforms (TC) and fecal coliforms (FC) were tested using the Membrane filtration method. The heterotrophic bacteria and fungi were tested using the pour plate method and spread plate method, respectively. Sedgwick rafter cell was used to identify the algae species. Fifty percent of brands tested were positive for the presumptive TC. Out of that, 19% of brands violated the Sri Lanka Standards Institution (SLSI) permitted levels for presumptive TC (<10 CFU/100 ml). Further, fifty percent of brands exceeded the presumptive TC level violating the Health Ministry standards of Sri Lanka and the World Health Organization (WHO) permitted levels (0 CFU/100 ml). Similarly, 23% of brands exceeded the limits for presumptive FC (0 CFU/100 ml following WHO permitted levels, SLSI, and the Sri Lanka Health Ministry requirement). Thirty-five percent of brands showed higher heterotrophic plate count (HPC) which exceeded the WHO guidelines for bottled drinking water (<50 CFU/ml). The dominant fungi identified were *Aspergillus* sp., *Rhizopus* sp., *Trichoderma* sp. and *Mucor* sp. Eight percent of brands were positive for algae, and *Chlorella vulgaris* was identified as the algae species in tested bottled drinking water. The results of this study revealed that the bottled water industry needs to be closely supervised by the competent authorities to ensure that customers in Sri Lanka have safe bottled drinking water.

Keywords: Bottled water, Microbiological quality, Total coliforms, Fecal coliforms

Sorption of Basic Cationic Dye onto Municipal Waste Biochar Equilibrium and Thermodynamic Study

P. Rajapaksha[1,2], M.C.M. Iqbal[2]*, C.S. Kalpage[1],
R.E.A. Dissnayake[2] and H. Wijesinghe[2]

*[1]Department of Chemical and Process Engineering, Faculty of Engineering,
University of Peradeniya 20400, Peradeniya, Sri Lanka*
*[2]Plant and Environmental Sciences Laboratory, National Institute of Fundamental
Studies, Kandy 20000, Sri Lanka*
*mcmif2003@yahoo.com

In the present world, environmental pollution is a global challenge closely linked with rapid industrialization. Contamination of the aquatic eco-system with discharges of industrial dye effluents is a critical environmental issue. The high cost of conventional treatments to remove dyes is a challenge both economically and technically. Hence, this study determined the removal of a synthetic basic cationic dye (methylene blue) in aqueous solution using municipal waste biochar as a low-cost sorbent derived from biosolids pyrolysis. Methylene blue is used as a model dye to study the effectiveness of different sorbents since it is rapidly adsorbed by sorbents. The effect of different experimental parameters such as contact time, pH, adsorbent dosage and temperature were determined to measure the dye removal efficiency. The adsorption isotherms of the process were evaluated using the data obtained from above experiments. Biochar was prepared through pyrolysis of sludge at 300 °C for ½ h with a constant heating rate of 10 °Cmin[-1].The results indicate that the optimum contact time for dye removal is 1.5 h, optimum pH and dosage ranges from pH 1-10, and 10-40 mg/L, respectively. All these optimum conditions showed a dye removal efficiency above 90%. The best-fitted isotherm models to describe the methylene blue adsorption onto biochar were Dubinin-Radushkevich, Langmuir and Temkin which gave R^2 values over 0.990. According to thermodynamic study, the sorption process was spontaneous and endothermic. The surface area of biochar was 82 m^2/g. Key functional groups identified through Fourier Transformed Infrared Spectroscopy (FTIR) analysis were phenolic, alcohol and carboxylic groups. Generally, biochar derived at low pyrolytic temperature preserves functional groups responsible for higher removal efficiencies as resulted in this study. Based on experimental results, the biochar derived from municipal waste biosolids is an effective sorbent for methylene blue removal which can be further experimented with other industrial cationic dyes.

Keywords: Isotherm, Methylene blue, Modeling, Pyrolysis, Sludge

Bio Inhibitory Potential of *Clidemia hirta* and *Mikania micrantha* on Selected Postharvest Fungal Pathogens and Weed Seed Germination

S.M.D.S. Gayathri[1]*, N.C. Bandara[2], N.S. Gama-Arachchige[1], and J.W. Damunupola[1]

[1]Department of Botany, Faculty of Science
[2]Postgraduate Institute of Science
University of Peradeniya, Peradeniya 20400, Sri Lanka
**sadhanasmd@gmail.com*

Botanical biocides are a trending sustainable strategy for agricultural pest and disease management. This study was focused on the bio inhibitory ability of two noxious invasive plant species in Sri Lanka; *Mikania micrantha* and *Clidemia hirta*. Air-dried plant materials were extracted into 50% dichloromethane/methanol using the bottle extraction method. Antifungal activity of the two extracts was tested against four postharvest fungal pathogens: *Cladosporium cladosporioides*, *Colletotrichum musae*, *Fusarium sp.*, and *Aspergillus niger*. Disc diffusion method (2 mg of extract/disc) was used with negative (50% dichloromethane/methanol) and positive (Mancozeb® and Propineb) controls for screening the antifungal activity. The herbicidal potential of the two extracts at different concentrations (0, 250, 500, 1000, and 2000 ppm) was evaluated using seed germination assay against three common weeds; *Pennisetum polystachion*, *Tridax procumbens*, and *Ludwijia perennis*. *M. micrantha* extract (2 mg) showed antifungal activity against *C. musae* and *Fusarium sp.* while *A. niger* and *C. cladosporioides* were insensitive to both plant extracts. *C. hirta* extract was not effective against the selected fungal pathogens. All three test species were non-dormant with germination percentage >70%. Seed germination of *P. polystachion* and *T. procumbens* was reduced to <7% by 1000 ppm *C. hirta* extract. Two thousand ppm extract of *M. micrantha* significantly reduced seed germination of *T. procumbens* and *P. polystachion* to 23% and 6%, respectively. . Seed germination of *L. perennis* was not significantly affected by either extract. The early seedling growth of the three weed species was affected by all four concentrations of the two plant extracts. In-general, 1000 ppm extracts of *C. hirta* and *M. micrantha* were effective in significantly reducing shoot and root lengths of all three weed species. Hence, the plant extracts of *M. micrantha* and *C. hirta* can be used as a potential eco-friendly solution in controlling the tested fungal and weed species.

Keywords: Antifungal, Invasive plants, Postharvest fungal pathogens, Seed germination, Weeds

Hexavalent Chromium (Cr(VI)) Removal Potential of Pure and Mixed Cultures of *Staphylococcus* spp. and *Bacillus* spp. in the Presence of Cd(II) and Cu(II)

K.C.B. Aththanayake[1]*, I.V.N. Rathnayake[1], and M.P. Deeyamulla[2]

[1]*Department of Microbiology*
[2]*Department of Chemistry*
Faculty of Science, University of Kelaniya, Kelaniya 11600, Sri Lanka
*kcbaththanayake@gmail.com

Hexavalent Chromium is a widely used heavy metal in textile, tannery, electroplating and wood preserving industries and discharged to the biosphere. Biological treatment is considered a cost-effective and eco-friendly method than available chemical and physical methods. Bacteria are proven Cr(VI) removers; hence, to obtain the maximum removal, the toxic effect of other heavy metals on the Cr(VI) removal efficiency of bacteria need to be investigated. Therefore, this study focused on analysing the efficiency of Cr(VI) removal by pure and mixed cultures of *Staphylococcus* spp. (2.93×10^7 CFU/mL) and *Bacillus* spp. (2.48×10^7 CFU/mL) in the presence of Cu(II) and Cd(II). Cultures were isolated and identified using standard morphological and biochemical bacterial identification protocols. Both strains were confirmed as Cr(VI) tolerant bacteria by dose-response analysis. All the tests were carried out with controls (with and without metals) in Tris minimal (modified) liquid medium in triplicates. Selected strains were exposed to their maximum metal removal concentrations in the presence of maximum allowable freshwater metal concentrations in Sri Lanka, 8.5 mg/L of Cr(VI), 0.1 mg/L of Cd(II) and 3.0 mg/L of Cu(II) in pure and binary mixed cultures. Removal of Cr(VI) was measured by 1,5-Diphenylcarbazide method, at 24 h time intervals up to 96 hours. According to the results, *Staphylococcus* spp. and *Bacillus* spp. have shown 15.05% and 100 % removal of Cr(VI) within 96 h, respectively, as in pure cultures, while mixed cultures have shown 100 % removal of Cr(VI) within 72 h in the presence of Cd(II) and Cu(II). This indicates that mixed bacterial consortium of *Staphylococcus* spp. and *Bacillus* spp. has an efficient Cr(VI) removal capacity than pure cultures in the presence of tested concentrations of Cd(II) and Cu(II), which will be useful in Cr(VI) bioremediation applications.

Keywords: Cr(VI), Cu(II), Cd (II), *Staphylococcus* spp., *Bacillus* spp.

Phylogenetic Relationships and Biogeographic Origins of Sri Lankan Sun Skinks (Reptilia: Scincidae: *Eutropis*)

P.L.T. Nirath[1]*, A. de Silva[2] and K.D.B. Ukuwela[1]

[1]Department of Biological Sciences, Faculty of Applied Sciences, Rajarata University, Mihinthale 50300, Sri Lanka
[2]Amphibia and Reptile Research Organization of Sri Lanka, 15/1, Dolosbage Road, Gampola 20500, Sri Lanka
*niraththilini@gmail.com

Sun skinks (*Eutropis*) are a diverse group of lizards (46 species) distributed in India, Southeast Asia, mainland Asia and the Philippines. Among the ~130 species of lizards in Sri Lanka, *Eutropis* are the second most diverse group of skinks in Sri Lanka which raise intriguing questions regarding their origins in Sri Lanka. Therefore, in this study phylogenetic affinities and biogeographic origins of Sri Lankan *Eutropis* were examined by placing 6 of the 9 Sri Lankan taxa with a dataset generated for 20 *Eutropis* species in previous studies. Field sampling was carried out in 15 selected locations in the country and sun skinks (3-5 individuals per species) were hand-captured and tail-tissue samples were collected upon identification. Mitochondrial protein-coding, *NADH dehydrogenase subunit 2* (*ND2*) and the nuclear protein-coding *Melanocortin receptor 1* (*MC1R*) genes were PCR amplified and sequenced upon DNA extraction from the tissues to evaluate phylogenetic relationships. Maximum Likelihood and Bayesian methods were used to evaluate phylogenetic relationships and species divergence times were estimated using a fossil-calibrated Bayesian framework. Representative species from Scincine, Lygosomine, Sphenomorphine and Xantusid lineages were used as outgroup taxa. Biogeographic origins of Sri Lankan *Eutropis* were evaluated through ancestral area reconstructions. Phylogenetic analyses indicated that all Sri Lankan taxa were closely related to Indian taxa. The findings further revealed that the majority of the Sri Lankan *Eutropis* (e.g. *Eutropis tammana*) originated from colonization events from India in the Miocene era [20-12 million years ago (mya)]. However, certain species colonized Sri Lanka from India (e.g. *E. bibronii* and *E. beddomei*) recently in the Pleistocene era (1.98-0.57 mya). Some of these dispersal events triggered *in-situ* speciation events within the island. Thus, the findings indicate that both multiple colonization events from India and diversification within Sri Lanka have been responsible for generating the present diversity of *Eutropis* in Sri Lanka.

Keywords: Ancestral area reconstruction, Biodiversity hotspot, Dispersal, Colonization, *in-situ* diversification

iPURSE 2021 – 120   *Environment and Natural Resources*

Geostatistical Method for Compilation of Spatial TDS Variations in Groundwater

S.U. Adikaram[1,4]*, T.K.S. Priyangani[1], M. Senarathna[1], P. Wijekoon[2], G. Bowatte[2],
X. Chen[3] and R. Weerasooriya[1]

[1]*National Institute of Fundamental Studies, Kandy 20000, Sri Lanka*
[2]*Postgraduate Institute of Science, University of Peradeniya,*
Peradeniya 20400, Sri Lanka
[3]*School of Resources and Environmental Engineering, Hefei University of Technology,*
Hefei 230009, China
[4]*Department of Computing and Information System, Faculty of Applied Sciences,*
Wayamba University of Sri Lanka, Kuliyapitiya 60200, Sri Lanka
*sanduniadikaram01@gmail.com

United Nations Sustainable development goal 6 declares Clean Water and Sanitation for the entire globe by 2030. Presently 15% of the Sri Lankan population or ~ 85% of the dry zone people do not have access to safe drinking water, which stems from high salinity (e.g., high total dissolved solids (TDS)), rendering water unpalatable. Presently the hydrogeochemical maps are prepared for the spatial distribution of TDS and other water quality parameters at different scales using the arithmetic averaging method within a pre-defined square lattice method, which does not account for the uneven water distribution, heterogeneous geology, etc. We used a geostatistical spatial method to account for the heterogeneity arisen in groundwater chemical composition. Thirty-six groundwater samples were collected from Nettiyagama Mihintale (36 km^2) to determine major ions by inductively coupled plasma optical emission spectroscopy (ICP-OES) and non-suppressed ion chromatography (IC). Ordinary Kriging (OK) and inverse distance weighting (IDW) analyses were chosen to construct hydrogeochemical spatial maps using ArcGIS. In OK, the variograms were calculated using Spherical, Exponential and Gaussian functions. The sill, nugget and range of the variograms are Spherical (0.0989, 0.0407, 645.5798), Exponential (0.0991, 0.0382, 834.3725) and Gaussian (0.1008, 0.0446, 583.6893), and the best fitted variogram for TDS values was derived from Spherical function. Comparing the lowest root mean square error (RMSE) value of OK (143.8236) and IDW (141.256), the IDW values were used to construct TDS maps and the leave one cross out method was used for data validation. Eighteen locations were used to validate the optimized TDS map constructed by the IDW method. The validated TDS spatial maps can be used as a predictive tool within the area using the experimental values received from the independent sampling program. The observed geological and experimental discrepancies will be further analysed to provide a robust methodology in preparing regional-scale spatial maps for TDS with predictive power. Also NO3- and F- spatial distribution maps were created to classify water based on its suitability for human consumption.

Keywords: Groundwater quality, TDS, Spatial map, Ordinary kriging, IDW

Enumeration of *Phlebiopsis flavidoalba* and *Schizophyllum commune* as Potential Polyethylene Degraders from Decaying Hardwood

P. Perera[1], H.M. Herath[1], C.S.K. Rajapakse[2],
W.R.P. Wijesinghe[3] and R.N. Attanayake[1]*

[1]Department of Plant and Molecular Biology
[2]Department of Chemistry
Faculty of Science, University of Kelaniya, Kelaniya 11600, Sri Lanka
[3]Department of Botany, University of Peradeniya, Peradeniya 20400, Sri Lanka
*renuka@kln.ac.lk

Global plastic accumulation has become a serious concern and each year several million tons of plastics are accumulated on earth. Although polyethylene is highly resistant to microbial biodegradation, it is one of the most environmentally friendly methods to manage this menace. Among various microorganisms with the ability to degrade synthetic polymers, fungi have been reported to play a key role. The main objective of this study was to assess the polyethylene degradation ability of hardwood decaying fungi isolated from a dry zone forest of Sri Lanka. Fungi were isolated into pure cultures using semi selective media consisted of potato dextrose agar and their ability to utilize wood as the sole carbon source and laccase and manganese peroxidase production abilities were determined. Selected high enzyme producers were identified using rDNA-ITS sequence analysis. Isolates were incubated with 20-micron Low Density Polyethylene (LDPE) sheets at room temperature for 60 days in Czapek-Dox broth statically. Biodegradation was assessed using percent reduction of tensile stress, Fourier transform infrared spectroscopy (FTIR) and scanning electron microscopy (SEM). Two fungal isolates with ligninase producing abilities were selected and identified as *Phlebiopsis flavidoalba* and *Schizophyllum commune*. The percent reduction of maximum tensile stress of *P. flavidoalba* and *S. commune* treated LDPE strips were 12.74% and 10.51%, respectively. The disappearance of some peaks that originally appeared in FTIR spectrum of the untreated sample and appearance of new functional groups attributed to hydrocarbon degradation after treatment with *P. flavidoalba* further confirmed the biodegradation of LDPE. Moreover, SEM analysis indicated the presence of cracks, holes and splits in *P. flavidoalba* and *S. commune* treated sheets compared to untreated controls. Findings of this study revealed that *P. flavidoalba* and *S. commune* have the potential to degrade 20 micron LDPE sheets**.**

Keywords: Biodegradation, Low density polyethylene, Polyethylene degradation, White rot fungi

Population Structure of Olive Ridley Turtle (*Lepidochelys olivacea*) Nesting on Southwestern Coast of Sri Lanka

W.G.A.P. Warallanda[1], M.P. Jensen[3], S.D.S.S. Sooriyapathirana[1] and R.S. Rajakaruna[2]*

[1]Department of Molecular Biology and Biotechnology
[2]Department of Zoology
Faculty of Science, University of Peradeniya, Peradeniya 20400, Sri Lanka
[3]Marine Mammal and Turtle Division, Southwest Fisheries Science Center,
National Marine Fisheries Service, NOAA, 8901 La Jolla Shores Drive, La Jolla,
California 92037, USA
*rupikar@pdn.ac.lk

Olive ridley turtle, *Lepidochelys olivacea* is one of the five marine turtle species that nest solitarily on Sri Lankan beaches. Although it is the most abundant marine turtle species globally, it is important to study the population structure and determine the genetic connectivity of the local nesting population with other populations for conservation and management efforts. This study analysed the mtDNA of the olive ridley turtle population nesting in the southwestern coast of Sri Lanka to determine population differentiation on a regional-scale. Twenty hatchlings were sampled from five turtle hatcheries scattered across ~70 km of coastline in one nesting season. The genomic DNA was extracted from tissues using DNeasy® Blood and Tissue Kit. The two primers *LTEi9* and *H950* were used to amplify the ~880bp fragment of the mtDNA control region using PCR. The genetic diversity was calculated by Arlequin version 3.5. The population was characterized by two new haplotypes: MW221480 (25%) and MW221485 (5%), and three previously reported haplotypes: Lo1 (50%), Lo5 (10%), and K (10%). Genetic diversity was highest in terms of the mean haplotype diversity (h = 0.7000), nucleotide diversity (π = 0.007908), and conventional F_{ST} and Φ_{ST} tests at p<0.05, compared to other regional and global rookeries *viz* Southeast India (F_{ST} = 0.54398, Φ_{ST} = 0.83345), Malaysia (F_{ST} = 0.14138, Φ_{ST} = 0.00513), Atlantic Ocean (F_{ST} = 0.63570, Φ_{ST} = 0.42963), Costa Rica (F_{ST} = 0.27147, Φ_{ST} = 0.44086), northern Australia (F_{ST} = 0.06048, Φ_{ST} = 0.14917) and the previously sampled Sri Lankan population (F_{ST} = 0.54398, Φ_{ST} = 0.83345). The phylogenetic analysis contributes to position the newly identified haplotypes in the turtle phylogeny. Evidently, the olive ridley turtles nesting in Sri Lankan beaches are genetically distinct to those in other rookeries emphasizing the importance of developing conservation strategies to conserve this distinct olive ridley turtle population.

Keywords: Marine turtles, Olive ridley turtles, mtDNA, Population differentiation

iPURSE 2021 – 123   *Environment and Natural Resources*

Diversity and Abundance of Avifauna around "Tea and Experience Factory" Hotel, Mandaramnuwara, Sri Lanka

P.H.M.G.C. Priyadarshana[1]*, T.S.P. Fernando[2] and M.P. Gunawardena[1,3]

[1]Biodiversity Educational Research Initiative (BERI), Avudangawa, Sigiriya 21120, Sri Lanka
[2]Department of Zoology, Faculty of Natural Sciences, The Open University of Sri Lanka, Nugegoda 10250, Sri Lanka
[3]Faculty of Science, Horizon Campus, Malabe 10115, Sri Lanka
*Priyadarshanachathura1@gmail.com

Birds can be considered as indicative of the health and wellbeing of the environment. They are effective focal species for promoting conservation action for wider range of animal groups. The booming bird watching industry makes a significant contribution to the national economy in many aspects. Here, we present the bird diversity and sites with potential to promote eco-tourism within the premises of Tea & Experience factory hotel in Kabaragalla Tea Esate, Mandaramnuwara in Nuwara Eliya, Sri Lanka. Mandaramnuwara is a small village located at the foot of the Piduruthalagala forest reserve. The objective of the present study was to determine the existing avian species diversity and abundance around the hotel premises surrounded by tea estate and vegetable cultivations. The observations were carried out from January to September 2020 twice a month except April to June 2020 due to the Covid-19 pandemic situation. The survey was done by point transect method between 06.00 –08.00h and 16.00 - 18.00h. The study area was scanned using 8×40 binoculars to count birds. A total of 3128 individuals of 40 species were recorded representing 23 families inclusive of 3 species of migratory birds: Kashmir Flycatcher (*Ficedula subrubra)*, Yellow Wagtail *(Motacilla flava*) and White-browed Wagtail (*Motacilla maderaspatensis)*. The observation of 3 endemic species; Greater Flameback (*Chrysocolaptes* (Lucidus) *stricklandi*), Ceylon scimitar babbler (*Pomatorhinus (schistieps) melanurus) and Sri Lanka White-eye (Zosterops ceylonensis)*, is an important record. Shannon and Simpson's diversity indices depicted a diversity of 3.22 and 0.95, respectively, of this study. The most abundant (9.2%) species was the spotted dove (*Streptopelia chinensis*) . Further studies must be directed along with long-term observations to declare the hotel area as an Important Bird and Biodiversity Area. It contributes noticeably to the local avian biodiversity and ecotourism in the region.

Keywords: Piduruthagala foothills, Theme resorts, Avifauna, Diversity index, Eco-tourism

Diversity of Butterflies in Horagolla National Park, Sri Lanka

P.H.M.G.C. Priyadarshana[1]*, R.A.H. Dilrukshi[2] and M.P. Gunawardena[1,2]

[1]*Biodiversity Educational Research Initiative (BERI), Le cube, No. 130,
High Level Road, Colombo 06, 00700, Sri Lanka*
[2]*Faculty of Science, Horizon Campus, Malabe 10115, Sri Lanka*
*priyadarshanachathura1@gmail.com

Butterflies play an important role in the environment as pollinators, in natural pest control and as model organisms to study habitat loss, fragmentation, and climate change. However, over the past few decades, the butterfly population has been affected negatively due to anthropogenic activities such as deforestation and urbanization which lead to environmental degradation. Therefore, a study was conducted in the smallest national park in Sri Lanka, the Horagolla National Park (33.6 acres) which is located in the Gampaha District with the objective of assessing the contribution of small protected areas for the diversity and conservation of butterflies. Sampling for butterflies was done two times per day, in the morning (8.30 am-10.30 am), and afternoon (1.30 pm-3.30 pm) for four months, from October 2019 to January 2020. Butterflies present within 5 m on either side of two line transects, each 1 km in length, were recorded. According to the observations, 79 individuals belonging to 15 species representing 3 Lepidoptera families were present in Horagolla National park. Out of the recorded species, 10 species are migratory indicating the presence of migratory butterfly species within the park. Shannon and Simpson's diversity indices depicted a relative diversity of 2.03 and 0.15, respectively. The most dominant butterfly species recorded were Common Grass Yellow (*Eurema hecabe*), Psyche (*Leptosia nina*), Common Evening Brown (*Melanitis leda*), and Jezebel (*Delias eucharis*), with a relative abundance of 27.85%, 18.99%, 13.92%, and 12.66%, respectively. Since flowering plant density is low in the park, butterfly diversity is low compared to man-made flower gardens. However, the study indicates that small protected areas can also act as refuges for butterflies in highly fragmented, changing landscapes. Through further research and studies, integrated conservation actions should be implemented to manage the influence of anthropogenic activities.

Keywords: Butterflies, Horagolla, National park, Small protected areas, Western province

Formulation of a Cost-Effective Rice Straw-Derived Medium and an Attempt to Create a Recombinant *Trichoderma reesei* Strain to Enhance Its Cellulase Activity in Search of Bioethanol

R.M.C.G. Ratnayake[1]*, Y.I.N.S. Gunawardena[3], J. Weerasena[2] and R.S. Dassanayake[1]

[1]*Department of Chemistry, Faculty of Science*
[2]*Institute of Biochemistry, Molecular Biology and Biotechnology*
University of Colombo, Colombo 00700, Sri Lanka
[3]*Molecular Medicine Unit, Faculty of Medicine, University of Kelaniya,*
Kelaniya 11600, Sri Lanka
*ratnayakechamilka@gmail.com

Oryza sativa L. (Rice) straw is a byproduct resulted while harvesting rice from paddy. *Trichoderma reesei* secretes numerous extracellular cellulases and hemicellulases, and degrades lignocellulosic matter giving fermentable reducing sugars. Linking these two 'assets' for bioethanol production this study proposes an economical and eco-friendly solution for exacerbating energy crisis. Therefore, the study aimed to obtain high yields of fermentable sugars, thus bioethanol, by cloning and expressing the lignin degrading laccase gene of the white rot fungus, *Rigidoporus microporus* in a highly cellulolytic *T. reesei* strain to further enhance its cellulase activity, and to induce the expression of the above cellulase and laccase genes by formulating a cost-effective rice straw-derived medium. Endo-1,4-beta-D-glucanase activity of the initial *T. reesei* strain on differentially formulated rice straw-derived culture media was studied against the standard medium, carboxymethyl cellulose. Reducing sugar concentrations caused by secreted cellulases in each culture medium were recorded at 24 hour intervals with 3,5-Dinitrosalicylic acid assay at 540 nm, converted into respective cellulase concentrations, and analyzed statistically. To clone the laccase gene by *Agrobacterium*-mediated pBI121 transformation, the *R. microporus* transcriptome was amplified using a gradient polymerase chain reaction with laccase gene-specific primers following reverse-transcription, and requires further optimization. Results suggested alkaline and acid pretreatments on mechanically processed straw were adding ($p<0.05$) to cellulolysis equally, since their cellulase concentrations were not significantly different. According to paired samples tests against the standard medium, Tween-80 was identified as a cellulase inducer ($p=0.051$), whereas gelatin ($p=0.657$) and L-ascorbic acid ($p=0.920$) alone could not significantly increase cellulase production. The medium containing alkaline-pretreated straw in a mineral salt medium with Tween-80, L-ascorbic acid and gelatin rendered the highest supernatant endo-1,4-beta-D-glucanase activity (3.599 Units/ml) on the 7th day after inoculation with *T. reesei,* and presents a promising medium for cellulase and laccase induction.

Keywords: Cellulolysis, Saccharification, Tween 80, Laccase, Gelatin, L-ascorbic acid

Morphometric Analysis of Genus *Elaeocarpus* L. (Elaeocarpaceae) in Sri Lanka

G.G.N.D. Silva[1, 2], D.M.D. Yakandawala[1,2]*, and K. Yakandawala[3]

[1]Postgraduate Institute of Science
[2]Department of Botany, Faculty of Science, University of Peradeniya,
Peradeniya 20400, Sri Lanka
[3]Department of Horticulture and Landscape Gardening, Faculty of Agriculture and
Plantation Management, Wayamba University of Sri Lanka,
Kuliyapitiya 60200, Sri Lanka
*deepthiyakandawala@gmail.com

The family Elaeocarpaceae consists of about 12 genera where Sri Lankan flora is represented by only one genus, *Elaeocarpus*. The island harbors nine species, *E. amoenus, E. coriaceus, E. glandulifer, E. hedyosmus, E. montanus, E. serratus, E. subvillosus, E. taprobanicus,* and *E. zeylanicus,* of which except *E. serratus* all are endemic to the country. Recent studies based on herbarium data suggest taxonomic ambiguities and the possibility of the occurrence of new *Elaeocarpus* species in Sri Lanka. The present study evaluates the morphological diversity of field collected *Elaeocarpus* spp. using morphometric analysis. Specimens of *Elaeocarpus* species were collected from the field based on the previous locality details included in Revised Flora of Ceylon and herbaria deposited at the National Herbarium, Sri Lanka. Morphological characters were studied in detail in the laboratory and coded into a data matrix. A Hierarchical Cluster Analysis (CA) and a Principal Coordinate Analysis (PCoA) was carried out using the statistical software PAST (Version 3.2). Hundred and ten morphological characters were coded which included 36 vegetative characters (27 qualitative and 9 quantitative) and 74 reproductive characters (44 qualitative and 30 quantitative). Both CA and PCoA resolved 11 major discrete phenetic groups within the Sri Lankan members of the genus *Elaeocarpus*. Nine of these clusters corresponded well with the previously reported species while two remaining clusters indicate the possibility of new species. Further, the main clusters corresponding to *E. hedyosmus* and *E. subvillosus* showed divisions indicating intra-species diversity.

Keywords: *Elaeocarpus*, Endemic plants, Cluster analysis, Morphology, Phenetics

Population Study of *Osbeckia lanata* Alston: Towards Its Conservation

R.M.K.S. Randeniya[1]*, E.H.C.M. Eeriyawala[2], A.M.T.A. Gunaratne[1],
K.M.G.G. Jayasuriya[1], A.M.A.S. Attanayake[3] and H.A.C.K. Ariyarathne[1]

[1]Department of Botany, Faculty of Science
[2]Postgraduate Institute of Science
University of Peradeniya, Peradeniya 20400, Sri Lanka
[3]Royal Botanic Gardens, Peradeniya 20400, Sri Lanka
*k.s.randeniya@gmail.com

Osbeckia lanata Alston. is an endangered endemic species inhabiting montane zone of Sri Lanka. Although studies on population ecology are important to comprehend the conservation status, there is no published record on ecology of this species. Thus, we investigated the ecology and seed biology of *O. lanata*. Four field sites (Thotupola, Kirigalpotta, Adam's peak, and Horton Plains) were selected for the study. In each site, four 5 m x 5 m quadrats were randomly laid where *O. lanata* occurred and percentage cover of all species and microhabitat factors were recorded. The phenology was recorded from March 2019 - March 2020 at monthly intervals. Seeds were collected for seed germination studies. In all the sites, *O. lanata* was recorded in areas with 62.0-90.0 % of relative humidity, 16.2-25.7 ^{0}C temperature, and 0-3.9 m/s wind velocity. The soil pH varied between 4.68-5.70. Soil moisture content was 17.5-33.83%. The soil colour was dark yellowish-brown or dark greyish-brown. The highest mean percentage cover of *O. lanata* (60% and 5.5%) was recorded in Thotupola and in Adams peak, respectively. Flowering of *O.lanata* started at the beginning of October 2019 and highest mean percentage of flowering was recorded between December 2019 and January 2020. At the peak flowering, 50±0.5 flowers bloomed on a single plant. The highest mean number of seed pods (33±0.5) were recorded between March-May 2019. Out of ten floral visitors, two were identified as *Xylocopa* sp. and *Ceratina* sp. Two different coloured seeds (brown and black) were observed in a single pod. Zero percent germination was recorded for black seeds under all germination treatments, while 13.8-22% of germination was recorded for brown seeds under light/dark treatment. This study stresses the importance of further research on pollinators, seed dispersal mechanism and propagation of *O. lanata* to fine-tune its conservation plan.

Keywords: *Osbeckia lanata*, Ecology, Seed germination

Preliminary Study of Age and Growth of Select Elasmobranch Fishes in Sri Lanka Based on Vertebral Growth Rings

A.G.G.C. Bandara[1,2,3], A. Tanna[2], M.F.M. Fairoz[1] and D. Fernando[2]*

[1]Department of Fisheries and Marine Sciences, Faculty of Fisheries and Ocean Sciences, Ocean University of Sri Lanka, Tangalle 82200, Sri Lanka
[2]Blue Resources Trust, Colombo 00700, Sri Lanka
[3]Department of Aquaculture and Fisheries, Faculty of Livestock, Fisheries, and Nutrition, Wayamba University of Sri Lanka, Gonawila 60170, Sri Lanka
*daniel@blueresources.org

Though Sri Lanka has a high diversity of elasmobranchs, species-specific studies are relatively few. Present study investigated the preliminary suitability of species for comprehensive age-growth studies as a first step for larger scale data collection. A systematic analysis of vertebrae obtained from fisheries bycatch was conducted to determine the optimum vertebrae and processing for best ring visibility as determined by three independent readers. *Acroteriobatus variegatus* (AV), *Carcharhinus leucas* (CL), *Centrophorus sp.* (GC), *Himantura leoparda* (HL), *Himantura uarnak* (HM), *Isurus paucus* (IP), *Maculabatis arabica* (MA), *Maculabatis gerrardi* (MG), *Mobula mobular* (MM), *Mobula tarapacana* (MT), *Neotrygon indica* (NI), *Pastinachus ater* (PA), *Pateobatis jenkinsii* (PJ), *Prionace glauca* (PG) and *Rhinoptera javanica* (RJ) were studied. According to the one-way ANOVA test, the central region had the best visibility for AV. There was no significant difference in ring visibility for PJ, HL and NI among the three regions. Also there was no significant difference in both bleaching and drying methods for all species. The vertebrae ring count method was not successful for GC. Vertebral ring counts for other sectioned species revealed that females live longer than males. The Von Bertalanffy growth curve was partially developed for AV and PJ, which accounted for more than 30 specimens each. However, a lack of young individuals prevented a complete life-history curve. Maximum age for male AV and PJ were estimated at 10 and 14 years, respectively, while for females it was 13 and 15 years, respectively. Analyses of preliminary data suggest that the central section of AV, with no bleaching or drying, is the most optimum method for ageing these species. Based on this study and other existing methodological procedures, it is recommended that the feasibility of counting rings be conducted for each species before proceeding to larger sample collections to support conclusions.

Keywords: Conservation, Guitarfish, Indian Ocean, Life-history, Von Bertalanffy

Evaluation of the Effect of Land-Use Practices on Nitrate Contamination of Groundwater in Kalpitiya

R.M.P Dilshara[1], L.D. Amarasinghe[1], H.M.A.K. Handapangoda[1],
J.C Edirisinghe[2], D.R. Gimhani[3], H.M.I.K Herath[4],
D.S.G.G.C Swarnathilake[4] and N.W.B.A.L. Udayanga[5]*

[1]*Department of Zoology and Environmental Management, Faculty of Science,
University of Kelaniya, Kelaniya 11600, Sri Lanka*
[2]*Department of Agribusiness Management* [3]*Department of Biotechnology*
[4]*Department of Plantation Management* [5]*Department of Biosystems Engineering
Faculty of Agriculture and Plantation Management,
Wayamba University of Sri Lanka, Gonawila 60170, Sri Lanka
udayanga@wyb.ac.lk

Regardless of the high agricultural productivity, the intensive agricultural practices in Kalpitiya have resulted in groundwater contamination with nitrate. This study was conducted to assess the influence of different land-use practices on the nitrate contamination of groundwater in Kalpitiya, with special emphasis on agricultural uses. Groundwater samples were collected at monthly intervals from November 2018 to January 2021 from 50 potable and agricultural wells located in five sentinel sites, namely Nawakkadu, Narakkalli, Thalavila, Kandakuli, and Kalpitiya town. In addition, the existing land-use practices surrounding the respective wells (within 150 m radius) were recorded. Electric Conductivity (EC), Total Dissolved Solids (TDS), salinity, nitrate, and phosphate concentrations of the water samples were measured using standard methods. The General Linear Model (GLM) followed by Tukey's pairwise comparison and Distance-based Redundancy Analysis (dbRDA) were used for statistical analysis. The highest pH and phosphate levels and the lowest conductivity, nitrate, salinity and TDS levels in groundwater were detected during the second inter monsoon period, followed by the North-East monsoon. The effect of the land-use practices on the variations of studied water quality parameters was found to be significant ($p<0.05$), except for phosphate. Agro-wells located surrounding the onion cultivations, showed the significantly highest nitrate (78.6 ± 16.4 mg/L), EC (2.2 ± 0.3 mS/cm), salinity (1.1 ± 0.2 %), and TDS (1111.0 ± 157.0 mg/L) levels, followed by tobacco and radish cultivations. On the contrary, pomegranate, eggplant, papaw cultivations and residential areas showed lower levels of the above parameters. In the dbRDA analysis, onion and tobacco cultivations formed a cluster, while residential areas, pomegranate, papaw, and coconut cultivations formed a separate sub-cluster verifying the findings of GLM. Therefore, crop diversification or shifting towards less nitrate leaching crops such as pomegranate, eggplant and papaw cultivations is recommended to regulate the nitrate contamination of groundwater in Kalpitiya.

Keywords: Groundwater pollution, Nitrate, Kalpitiya, Agriculture

Molecular Characterization for Identification of Endangered Sri Lankan Leopard: A Forensic Application

G.A. Gunawardana[1], P.P. Jayasekara[1]*, W.M.R.R. Wijethunga[2],
M.W.C.D. Palliyeguru[1] and K.H.D.T. Kasagala[1]

[1]Veterinary Research Institute, Peradeniya 20400, Sri Lanka
[2]Vitebsk State Medical University, Vitebsk 210009, Belarus
*jayasekarar@gmail.com

Sri Lankan Leopard (*Panthera pardus kotiya*) is an endemic subspecies and listed under endangered species by the International Union for the Conservation of Nature (IUCN). Even though killing of leopard is illegal, few incidences have been reported recently in Sri Lanka. To implement protection law effectively, precise forensic declaration of suspected body parts is necessary. Current investigation was conducted to identify the species from meat and fur samples suspected to be of a Sri Lankan Leopard using molecular sequence data. DNA from meat (n=2) and fur (n=2) were extracted using a commercial genomic DNA extraction kit (Qiagen, Germany). PCR was performed using previously published mitochondrial 16S rRNA primers and amplicons were sequenced bi-directionally by Sanger-sequencing method. Consensus sequences were generated in BioEdit 7 and MEGA 10, where identical sequences resulted from all samples. A phylogenetic tree was constructed in MEGA 10 under maximum parsimony criterion at 500 bootstrap replicates. National Center for Biotechnology Information *(*NCBI) BLAST search for consensus sequence showed 99.58% identity and 100% query cover with *Panthera pardus* mitochondrion complete genome with an E-value of 0.0 showing near complete match. Obtained phylogeny based on mitochondrial 16S rRNA sequence further suggested that *P. p. kotiya* is closely related to leopard subspecies from Russia (*P. p. orientalis)* and China (*P. p. japonensis)*. However, mitochondrial 16S rRNA sequence of Indian subspecies *P. p. fusca* was not available in GenBank for comparison. This is the first reported genotypic identification of Sri Lankan subspecies *kotiya* by 16S rRNA primers and sequence alignment. Sequences generate in this study for *P. p. kotiya* were submitted to GenBank under the accession number MW703705. Present study provided new data on 16S rRNA sequence of subspecies *P. p. kotiya* in Sri Lanka.

Keywords: *Panthera pardus kotiya*, 16S rRNA, PCR, Sri Lanka

Pollen Morphology, Viability, and *In Vitro* Germination Studies in *Carica Papaya* L.

E.U.U. Rathnathunga*, W.H.N.Y. Hewage and E.P.S. Chandana

Department of Biosystems Technology, Faculty of Technology, University of Ruhuna, Matara 81000, Sri Lanka
*udari@btec.ruh.ac.lk

Carica papaya L. belongs to the family Caricaceae which is a gynodioecious plant. The systematic morphological and floral diversity of Sri Lankan varieties are yet to be characterized. The objective of the study was to investigate the floral morphology, pollen viability and germination ability of the red lady variety and a local variety. The research was conducted at the Faculty of Technology, University of Ruhuna, Karagoda-Uyangoda, Kamburupitiya, Sri Lanka of IL1A agroecological region. The experiment was designed in Randomized Complete Block Design (RCBD) of 30 replicates in each variety with 1.8 X 1.8 m spacing. The floral morphology of two selected varieties was observed through visual observations and the light microscope. The dimensions of the flower morphology were measured using a vernier caliper. The pollen viability rate and the germination rate were tested with the iodine-potassium iodide test and the *in vitro* pollen germination test. Both the pollen viability rate and the pollen germination rate were observed through the imagery microscope and the hemocytometer using 3 replicates of each sample. The data were analyzed by t test through the Analysis ToolPak of MS Excel. Papaya has three flower types: female, male, and hermaphrodite. The male flower of the red lady had five petals and ten stamens while the local variety possessed four petals and eight stamens. The stamens' arrangement of the hermaphrodite flower of the two varieties was comparatively different. The height of the male (40.1 mm) and the hermaphrodite flowers (64.7 mm) of the red lady variety were significantly greater than local variety (30.7 mm and 48.8 mm, respectively). The *in vitro* germination rate of pollen from male flowers was significantly higher (22%) in local variety while the *in vitro* germination rate of the pollen from hermaphrodite flowers were significantly higher (50%) in red lady variety compared to local variety. The viability rate of the pollen from male flowers were higher in red lady variety (98%). The study highlights the importance of strengthen the production of local varieties and understand its yield potential.

Keywords: *Carica papaya* L., *In vitro* pollen germination, Pollen morphology, Pollen viability

Performance Analysis of Monolayer Nanoporous Graphene Oxide Membranes for Pressure-Driven Desalination: A Molecular Dynamics Study

K.Y. Heenkenda[1], H. Wijekoon[1,2], W. Zhiguo[2,4], R.J.K.U. Ranatunga[3]*, X. Chen[4],
A.C.A. Jayasundera[3] and R. Weerasooriya[1]

[1]*National Institute of Fundamental Studies, Kandy 20000, Sri Lanka*
[2]*Postgraduate Institute of Science*
[3]*Department of Chemistry, Faculty of Science*
University of Peradeniya, Peradeniya, 20400, Sri Lanka
[4]*School of Resources and Environmental Engineering, Hefei University of Technology,
Hefei 230009, China*
**udayana.ranatunga@sci.pdn.ac.lk*

Although Sri Lanka is not a water scarce nation, over 3.5 million people currently suffer from acute drinking water stress due to high salinity. Both reverse osmosis (RO) and nanofiltration membranes (NM) pressure-driven methods are widely used in water desalination. However, the resulted water is often overtreated causing problems due to lack of solutes in the permeate. Therefore, the development of tunable membranes for permeation of ions as required in the permeate is timely. Graphene and its derivatives have shown promise in the fabrication of pressure-driven membranes for water desalination. However, the fabrication of tunable graphene derived membranes is challenging. To complement experimental work, we have designed a new model graphene oxide membrane *in silico* and examined its selective the molecular sieving properties using molecular dynamics simulations. Mono-layer graphene and graphene oxide membranes were simulated using the LAMMPS code with the OPLS-AA force field to determine interactions between the membrane, water molecules and salt ions. The TIP3P was applied to water molecules with the SHAKE derived constrains. The initial simulation system contained membrane and water molecules sandwiched between two pistons, which allows for external pressure on the solution on either side of the membrane. We developed a molecular dynamics model to investigate monolayer nanoporous graphene and graphene oxide membrane performance at a pressure of 2000 atm and calculated the salt rejection and solute flux gradients. When comparing to graphene with graphene oxide membranes, graphene has a better salt rejection ability. Due to the functional groups present on graphene oxide membrane, solute flux is higher (around 70-80%) when compared with graphene membranes. Calculations of the thermodynamic parameters of water permeation and diffusion coefficient values of the membrane system under the realistic pressure range, 150 atm to 2500 atm are currently in progress. The data will be used in refining our MD model that is vital in designing experiments for membrane fabrication with desired performance.

Keywords: Nanoporous graphene oxide, Reverse osmosis, Molecular dynamics simulations, Water desalination

Spatial Variation of the Quality of Surface Water over Different Land Use Types in Upper Mahaweli Catchment

I.S. Somasiri[1,2]*, T. Hewawasam[2] and M.P. Rambukkange[2]

[1]*Postgraduate Institute of Science*
[2]*Department of Geography, Faculty of Arts*
University of Peradeniya, Peradeniya 20400, Sri Lanka
*ishanisomasiri@yahoo.com

The Mahaweli, Sri Lanka's longest river, is used extensively for supplying domestic water. However, its water is polluted in many places at different scales. We monitored the quality of water and suspended load of three micro-catchments of the Ma Oya (ca. 1 km^2), six-sub catchments (ca. 50-100 km^2) of Upper Mahaweli Catchment, and the Mahaweli River at Gatambe on monthly basis over a hydrological year (October 2018 to September 2019). Land use maps of these catchments were developed in the ArcGIS platform to examine the effect of land use on the quality of water. The mean and standard deviation of measured parameters were as follows: temperature (27.2± 3.8 ^{o}C), pH (7.3± 0.6), Electrical Conductivity (102.2± 74.9 µS/cm), alkalinity (49.7± 48.3 mg/L), hardness (53.1± 42.6 mg/L), Nitrate (1.6± 1.5 mg/L), Phosphate (0.1±0.16 mg/L), Sulphate (3.3± 4.7 mg/L), Fluoride (0.1± 0.06 mg/L), Chloride (6.7± 4.2 mg/L), Calcium (7.7± 8.0 mg/L), Sodium (3.1± 3.1 mg/L), Magnesium (1.5± 1.6 mg/L), Iron (168.8± 172.3 µg/L), Aluminum (42.3±60.0 µg/L) and Phosphorus (1.7± 2.0 mg/L). The catchments were categorized based on the land use as a percentage: (i) forest (ii) tea (iii) crops (seasonal crops, paddy, agricultural farms, pepper, chena, and coconut cultivation), and (iv) home gardens. Nitrate, Phosphate, and Sulphate concentrations of surface water showed a positive correlation (0.50, 0.61, and 0.79, respectively) with land use cover of crops. Nitrate concentration also showed a positive correlation (0.51) with land use cover of home gardens. The suspended load concentration positively correlated with Nitrate (0.48) and Sulphate (0.84). Alkalinity, Hardness, pH, EC, Total Dissolved Solids and, K, Mg, Na, Ca, Al, Fe, F$^-$ and Cl$^-$ concentrations also demonstrated positive relationships with crops. Therefore, this study reveals that land use cover of crops and sediment delivery from the catchments play a major role in polluting the Mahaweli river.

Keywords: Water quality, Land use types, Spatial variation

Environment and Natural Resources

Microbial Toluene Utilization Capability in Petroleum Waste Contaminated Soil

Y.H.K.I.S.Gunasinghe[1]*, M.P. Deeyamulla[1], I.V.N. Rathnayake[2] and A.T. Kannangara[1]

[1]Department of Chemistry
[2]Department of Microbiology
Faculty of Science, University of Kelaniya, Kelaniya 11600, Sri Lanka
*kaviisugunasinghe@gmail.com

BTEX (Benzene, toluene, ethylbenzene, and xylene) compounds are volatile monoaromatic hydrocarbons common in crude petroleum and petroleum products. Petroleum hydrocarbon contaminated soil microflora was qualitatively and quantitatively examined for its toluene removal and degradation capability. Petroleum hydrocarbon contaminated soil was collected from a fuel filling station in Kiribathgoda, Sri Lanka. The soil suspension was prepared. Flask with Bushnell Haas broth (9.00 mL) with toluene 20% (v/v) was incubated for one day to get equilibrated with toluene, and soil suspension (1.00 mL) was transferred to the flask. Flasks were sealed with rubber silicone septa and paraffin tapes and incubated at 100 rpm, 30 °C. Soil suspension was enriched in 3 stages as 1st, 2nd and 3rd by providing toluene as the whole carbon source. Headspace air (1.00 mL) of each enrichment sample was withdrawn after one, four, and seven days and manually dissolved in dichloromethane (2.00 mL) and analyzed using Gas Chromatography-Mass Spectrometry (GC-MS). After seven days, the number of toluene degrading bacteria in each enrichment was isolated using BHA, and plates were incubated at 30 °C for seven days with a toluene containing filter pad. The toluene reduction percentages were calculated compared to the initial toluene level in the headspace of the 1st, 2nd, and 3rd enrichments; it revealed 54.88%, 54.42%, and 79.36% toluene reduction within three days. After six days, 1.76×10^3, 6.68×10^5, 1.57×10^6 CFU/mL of bacteria from 1st, 2nd, and 3rd enrichments reduced the initial toluene amount by 67.87%, 45.70%, and 80.94%, respectively. During the enrichment, the number of bacteria present in the suspensions and the toluene utilization amount by bacteria increased. Five morphologically distinct bacterial colonies were isolated. According to the results, headspace toluene reduction pattern is obtained, which may be helpful for the development of novel environmentally friendly VOC bioremediation methodologies.

Keywords: Toluene, BETX, Bacterial degradation, Petroleum contaminants

Variation of Air Temperature of Anuradhapura in Dry Zone of Sri Lanka

L.P.S.D.N. Wijerathna[1]* and U.S. Meegahakotuwa[2]

[1]Kingswood College, Kandy 20000, Sri Lanka
[2]Mulgama College, Gampola 20500, Sri Lanka
*Wijerathnaw1972@gmail.com

The climate of Sri Lanka is characterized as a tropical monsoonal. Temperature is one of the most important elements in the tropical climate. Anuradhapura is situated in the dry zone of Sri Lanka and is one of the historical tourist attracted places on the Island. Paddy cultivation is the key farming practice and the irrigation system is one of the main characters in the cultural landscape in Anuradhapura. The main objective of this study was to examine the long-term temperature variation in Anuradhapura. The annual average temperature data has been collected from Anuradhapura station for the period from 1920 to 2019. The data was obtained from the Department of Meteorology, Colombo. To identify long-term variation in temperature, the data set was divided into two observation periods from 1920 to 1969 and 1970 to 2019. The trend was estimated from 1920 to 2019 using the time series and linear regression techniques. The Man-Kendall statistical test was applied to identify significant and non-significant monotonic trends. The result revealed that the annual average temperature in Anuradhapura has been increased by an amount of 0.9 ^{0}C during the 1970-2019 period compared to the 1920-1969 period. The annual average temperature has shown a statistically significant (P<0.05) increasing trend during 1920-2019. The rate of increase of annual average temperature is in the order of 0.017^{0}C per year. The study revealed that the temperature has a significant increasing trend during the last 100 years in Anuradhapura. The temperature increases will negatively impact the irrigation water management system, paddy productions, other human activities and natural environmental processes of Anuradhapura.

Keywords: Annual, Dry zone, Temperature, Trend, Variation

Measuring Individual Carbon Footprint and Exploring Its Determinants: A Case Study of Galewela Divisional Secretariat in Matale District, Sri Lanka

D.M.M.G.J.M. Disanayaka

Department of Environmental Management, Faculty of Social Sciences and Humanities, Rajarata University of Sri Lanka, Mihintale 50300, Sri Lanka
janakimanjula1994@gmail.com

Carbon footprint (CFp) is the measure of the amount of carbon dioxide emission associated with all the activities of a person or other entity. The overall aim of this study was to measure the individual CFp and its determinants of selected samples in the Galewela Divisional Secretariat in the Matale District. The specific objectives were to measure individual CFp, to measure per capita CFp, to identify the factors affecting the individual CFp and to formulate guidelines to reduce CFp. In order to achieve these objectives, primary data were collected from questionnaire surveys and interviews. Secondary data were collected from the journal articles, reports and websites. Convenience sampling method was used and it consisted of 120 respondents in the Pattiwela, Pathkolagolla and Hombawa villages in the Galewela Divisional Secretariat Area. https://www.carbonfootprint.com website was used to calculate the individual CFp. Data were analyzed by using SPSS and MS Excel software. Multiple regression, correlation analysis and descriptive analysis were employed for data analysis. According to the result, the total individual CFp of the study sample is 13.43 tons /month. Of this, the male respondents produce 8.62 tons of CFp and Female respondents released 4.81 tons of CFp. The per capita CFp of the study area is 0.11 tons/ month. Household activities of the respondents produced 27% of CFp per month. Respondents public transportation produced 19% CFp and private transportation produced 15% of CFp. Furthermore, secondary consumption produced 39% of CFp in the study area. The statistical findings revealed that, gender (sig = 0.010), age (sig = 0.01) and monthly family income (sig = 0.000) of the respondents are significantly influenced for the individual CFp in this area. Therefore, this study recommends that people should adopt a sustainable and environmentally friendly lifestyle to reduce their CFp.

Keywords: Carbon footprint, Carbon dioxide, Household, Per capita, Individual

Mechanical Exfoliation of Large Area Graphene from Sri Lankan Graphite for Device Application

M.J. Karunya, A. Suvanya, U. Sutharsini and M. Thanihaichelvan*

*Department of Physics, Faculty of Science, University of Jaffna,
Jaffna 40000, Sri Lanka
thanihai@univ.jfn.ac.lk

Graphene is known as a unique material with wide range of applications in renewable energy generation and storage, biosensors, and device applications. Single atomic thickness with extremely high electron mobility and a zero-band gap provide many advantages to the graphene as an electronic material. Sri Lankan graphite is known for its very high carbon content and high purity. However, Sri Lanka is still exporting the graphite as a raw material. Recently, the government of Sri Lanka launched a project for value addition of local minerals and the Sri Lankan vein graphite has been identified as a potential candidate in energy storage devices. In this work, we attempted to exfoliate single layer graphene from Sri Lankan graphite and to fabricate field effect transistors and to study their electronic properties. We used a simple scotch tape technique and transferred graphene onto a 100 nm SiO_2 coated Si substrate. The thickness and the uniformity of the graphene layer were tested using Atomic Force Microscopy (AFM). The thickness was confirmed to be 0.4 nm and the surface roughness was found to be 0.04 nm. The AFM images also confirmed the growth of double layer graphene also with the thickness of 0.9 nm. The Field Effect Transistor was fabricated by making electrical contact using thermal evaporation of gold and we found that the graphene layer showed an ambipolar current response with a positive Dirac voltage. Our studies suggested that the Sri Lankan graphite is one of best raw material for graphene exfoliation and the graphene exfoliated can be used for device applications.

Keywords: Graphene, Graphite, Sri Lankan vein graphite, Field-effect transistor

Diversity, Abundance and Distribution Patterns of Odonata in Royal Botanical Gardens, Peradeniya

A.M.P.E.K. Atapattu[1]* and S.K. Yatigammana[2]

[1]*Postgraduate Institute of Science*
[2]*Department of Zoology, Faculty of Science*
University of Peradeniya, Peradeniya 20400, Sri Lanka
prabashia@yahoo.com

Dragonflies and damselflies are odonate insects (Order: Odonata) associated with water bodies. They are considered as indicator organisms of water quality in aquatic ecosystems. The objective of this study was to identify the Odonata species present in the Royal Botanical Gardens (RBG), Peradeniya to understand the distribution patterns of dominant species and hence to provide guidance for educational activities. Sampling was carried out daily, from December, 2015 to January, 2016 from 0900 - 1600 hours, to record their diversity and abundance in each study site separately. Observations were taken at some selected man-made water bodies, open areas and in the marginal vegetation of River Mahaweli nearby the River Drive. Standard field guides were used for the species identification. A total of 17 Odonata species were recorded including ten damselfly species and seven dragonfly species. Out of the 56 endemic Odonata species in Sri Lanka, only four endemic damselfly species were recorded in RBG, while no endemic dragonfly species were recorded. Therefore, the percentage endemism of recorded damselfly species was 40%. The most abundant damselfly species recorded throughout the study was *Ceriagrion coromandelianum* (51.89%), while *Pantala flavescens* (45.64%) was the most abundant dragonfly species. The highest diversity of both damselflies and dragonflies was recorded at Lanka Pond bearing a Shannon Diversity Index value of 1.57 and 1.34, respectively. Shannon evenness values of damselflies and dragonflies at Lanka Pond were 0.682 and 0.688, respectively. Species richness and evenness at Lanka pond was higher than other sites. Most of the sites are dominated by one or two species, reducing species richness and evenness. Though a high diversity of Odonata are recorded from mid elevations to the highlands of Sri Lanka, low diversity was recorded in RBG during this study.

Keywords: Evenness, Odonata, Species richness

iPURSE 2021 – 139   *Environment and Natural Resources*

Geochemistry of Rare Earth Elements in Mollusk Shells from a Sediment Core from Southeastern Sri Lanka and Its Paleoceanographic Implications

K. Premaratne[1]*, R. Chandrajith[1], N. Ratnayake[2] and Si-Liang Li[3]

[1]Department of Geology, Faculty of Science, University of Peradeniya, Peradeniya 20400, Sri Lanka
[2]Department of Earth Resources Engineering, Faculty of Engineering, University of Moratuwa, Moratuwa 10400, Sri Lanka
[3]Institute of Surface Earth System Science, Tianjin University, Tianjin, China
*kusalamadhushani@gmail.com

Bio-mineralization of carbonate shells is sensitive to changes in the physico-chemical conditions of the ambient water. Despite the possible vital effects, Rare Earth Elements (REE) could be incorporated in biogenic carbonates without major mass fractionation, thus it can be used as a proxy for climate, environmental and oceanographic applications. Mollusk shells (43) from families *Veneridae* and *Potamididae* collected at different depths of a sediment core retrieved from the Pottuvil Lagoon were used to trace REE imprints of environment changes around southeastern Sri Lanka during the Holocene. Shells were digested using the reverse aqua-regia (3:1 HNO_3: HCl) method and the REE contents were measured using ICP-MS. Chronology of the sediment core was established by the Bacon age-depth modeling based on calibrated AMS ^{14}C dates of mollusk shells and bulk sediments. North American Shale Composite (NASC) normalized REE patterns showed that the shells are enriched in light REE (LREE) with prominent negative Eu and Ce anomalies and a slightly positive Gd anomaly. In addition, total REE (ΣREE), Y/Ho ratio, and magnitude of LREE enrichment exhibited distinct variations with depth. The phases of increased ΣREE concentration, Y/Ho and enhanced LREE enrichment with troughs or no Ce anomaly were corresponded with increased terrestrial input recorded in lithogenic proxies from 5141 to 4223 BP and from 2918 to 2688 BP. The phases of decreased ΣREE concentration, Y/Ho and declined LREE enrichment with enhanced Ce anomaly were consistent with decreased terrestrial input during 4223-4021 BP and 3537 to 3260 BP periods. Thus, these periods reflect (i) declined salinity (freshening) in the ambient water and a wet climate; (ii) increased salinity in the ambient water and a dry climate, respectively. Based on the whole shell geochemistry of REE, this study was able to reconstruct the paleoceanographic conditions around southeastern Sri Lanka from the Mid to Late Holocene.

Keywords: Holocene, Marine, Terrestrial, REE, Paleoclimate; AMS ^{14}C dating

FOOD, NUTRITION AND LIVESTOCK

Effect of Marination Technique and Holding Time on Physicochemical and Sensory Attributes of Marinated Pork Chops

S.C. Thambawita[1], R.K. Mutucumarana[1]* and J. Mahindarathna[3]

[1]Department of Livestock Production, Faculty of Agricultural Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya 70140, Sri Lanka
[2]National Livestock Development Board, Bangadeniya 61238, Sri Lanka
*ruvinim@agri.sab.ac.lk

This study was conducted to evaluate the effect of holding time on physicochemical and sensory attributes of marinated pork chops. The experimental design was 3 x 3 factorial arrangement of treatments evaluating three marination techniques (unmarinated control, injection and immersion) and three holding times (4, 8 and 12-h). A total of 63 pork chop samples (40 ± 5 g) obtained from a female fattener pig (12-months old; live weight, 88 kg) were marinated and allocated randomly into treatment combinations. Uncooked and cooked pork chops were analysed for physicochemical and sensory attributes, respectively. An interaction between (P<0.05) the marination technique and the holding time was observed only for pH, cooking yield, marinade loss, hardness, redness and yellowness. Injection marination improved (P<0.05) the marinade uptake than immersion. Holding 8-h after injection marination improved pH of meat (P<0.05). Cooking loss was affected (P<0.01) by the technique of marination. Holding pork chops for 8-h after injection and immersion marination (P>0.05) resulted the highest cooking yield. Meat held for 12-h after immersion marination (4.64%) and unmarinated control (4.45%) held for 12-h resulted the highest (P<0.05) marinade loss. Treatments when held at 8-h reported the highest tenderness. Meat subjected to immersion and injection marination and held for 4 and 8-h increased (P<0.05) the redness (a*). Unmarinated control poorly developed the yellowness (P>0.05) over three holding times. Injection marination resulted the highest scores for flavour, marinade penetration and overall acceptability when held for 8-h. Holding pork chops for 8-h after injection marination maximized cooking yield, tenderness, redness, yellowness while minimizing marinade loss. The panelists preferred mostly the meat marinated using injection method held for 8-h. Direct application of marinade into meat during injection process have resulted meat quality to improve. In conclusion, the injection method with 8-h holding time best contributes to the development of physicochemical and sensory attributes of pork chops.

Keywords: Holding time, Immersion, Injection, Marination, Pork chops

Effect of Ethylene and Acetylene Treatments on Phenolics, Flavonoids and Antioxidant Activity of Ambul Banana (*Musa acuminata*, AAB)

S.D.T. Maduwanthi* and R.A.U.J. Marapana

*Department of Food Science and Technology, Faculty of Applied Sciences,
University of Sri Jayewardenepura, Nugegoda 10250, Sri Lanka
tharaka@sci.sjp.ac.lk

Banana is one of the most consumed fruits in the world. It is rich in bioactive compounds. Since banana usually undergoes induced ripening, it is important to study the effects of ripening agents on nutritional value of banana. The present study was a comparison of total phenolics, total flavonoids and antioxidant activity in flesh of Ambul banana (*Musa acuminata*, AAB) ripened using ethylene and acetylene generated by Ethephon and calcium carbide, respectively. Banana in same maturity stage were subjected to 1000 ppm ethylene and 1000 ppm acetylene and kept at 20 ℃ and 80-85% RH until they are fully ripened. A control sample was kept at similar conditions without any treatments allowing natural ripening. The samples were analyzed for total phenolic content (TPC), total flavonoid content (TFC) and antioxidant activity (DPPH, ABTS and FRAP assays) at fully yellow stage (Stage 6). TPC and TFC in control sample were 39.69 ± 0.77 mg of GAE/100 g fresh weight and 2.19 ± 0.14 mg of QE/100g fresh weight, respectively and were significantly higher ($p < 0.05$) than those in treated samples. There was no significant difference ($p < 0.05$) in TPC and TFC between ethephon and acetylene treated banana. ABTS, DPPH and FRAP values showed the similar behavior having significantly high scavenging activities in naturally ripened banana compared to treated samples. Ethephon treatment showed the lowest ($p < 0.05$) antioxidant activity where DPPH activity was 409.85 ± 0.96 mg TE*/100 g and ABTS activity was 906.95 ± 1.74 mg TE*/100 g. FRAP activity values were not significantly different ($p < 0.05$) in acetylene and ethephon treatments. The result showed that ethephon and acetylene treatments at 1000 ppm level can considerably affect bio active compounds in banana.

Keywords: Artificial ripening, Bioactive compounds, Antioxidant activity, Mysore banana

Phospholipase Application in Milk: Does It Improve Cheese Yield of Gouda?

T.I.G. Prabashwari[1], J.K. Vidanarachchi[1]*,
P.H.P. Prasanna[1] and L.P.I.N.P. Jayawardene[2]

*[1]Department of Animal Science, Faculty of Agriculture, University of Peradeniya,
Peradeniya 20400, Sri Lanka*
[2]Aletek International (Pvt) Ltd, Rajagiriya 10100, Sri Lanka
*janakvid@agri.pdn.ac.lk

Gouda cheese is one of the most important and value-added dairy products, which has expanded over the world market as a commodity type cheese. Cheese yield has a great economic importance when determining the profitability of a cheese manufacturing plant. This study was conducted to evaluate the effect of fungal phospholipase A_1 (PLA_1) from *Fusarium venenatum* on the yield of Gouda by adding PLA_1 prior to renneting of Gouda cheese milk. In the current study, the most appropriate PLA_1 concentration on the yield improvement of Gouda was determined out of three different PLA_1 concentrations. Thus, four Gouda samples were manufactured from cow milk; T_1 (1.26 g PLA_1/15 L of milk), T_2 (1.44 g/15 L), T_3 (1.62 g/15 L) and control Gouda. The compositional analysis of whey, sensory evaluation, compositional analysis and microbiological analysis of Gouda samples were carried out. Standard formats of yield expressions were calculated for all the treatments. The use of high concentration of PLA_1 (1.62 g/15 L) in Gouda cheese milk had increased ($p<0.05$) the actual yield, the milk protein plus fat adjusted yield and the moisture adjusted milk protein plus fat adjusted yield by enhancing fat and crude protein composition in cheese. The sensory evaluation revealed that the Gouda manufactured using minimum concentration of PLA_1 (1.26 g/15 L) was highly preferred ($p<0.05$) by the panelists. Microbiological tests revealed that all treatments were safe to consume within forty-five days of ripening period at 10-17 ºC and 80-85% RH. The highest PLA_1 (1.62 g/15 L) concentration can be selected as the most appropriate treatment on yield improvement of Gouda which can be further improved in industrial cheese trials.

Keywords: Cheese milk, Cheese yield, Fat adjusted, Gouda cheese, PLA_1

Development of Aloe Vera (*Aloe barbadensis* Mill) Cubes-Incorporated Set Yoghurt

K.G.L. Manjitha*, R.D.A.K. Ranasinghe and K.M.W. Rajawatta

Department of Biosystems Technology, Faculty of Technology, University of Ruhuna, Matara 81000, Sri Lanka
*lasni91@yahoo.com

This study was conducted to investigate the possibility of developing set yoghurt incorporated with treated Aloe Vera cubes and to evaluate the physicochemical, microbial and sensory quality parameters of the product. Aloe Vera cubes treated with sugar syrup were incorporated before the incubation process of yoghurt preparation. Yoghurts prepared with three differently treated Aloe Vera cubes (T_1 - heated Aloe Vera cubes at 60 ^{0}C and soaked in sugar syrup for two days, T_2- non-heated Aloe Vera cubes soaked in sugar syrup for two days, T_3 - untreated Aloe Vera cubes) were compared with the control sample arranged in Complete Randomized Design. Products were stored at 4 ^{0}C for 21 days and different physicochemical and microbial properties such as pH, moisture, titratable acidity, yeast and mould count were tested at 01, 07, 14 and 21 days of storage. A sensory evaluation was done with 35 untrained panelists to get the consumer attributes. Data were analyzed using one-way Analysis of Variance in Microsoft excel. Results revealed that, pH and titratable acidity were significantly different among the products ($p<0.05$). The highest yeast and mould counts were presented at the treatment with untreated Aloe Vera cubes (T_3). Sensory analysis suggested that the treatment with heated Aloe Vera cubes at 60 ^{0}C and soaked in sugar syrup for two days (T_1) had the best sensory qualities and it complies with the standards of Sri Lanka Standards Institute up to 14 days of storage under 4 ^{0}C. The study concludes that, the set yoghurt incorporated with heated Aloe Vera cubes at 60 ^{0}C and soaked in sugar syrup for two days had the best qualities and can be stored up to 14 days at 4 ^{0}C without any quality deterioration.

Keywords: Aloe vera, Yoghurt, Storage, Sensory analysis

A Study on Perception and Usage of Herbs among Young Adults in Gampaha District

D.V.S.S. Diyapaththugama[1]*, N.R. Abeynayake[2], and G.A.P. Chandrasekara[1]

[1]Department of Applied Nutrition, Faculty of Livestock, Fisheries and Nutrition
[2]Department of Agribusiness Management, Faculty of Agriculture and Planation Management
Wayamba University of Sri Lanka, Makandura, Gonawila NWP 60170, Sri Lanka
*savindyashashya@gmail.com

Several bioactive compounds present in herbs help in the prevention and management of non-communicable diseases (NCDs) and maintenance of wellness. Relatively less attention is given to studying whether people know and use the available herbs against NCDs, which are public health issues in the country. It is important to study the extent of knowledge, attitudes, and behavior (KAB) on the herbs among young adults, who are the key contributors of the country's workforce and the deciders of well-being of the future generations. The objective of this online cross-sectional survey, done on young adults of 20-34 years old, was to determine their levels of KAB on herbs and the associations between KAB and socio-demographics. The pre-tested questionnaire randomly forwarded to respondents through email, Facebook and WhatsApp, was used for data collection from a sample of 344 participants. Respondents showed socio-demographic variations of district, gender, ethnicity, education, income, NCDs presence. Data analysis for exploratory and confirmatory factor analysis was performed with SPSS and AMOS statistical software. AMOS tested the associations between KAB and the socio-demographics. Calculations based on a scoring system revealed that KAB levels were 75, 68 and 48%, respectively. Gender, ethnicity and education levels showed significant correlations with KAB. From a list of 39 herbs, ginger, garlic, curry leaves, turmeric and lime were consumed by the majority. The major knowledge sources were family, books or media. Knowledge on herb-nutrient and herb-prescription drug interactions was lacking. The majority used herbs during common cold/fever and for improvement of immunity. Problems faced during herb consumption were undesirable taste, lack of ingredients and time for preparation. Thus, it was concluded that young adults have high knowledge, medium attitudes and behavior towards herbs; and KAB depends on socio-demographics. It is recommended to conduct future research to determine other socio-demographic factors affecting KAB and plan approaches to replenish the identified gaps in KAB.

Keywords: Attitude, Behavior, Knowledge, Socio-demographic, Sri Lanka

Rice, Soybean, and Finger Millet Milk-Incorporated Non-dairy Drinking Yoghurt Analogue with Desired Food Quality Attributes

O.D.A.N. Perera* and G.R.K.H. Karunathilake

Department of Food Science and Technology, Faculty of Livestock, Fisheries, and Nutrition, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP) 60170, Sri Lanka
*kaviniheshani@gmail.com

The development of non-dairy food products has been a growing trend as functional food to respond to the problems of cow's milk allergy, lactose intolerance, hypercholesterolemia and vegetarianism. During this study, a plant-based drinking yoghurt analogue was developed using rice (*Oryza sativa*) "Suwandal'' with a milky taste and exquisite aroma, finger millet (*Eleusine coracana*) with high fibre, and soybean (*Glycine max*) with high protein with improved sensory characteristics. Each milk substitute was prepared by a wet grinding process with optimized water: bean/grain ratio (1:1). The sensory evaluation with 30 untrained panelists selected 25% soy milk: 25% rice milk: 25% finger millet milk ratio, 5% (w/v) sucrose, 2% (w/v) glucose, 3% (w/v) sago starch, 10% (v/v) pineapple pulp as the best formulation. Non-dairy yoghurt analogue was fermented with *Streptococcus thermophilus* and *Lactobacillus delbrueckii* sub sp. *Bulgaricus*. The proximate composition results indicate crude protein (12.03%), crude fat (0.11%), moisture (78.49%), crude ash (0.33%), crude fibre (1.30), and nitrogen-free carbohydrate (7.74%). As functional properties, total phenolic content (5.83 mg (GAE)/g) and DPPH scavenging activity (33.24 mg/mL) were analyzed. The physicochemical and microbial properties were evaluated for a storage period of 21 days. The initial day values revealed the pH (4.56), titratable acidity (0.51% of lactic acid), total soluble solid (13%), viscosity (19.52 mPa.s) and water holding capacity (64.68%). Furthermore, the viability of *Lactobacillus* remained above 10^6 CFU/mL up to 14 days and after 14 days, yeast and mould count exceeded the safe level (10^2 CFU/mL). A shelf life study revealed that the product can be stored up to 14 days at 4 ^{o}C with desired food quality. In summary, the prepared cereal and legume blended novel non-dairy yoghurt analogue is a potential candidate to be used as a protein-rich, functional, non-dairy yoghurt analogue to consumers looking for dairy alternatives.

Keywords: Finger millet milk, Non-dairy, Rice milk, Soy milk, Yoghurt

Method Validation for Quantification of Selected Non-Nutritional Sweeteners and Preservatives and Caffeine in Carbonated Beverages Commercially Available in Sri Lanka

J.A.G.K. Jayasooriya[1], K.P.G.K.T. Guruge[2]* and W.M.T. Madhujith[1]

[1]Department of Food Science and Technology, Faculty of Agriculture, University of Peradeniya, Peradeniya 20400, Sri Lanka
[2]Government Analyst's Department, Battaramulla 10120, Sri Lanka
*thusharaguruge@yahoo.com

A study was carried out on validating a method for quantification of selected non-nutritional sweeteners and preservatives and caffeine in carbonated beverages commercially available in Sri Lanka. A liquid chromatography method with photodiode array detection was developed with SHIMADZU Shim Pack HR ODS column with particles of 3.0*150mm and potassium dihydrogen orthophosphate (pH 4.3) and acetonitrile as mobile phases in 88:12 ratio. Validation was performed in terms of linearity, specificity, reproducibility, recovery, Limit of Detection (LOD), and Limit of Quantification (LOQ) values. Detection was done by photodiode array detector and wavelengths used were 200 nm, 214 nm, 230 nm, 235 nm, 258 nm and 275 nm. Aspartame, acesulfame-K, sodium saccharin were selected as non-nutritional sweeteners, and benzoic acid, sorbic acid were selected as preservatives. Aspartame, acesulfame-K, sodium saccharin, benzoic acid, sorbic acid, and caffeine showed linearity within the 1-100 ppm range. The correlation coefficient (R^2) for all the compounds tested was higher than 0.996. Recovery of all the compounds ranged between 70% and 120%. The LOD values ranged between 0.054 and 0.097 while LOQ values ranged between 0.18 and 0.32. The percentage relative standard deviations were ≤ 5 for all the compounds. The extraction process was optimized using the surface response methodology and box Behnken design. Process optimization was carried out by Design-Expert Software Version 12.0. The optimum extraction conditions were found to be ultrasonic temperature 25 °C, time 10 minutes and mobile phase concentration 50% (V/V). Good separation and quantification could be obtained within 15 minutes of total run time.

Keywords: Aspartame, Acesulfame-K and Sodium saccharin, Benzoic acid and Sorbic acid, Caffeine, Carbonated beverages

Simple and Rapid Method for Underivatized Analysis of Glyphosate Residues in Tea (*Camellia sinensis*) Using LC-MS/MS Detection

Y. Samanthy[1]*, G.V.V. Liyanaarachchi[2], K. Abarna[1], R.A.D.S.M.R. Weerasekara[2], D.A.U. Chathurangani[3], P.I.D. Weeraman[3] and M.N.A. Mubarak[2]

[1]*Department of Export Agriculture, Faculty of Animal Science and Export Agriculture, Uva Wellassa University, Badulla 90000, Sri Lanka*
[2]*Residue Analysis Laboratory (RAL), Industrial Technology Institute, Colombo 00007, Sri Lanka*
[3]*Institute of Chemistry Ceylon, Rajagiriya 10107, Sri Lanka*
*yogendrarajah.samanthy@gmail.com

Tea (*Camellia sinensis)* is among the most popular beverages around the world. The use of pesticides to abate the frequent attacks on tea plants by pests and invasion by weeds, which pose a threat to the growth and nutrition of tea plants, has become a crucial part in the tea industry and has increased over the years. Glyphosate belonging to the broad-spectrum herbicide category is the most widely used herbicide in the local tea industry. Due to the unavailability of an accurate method, the health risk arising from Glyphosate residues left on dried tea leaves being transferred to tea infusions has been overlooked. This study presents the validation data of an accurate and precise method developed for quantitative analysis of Glyphosate residues in tea using liquid chromatography-tandem mass spectrometry (LC-MS/MS). Glyphosate residues in tea were extracted using water and chloroform. The extracted samples were analyzed using liquid chromatograph coupled to tandem mass spectrometer (LC-MS/MS). Chromatographic separation was achieved on an Atlantis T3 column with isocratic elution. Glyphosate was detected with electron spray ionization (ESI) in negative polarity using multiple reaction monitoring (MRM) transitions. Accuracy evaluated based on recoveries obtained for samples fortified at three concentration levels: low mid and high, covering the working range of the method were within 92%–100%. Precision measured in terms of repeatability and reproducibility expressed as percentage relative standard deviation was below 6%. Detection limit and quantification limit of the method were 1.1 mg/kg and 1.8 mg/kg respectively. The method had a wide linear working range of 1.25–100 mg/kg with correlation coefficient greater than 0.999 over six calibration levels. The method developed in the present study is in compliance with international validation guideline requirements, and is accurate and reproducible enabling simple, rapid and underivatized analysis of Glyphosate residues in tea.

Keywords: Glyphosate, Tea, Method validation, LC-MS/MS

Development and Validation of a Method for Analysis of Carbosulfan Residues in Tea (*Camellia sinensis*) Using LC-MS/MS Technique

K. Abarna[1]*, G.V.V. Liyanaarachchi[2], Y. Samanthy[1], R.A.D.S.M.R. Weerasekara[2], D.A.U. Chathurangani[3], P.I.D. Weeraman[3] and M.N.A Mubarak[2]

[1]Department of Export Agriculture, Faculty of Animal Science and Export Agriculture, Uva Wellassa University, Badulla 90000, Sri Lanka
[2]Residue Analysis Laboratory (RAL), Industrial Technology Institute, Colombo 00007, Sri Lanka
[3]Institute of Chemistry Ceylon, Rajagiriya 10107, Sri Lanka
*94abar@gmail.com

The presence of pesticide residues above the maximum residue levels in tea, which results from field application of pesticides without following precautionary measures, is one of the major issues faced in the tea sector. However, with increased health *consciousness*, it has become a need of the day to assure that tea is free of pesticide residues. Therefore, introducing appropriate methods to determine pesticide residues in tea is of timely importance. This study highlights a method developed and validated for the determination of Carbosulfan in tea. Carbosulfan is a systemic pesticide that belongs to the carbamate group, which affects the nervous system of the pest. The carbosulfan residues in tea were extracted following the QuEChERS approach using acidified acetonitrile, which was buffered using sodium acetate. The clean-up of the extract was carried out using a combination of primary secondary amine, graphitized carbon black and C18 dispersive clean-up materials. The detection of carbosulfan was carried out using liquid chromatography-tandem mass spectrometry with electron spray ionization and multiple reaction monitoring. The chromatographic separation was achieved using a C 18, Synergy 4u fusion column. Methanol and water acidified with formic acid (0.1%) were used as mobile phases. The method was validated considering accuracy, precision and recovery at three different concentration levels: low, mid and high. The linear working range of the method was 0.005–0.250 mg/kg with a correlation coefficient of 0.999 over six calibration levels. Recoveries were in range of 70-120% and percentage relative standard deviation was below 6% over the three concentration levels (0.040, 0.100 and 0.200 mg/kg). The limit of detection and limit of quantification were 0.004 mg/kg and 0.005 mg/kg respectively. The method developed in the present study is accurate and reproducible and, it complies with the international validation guideline requirements allowing determination of carbosulfan residues in tea.

Keywords: Carbosulfan, Tea, QuEChERS, Method validation, LC-MS/MS

Ceylon Cinnamon Value Chain Profiling

I.C. Hettiarachchi*, D.A.M. De Silva and M. Esham

*Department of Agribusiness Management, Faculty of Agricultural Sciences,
Sabaragamuwa University of Sri Lanka, Belihuloya 70140, Sri Lanka
isuru.susl@gmail.com

This paper presents a framework for value chain profiling developed for the Ceylon cinnamon industry of Sri Lanka. The value chain profiling framework is the first step towards developing a value chain description scheme for the Ceylon cinnamon industry. Four leading cinnamon producing districts (Galle, Matara, Kalutara, and Ratnapura) were considered for the study. Filed observations, in-depth interviews, and focus group discussions were the principal data sources. Both qualitative and quantitative techniques were instrumental in data analysis and the responses of 351 growers, 85 collectors, and 58 exporters were considered in developing the value chain profiles. The framework captured a characteristic profile of a value chain covering a wide range of operational aspects. The framework separated the value chain into seven categories, where the content and purposes were explained. Though these categories could have been considered individually, recognition of their reciprocity was vital for in-depth analysis of collected data. The Average Monthly Trading Volumes of the producers, mobile collectors, lead collectors, and exporters were 47, 3850, 14482, and 30414 kilograms respectively. Ninety-five percent of the farm gate production revealed concentration at the exporter node as lead collectors, mobile collectors, and producers exchanging 69, 39, and 22 percent of their total output directly with the exporters. 'Higher prices, faster payments, fewer risks', 'higher prices, faster payments, repeat sales', and 'repeat sales, mutual trust, large volumes' were the factor combinations influencing the growers, collectors, and exporters in decision making. The domestic facet of the value-added and ultra-value-added product exporters constituted with own retail establishments (21%) and outlets at one-stop luxury stores (14%). The volume traded between the exporters and their domestic client base was less than 10 percent of the total input volume. Entrepreneurial skills, risk taking, profit and market orientation, networking, and decision making varied and each value chain profile had its own unique features.

Keywords: Profiling, Value chain, Normative frameworks, Value chain analysis

A Ready-Meal Functional Soup Mix Supplemented with Potential Antidiabetic Herbs

M.A. Wickramasinghe[1]*, P.G.I. Dias[1], N.G.D. Anuradha[2], T.C. Kananke[1],
M.G.A.N. Perera[2], R.M.K.T. Rathnayaka[2], R.S. Sabaragamuwa[1],
M.N. Wickramarathne[3] and R.M.U.S.K. Rathnayaka[1]

[1]*Department of Food Science and Technology*
[2]*Department of Physical Sciences and Technology*
Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka,
Belihuloya 70140, Sri Lanka
[3]*Department of Biochemistry, Faculty of Medicine,*
Sabaragamuwa University of Sri Lanka, Ratnapura 70000, Sri Lanka
*93malmi2449@gmail.com

The commercial demand for functional foods is increasing with shifting consumer perspectives towards the consumption of healthy meal alternatives. However, there seems to be a vacuum in the Sri Lankan food market for convenient healthy meal alternatives, especially for individuals with diabetes or with the potential risk of developing diabetes. This study was carried out to develop a nutritious and healthy instant soup mix with grain, vegetables and spice base, additionally incorporating selected functional herbs; *Osbeckia octandra* (leaves), *Cassia auriculata* (flowers) and *Passiflora foetida* (leaves), screened for their α-amylase inhibition activities and the total phenolic contents (TPC). The product formulation was carried out by changing the proportions of ingredients and their particle sizes to obtain optimum organoleptic properties. The shelf life of the ambient stored product in aluminum package was evaluated by the microbial quality and consistent sensory properties throughout a storage period of six months. α-amylase inhibition activities (IC50) and the TPC of *O. octandra*, *C. auriculata*, *P. foetida* and the plant mix (1:1:1) were 1.78±0.07, 2.01±0.38, 1.70±0.01 and 2.05±0.31 mg/mL and 2.16±0.19, 1.97±0.13, 2.04±0.03, and 2.68±0.03 GAE mg/g DW, respectively. The rank-sum test identified that the most preferred formulation was the one with all three herbs incorporated. There was no any significant ($p > 0.05$) difference in preference for different particle sizes of dried herbs. The proximate composition of final soup mix was, 77.3±0.5% carbohydrates, 17.8±0.2% protein, 3.5±0.0% fat, 11.1±0.1% crude fiber, 1.4±0.4% ash and 8.4±0.3% moisture. The microbial analysis confirmed the acceptable levels of total plate counts, while the sensory evaluation showed that there was no significant ($p > 0.05$) variation in organoleptic properties of the soup mix in aluminum packaging, during the six months' storage period at ambient conditions. The present study successfully conceptualized and developed a functional soup mix as an alternative healthy choice of a meal for the commercial market.

Keywords: Soup mix, Functional, Herbs, Alpha-amylase activity, Diabetes

Effect of Acmella Pod Extracts on Controlling Microbes Present on Dairy Processing Surfaces

T.G.G. Uthpala* and S.B. Navaratne

Department of Food Science and Technology, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda 10250, Sri Lanka
*gimhani@sci.sjp.ac.lk

Identification of microorganisms in dairy processing surfaces (DPS) is important in controlling safety of the finished products. Hence, this study was conducted to identify and control bacteria on stainless-steel (SS) DPS using Acmella (*Acmella oleracea* L.) flower pod water extract. Three SS (ALSI 304) food processing surfaces were contacted with fresh pasteurized milk for 2 hours, and then the surfaces were rinsed with fresh water. Two of the surfaces were sanitized with Acmella extract and a commercial sanitizer (positive control) separately while keeping the remaining one untreated as the negative control. Swab samples were collected using $100cm^2$ template after 2, 4, 8, 12, 24 and 48-hour time periods, and the total plate counts were obtained using the plate count agar media. All the test surfaces were kept undisturbed at ambient condition (28-30°C RT, 75-80% RH) for 48 hrs. Further, the samples taken from the inoculated surfaces after two hours were subjected to Gram staining and VITEK 2 analyzer for microbial identification. The results revealed that there were 2.31, 1.39 and 5.59 Log $CFU/100cm^2$ of bacterial counts in the Acmella treated, positive control and negative control surfaces, respectively after 12 hours, where the initial population was 3.35 Log $CFU/100cm^2$. The reduction of microbial growth in Acmella treated surface was not significantly different ($p>0.05$) to the reduction observed in positive control, but differed significantly from the negative control ($p<0.05$). Moreover, there was a significant difference ($p<0.05$) of 5.52 $LogCFU/100cm^2$ microbial density between Acmella sprayed and the negative control surfaces at 48-hour. Further, there were six gram-positive and one gram-negative isolates identified on SS of DPS namely *Pseudomonas fluorescens, Staphylococcus warneri, Staphylococcus pasteuri, Staphylococcus haemolyticus, Bacillus circulans, Microbacterium lacticum* and *Paenibacillus odorifer.* Hence, Acmella pod extract can be used as an effective alternative for commercial sanitizers in suppressing the growth of microorganisms on DPSs.

Keywords: Dairy processing surfaces, Pasteurized milk, Acmella extracts, Stainless steel surfaces, Surface sanitiser

Development of Fiber-Enriched Bun from Wheat Flour Fortified with Kohila (*Lasia Spinosa*) Flour

E.G.K.M. Karunarathna* and W.D.S.S. Pemasinghe

Department of Food Science and Technology, Faculty of Livestock, Fisheries and Nutrition, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP) 60170, Sri Lanka
*kmadhuk2016@gmail.com

Wheat flour buns are generally rich in carbohydrates, energy and low in dietary fiber. Due to affordability, easy access, and convenience in consumption, buns have become a ready-to-go type food source in the community. The regular consumption of carbohydrate rich wheat flour buns can result in health issues such as obesity, constipation, and other non-communicable diseases. This study was conducted to develop a fiber-enriched wheat flour bun by adding kohila (*Lasia spinosa*) flour to wheat flour. Kohila was specifically selected due to its high dietary fiber content. Buns were prepared by blending 5, 7.5, 10, and 12.5% (by mass) kohila flour with wheat flour. A 100% wheat flour bun was used as a control. After mixing all the ingredients (wheat flour, kohila flour, egg, yeast, salt, margarine and water) the fermented dough in the molds was baked in a hot air oven at 200 ± 5 $^\circ$C for 15 min until golden-brown colour appeared on the surface of buns. At 0.05 significance level, the highest acceptability (5.93 ± 1.143) by sensory evaluation was achieved by the 7.5% kohila flour substituted buns on a hedonic scale (7 points, 1: dislike very much, 7: like very much). The proximate composition of 7.5% kohila flour added bun revealed higher amounts of moisture (48.63 ± 0.68), dietary fiber (3.49 ± 0.88), ash (1.16 ± 0.05), lower amounts of proteins, (13.78 ± 0.29) carbohydrates (26.24 ± 1.25) and significantly lower calorie value (217.65 ± 1.80) compared to the control sample. There was no significant difference in crude fat content between the 7.5% kohila flour sample (6.39 ± 0.3) and the control (6.27 ± 0.95). The lightness value of 7.5% kohila flour containing bun (57.12 ± 0.64) was significantly lower than the control sample (67 ± 3.64). In conclusion, 7.5% kohila flour substituted wheat flour is a potential enrichment for the dietary fiber content in buns providing health benefits for regular bun consumers.

Keywords: Bakery products, Consumers, Crude fiber, Non-communicable diseases

Effect of Tea and Coffee Polyphenols on Syneresis and Quality of Set Yoghurt during Refrigerated Storage

S.P.J.C. Karunathilaka* and O.D.A.N. Perera

Department of Food Science and Technology, Faculty of Livestock, Fisheries, and Nutrition, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP) 60170, Sri Lanka
*jathyachathu@gmail.com

Syneresis is the most pronounced textural defect in yoghurt. Polyphenols can bind with milk proteins to form a network in dairy matrices, minimizing the syneresis. The study evaluated the concentration effect of polyphenols derived from green tea (GT), black tea (BT), and coffee (CF) on syneresis, physicochemical, and quality attributes of yoghurt during refrigerated storage (4°C). Green tea yoghurt (GTY), black tea yoghurt (BTY), and coffee yoghurt (CFY) with four different polyphenol concentrations (10, 20, 30, and 60 mg (GAE)/100 ml) were prepared by adding different volumes of the infusions. All yoghurts, including the plain yoghurt [Control (CY)], were prepared without stabilizers. Chemical characteristics (pH, titratable acidity) and physical characteristics (degree of spontaneous syneresis, water holding capacity, and colour) were evaluated for the storage period of 21 days. The yoghurt samples with the highest sensory acceptance were examined to determine the Total Phenolic Content, Antioxidant Capacity, and microbial analysis (Total Plate Count and Yeast and mould count). All treated yoghurt samples showed a significantly ($p<0.05$) lower level of spontaneous syneresis than the control samples. With increasing concentration, the ability to reduce syneresis was increased except in CFY. Treated yoghurts showed a significantly higher viscosity indicating the possible polyphenol-milk protein matrix formation. GTY and CY had no significant difference ($p>0.05$) in colour, while BTY and CFY showed a significant ($p<0.05$) colour difference when increasing the polyphenol concentration. GTY-10, BTY-10, and CFY-20 achieved the highest overall acceptability from the sensory analysis where GTY-10 represents green tea yoghurt with 10 mg (GAE)/100 ml added polyphenol, etc. In conclusion, adding natural polyphenols can reduce syneresis in set yoghurt while stabilizing colour and maintaining its chemical properties within the acceptable range. The degree of syneresis reduction is determined by polyphenol type and concentration.

Keywords: Yoghurt, Syneresis, Polyphenols, Black tea, Coffee, Green tea

An Improved Method to Produce Cholesterol Reduced Dairy Cream and Skimmed Milk Directly from Pasteurized Non-Homogenised Milk with Single Step Centrifugation

P.A.N.K. Jayakody[1], B.E.P. Mendis[1]* and M. Gunawardana[2]

[1]Department of Food Science and Technology, Faculty of Agriculture, University of Peradeniya, Peradeniya 20400, Sri Lanka
[2]Sri Lanka Institute of Nano Technology (SLINTEC), Homagama 10206, Sri Lanka
*ereshamendis@agri.pdn.ac.lk

There is a strong positive correlation between serum cholesterol level and coronary heart diseases. Due to the effect of dietary cholesterol on serum cholesterol levels, the removal of cholesterol from milk and other dairy products is a process that has attracted great interest. The use of β-cyclodextrin has been reported as an effective method to remove cholesterol from milk and other dairy products, though studies have not been conducted to assess the effect of cholesterol removal process on the other milk constituents. The purpose of this study was to assess the effectiveness of the cholesterol removal process under different conditions (cyclodextrin percentage, mixing time, centrifugal force) and to assess the effect of this process on the availability of lactose, solid non-fat, fat, protein and salt in milk. Different β-cyclodextrin percentages (0.5, 1.0, 1.5, 2.0, and 2.5) were added to milk, stirred and the mixture was then centrifuged. The upper layer and the middle layer were analysed separately. Pasteurized non-homogenized milk provided the highest cholesterol reduction with 2% β-cyclodextrin which was mixed for 5 min and centrifuged at 2000 rpm for 10 minutes. It provided 67.3% and 70.7% cholesterol reduction in the upper layer and the middle layer respectively. Fat, solid non-fat, lactose, salt and protein percentages of milk were significantly ($p<0.05$) affected during the cholesterol removal process. The ultimate effect was different depending on the milk constituent and the conditions of the cholesterol removal process. Fat percentage of resulted upper and middle layer was 0.22% and 11.77% respectively, which can be called cholesterol-reduced skimmed milk and dairy cream respectively according to the United States Department of Agriculture regulations. Hence, this method can be recommended as an improved method to produce cholesterol-reduced dairy cream and skimmed milk directly from pasteurized non-homogenised milk treated with β-cyclodextrin with single-step centrifugation where-in tested regular methods, milk should undergo centrifugation twice to achieve that.

Keywords: β-cyclodextrin, Complex formation with cholesterol, Main milk constituents, Dairy cream, Skimmed milk

Impact of Molasses and Foxtail Millet Incorporation on Physicochemical, Organoleptic and Biological Properties of Traditional Cereal Bread

J. Jeyakirishanth and M.C.N. Jayasooriya*

Department of Food Science and Technology, Faculty of Applied Sciences,
Sabaragamuwa University of Sri Lanka, Belihuloya 70140, Sri Lanka
*niroshanmcn@gmail.com

Molasses is a viscous product originated from the refining of sugarcane, which has a high content of total sugar. Common bread is made from wheat flour with different extraction rates. This study is aimed at investigating the impact of molasses (M) and foxtail millet (FM) incorporation on the physicochemical, biological and organoleptic properties of traditional cereal bread. The standard bread preparation was done with four combinations namely MB (10% M), FMB (10% FM), MFMB (M and FM, 5% each) and WB (100% wheat flour) and baked at 180 ^{0}C for 35 minutes. As the control commercial bread (CB) was used. The analysis of variance (ANOVA) was done with MINITAB-18 and Friedman rank test was performed to identify significant differences ($p < 0.05$) among treatments. The highest overall acceptability was for CB followed by MB and MFMB. The whiteness increased in the order MFMB (40.60±1.47), MB (42.62±1.05), FMB (58.87±1.66), WB (61.64±2.45) and CB (63.30±4.07), whereas the hardness increased in the order CB (262.6±63.4 g), WB (371.8±115.9 g), MB (428.0±174.0 g) MFMB (557.9±199.1 g) and FMB (673.1±119.3 g). The adhesiveness of the bread was 0.0240±0.028, 0.0740±0.074, 0.1680±0.168. 0.2000±0.200, and 0.5600±0.335 mJ for WB, FMB, MFMB, MB and CB, respectively. The FMB and MFMB recorded significantly high crude protein percentage as 15.56±0.74% and 15.05±0.74%, and the total plate count and yeast and mould count were below the detection limit until four days. The molasses and foxtail millet incorporation has improved the organoleptic and physicochemical properties of traditional cereal bread.

Keywords: Bread, Molasses, Foxtail millet, Sensory-evaluation

Utilization of Embul Banana (*Musa* spp.) Variety for Preparation of Flour as a Food Ingredient

P.N.T. De Zoysa[1], H.P.S. Senarath[1]* and R.M.N.A. Wijewardhana[2]

[1]Department of Food Science and Technology, Faculty of Livestock, Fisheries, and Nutrition, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP) 60170, Sri Lanka
[2]National Institute of Post-Harvest Management, Anuradhapura 50350, Sri Lanka
*samanthi123@hotmail.com

Embul banana (*Musa* spp.*)* is the most cultivated banana variety in Sri Lanka and the post-harvest loss is nearly 40% per annum. Therefore, this study was conducted to develop flour using embul banana while optimizing the keeping quality. Banana flour is a gluten-free alternative to wheat in bakery products. Preliminary studies were done to identify the optimum maturity level of banana for flour production. Embul banana flour was prepared using unripe mature banana with a mixture of citric acid and sodium metabisulphite (SMS) to optimize the keeping quality of banana flour. The recovery percentage of flour was determined according to peel and flesh weight. The antimicrobial property of flour was tested using the total plate count and yeast and mold count. The proximate composition flour formulations were tested. The results revealed that the recovery percentages of flour with peel and flesh were 15.20% and 21.68%, respectively. Yeast and mold growth was significantly ($p<0.05$) controlled by adding SMS (0.2%). The selected formulation of flour contained, carbohydrates (82.21%), crude fiber (5.77%), crude protein (2.50%), crude fat (0.74%), moisture (6.60%), and ash (2.21%). The color change of banana flour during storage was minimized using anti-browning agents. Water activity and moisture content of flour were slightly changed (0.45–0.59 and 4.67–7.23%, respectively) during the storage period. The particle size of flour (106–150 μm), pH (5.3–5.4), water holding capacity (167–170%) and oil holding capacity (72–75%) were measured in the selected banana flour. Mature unripe embul banana can be utilized in flour production as a gluten-free alternative and a potential ingredient in the food industry.

Keywords: Anti-microbial property, Embul banana flour, Gluten free, Keeping quality

Status of Whole Grain Cereal Consumption: An Online Survey

M.S.N. Sahabandu[1]*, N.R. Abeynayake[2] and G.A.P. Chandrasekara[1]

[1]*Department of Applied Nutrition, Faculty of Livestock, Fisheries and Nutrition*
[2]*Department of Agribusiness Management, Faculty of Agriculture and Plantation Management*
Wayamba University of Sri Lanka, Makandura, Gonawila NWP 60170, Sri Lanka
*michellesahabandu@gmail.com

Encouraging healthy diets among the general public is necessary to mitigate the increasing prevalence rates of diet-related diseases in Sri Lanka. Whole grain cereals (WGC) are pivotal components of healthy diets and have proven effects against a range of non-communicablediseases (NCDs). An online survey was conducted to determine the levels of knowledge, attitudes and behavior (KAB) on WGC consumption and barriers towards adequate intake. It further evaluated the associations between socio-demographic factors and KAB levels on WGC consumption among Sri Lankans. The data were collected from female adults living in Sri Lanka assuming they were responsible for food behavior of the household. An online questionnaire was developed, pretested and used to collect data by posting on social media such as Facebook and WhatsApp. In total 416 responses were used for analysis after cleaning, using SPSS, AMOS and descriptive statistics. The construct validity of the questionnaire was examined using Factor Analysis and the resulted model of the questionnaire exhibited appropriate model fit in AMOS (cmin/df= 2.069, RMSEA= 0.051, GFI: 0.855, CFI= 0.813). The majority of the population had an average knowledge score (66%), high attitude score (75%) and a low behavior score (33%). The lack of knowledge on specific health benefits provided by WGC, the inability to distinguish between whole grains and refined cereals, unacceptable organoleptic properties, longer preparation time duration, low market availability and high cost were identified as the major barriers in WGC consumption. Significant correlations ($p<0.05$) were obtained between education level and knowledge on WGC. Family income significantly correlated with knowledge and attitudes on WGC while the location of residence significantly correlated with behavior on WGC. Thus, addressing the issues through pricing strategies, providing education on specific health benefits and identification of WGC, and improving market availability of WGC products is required to uplift WGC consumption among Sri Lankans.

Keywords: Attitudes, Behaviour, Female adults, Knowledge, Sri Lanka

Proximate Nutritional Composition of Ceylon Cinnamon (*Cinnamomum zeylanicum* Blume) Leaves in Different Agro-Ecological Regions in Sri Lanka

R.K.C. Jeewanthi*, D.A.M. De Silva, K.B.S.S.J. Ekanayaka,
N.S.A. Senarathne and W.M.T.B. Weddagala

*Department of Agribusiness Management, Faculty of Agricultural Sciences,
Sabaragamuwa University of Sri Lanka, Belihuloya 70140, Sri Lanka
chatu03@gmail.com

Cinnamon is one of the oldest renowned spices that belong to the genus of *Cinnamomum* of the Laurel family (*Lauraceae*). Ceylon cinnamon (*Cinnamomum zeylanicum* Blume) is designated globally as the true cinnamon due to its distinct characteristics among the other substitutive cinnamon; especially differentiate from cassia, the Cassia cinnamon. The taste and aromatic characteristics of cinnamon drastically vary with the origin and their nativity. Although substantial number of studies were done on identifying the health benefits of the Ceylon cinnamon bark, there is a wider hiatus in studies on the nutritional and physiological characteristics of its leaves. Therefore, the present study attempted to fill this knowledge gap and suggest an approach to utilize Ceylon cinnamon leaves in an economical way by identifying the proximate nutrition composition, which are different according to the ecological regions in Sri Lanka. Cinnamon leaf samples at two maturity levels namely, semi-matured and matured, were collected from five different agro-ecological regions based on the distribution of cinnamon cultivation in Sri Lanka. The crude fat content, protein, ash content, and mineral composition of the leaf samples were analyzed. The results showed that, at an average, the leaf samples contained of 12.5 % moisture, 7.63 % crude protein, 2.28 % crude fat, and 15.36 % of ash. The crude protein and ash contents showed a marginally higher values in the matured leaf samples compared to those of the semi-matured leaves ($P>0.05$). However, the fat content in mature leaves showed significantly higher value ($P<0.05$) compare to the semi-matured leaves. Therefore, semi-matured cinnamon leaves could be used to develop food-grade products for human consumption.

Keywords: Ceylon cinnamon, Cinnamon leaves, Cinnamon consumption, Nutritional composition

Evaluation of Antibiotic Resistance in Soil Amended with Cow Manure

A.D.D.M. Siriwardhana[1], R. Salih[2], S.P. Abeysundara[3] and W.R.P. Wijesinghe[1]*

[1]Department of Botany
[2]Department of Molecular Biology and Biotechnology
[3]Department of Statistics and Computer Science
Faculty of Science, University of Peradeniya, Peradeniya 20400, Sri Lanka
*Priyangaw@pdn.ac.lk

Livestock manure is a potential reservoir for antibiotic-resistant (AR) bacteria. Recently, cattle manure from farms harbored AR genes (β-lactam antibiotics) despite the use of antibiotics. These AR genes can be transferred to pathogenic bacteria in soil via horizontal gene transfer and impose adverse effects on agriculture and human health. Therefore, this study was set up to explore whether soil amended with cow dung containing AR bacteria could induce AR bacteria in soil. Accordingly, untreated soil (pH 8.5, 78% moisture, brunette, friable) encompassing *Centella asiatica* in each tray was treated with cow dung with amoxicillin-resistant bacteria (ARB) and cow dung without ARB (2 kg/m^2) separately and with NPK fertilizer (0.075 kg/m^2). Soil without any fertilizer amendment was the control. These cow dung samples were previously screened for ARB using 96 well plate based assay. The experiment was conducted in a greenhouse to ensure all treatments were carried out under similar temperature and relative humidity. Soil samples from trays were screened every two weeks up to 16 weeks according to previously published work. To detect the presence of ARB, 96 well plate-based high-throughput assay and three susceptibility testing strains *Escherichia coli* (ATCC 25922), *Pseudomonas aeruginosa* (ATCC 25619) and *Staphylococcs aureus* (ATCC 25923) were used as controls followed by pour plate to determine the CFUs. Eighth week after treatments, the soil treated with cow dung containing ARB showed an increase in ARB relative to the control (p<0.001), while, the amount of ARB in soil samples treated with cow dung without ARB did not show a significant increase (p=0.630). Consequently, it can be argued that the proliferation of ARB is due to cow dung with ARB at least under the afore used soil conditions. Further, large-scale experiments are warranted before relating the afore mentioned findings to agriculture in Sri Lanka.

Keywords: Amoxicillin resistant bacteria, Antibiotic resistance, Cow dung, High-throughput-assay, Agriculture

Replacement of Palm Oil with Refined Coconut Oil in Bakery Products – Biscuit Manufacturing

K.G.K.B. Chandrasiri[1]*, C. Yalegama[2], D.T.H. Patirana[2] and M.C.N. Jayasooriya[1]

*[1]Department of Food Science and Technology, Faculty of Applied Sciences,
Sabaragamuwa University of Sri Lanka, Belihuloya 70140, Sri Lanka
[2]Coconut Processing Research Division, Coconut Research Institute,
Lunuwila 61150, Sri Lanka
cyalegama@yahoo.co.in

Palm-oil (PO) is a primary ingredient for confectionery industry in Sri Lanka. At present, government of Sri Lanka has banned the cultivation and importation of oil palm to encourage the utilization of coconut oil (CO). Thus, this research was conducted to evaluate the replacement of PO with CO for making soft dough biscuit (MARI). The dough preparation was done with five oil combination, namely OB1 (100% CO), OB2 (75% CO), OB3 (50% CO), OB4 (25% CO) and OB5 (100% PO). Physio-chemical properties of oil blends and oil in biscuits after baking process were compared using standard methods. The MARI was further evaluated to its physic-chemical, and biological properties by using commercial MARI as a reference sample. Significantly low level of peroxide, Iodine, free fatty acid, conjugated diens and triens, moisture content, refractive index, relative density and melting point were observed in OB1 as 0.80 ± 0.80 meqO$_2$/kg, $2.90\pm0.14\%$, $0.03\pm0.01\%$, $0.02\pm0.03\%$, 0.0005%, $0.03\pm0.008\%$, 1.4480, 0.917g/ml and 24.42 ± 0.63 ^{0}C respectively and values were increased by palm oil substitution and OB5 contained higher values as 4.60 ± 0.20 meqO$_2$/kg, $9.38\pm0.21\%$, $0.14\pm0.06\%$, $0.1328\pm0.05\%$, 0.0033%, $0.037\pm0.01\%$, 1.4580, 0.9091g/ml and 27.42 ± 0.38 ^{0}C respectively. Moreover, these values were increased by baking process and high level of peroxide, free fatty acid, conjugated diens and triens were observed in pure palm oil added biscuit sample as 6.74 ± 0.33 meqO$_2$/kg, $1.70\pm0.48\%$, $39.45\pm0.30\%$ and $0.27\pm0.02\%$ and low in pure coconut oil added sample as 4.69 ± 0.61 meqO$_2$/kg, $0.78\pm0.05\%$, $28.40\pm0.08\%$ and $0.18\pm0.005\%$, respectively. Adhesiveness, fracturability, hardness, thickness, spread ratio and diameter of OB1 did not show significant difference ($p>0.05$) compared to the commercial MARI and OB5. OB1 was the preferred sample by semi-trained sensory panel and no objectionable characteristics of OB1 were observed due to coconut oil. Therefore, refined bleached and deodorized coconut oil can be used for production of soft dough biscuit MARI instead of palm oil.

Keywords: Coconut oil, Oil blenders, MARI, Palm oil, Physio-chemical properties

Knowledge, Attitudes and Practices among Food Handlers on Food Safety during Orthodox Black Tea Manufacturing in Uva Medium Region of Sri Lanka

K.P.M. Kahandage[1,2]*, I. Wickramasinghe[1], S.B. Navarathne[1] and W.A.J.P. Wijesinghe[2]

[1]*Faculty of Graduate Studies, University of Sri Jayawardenapura,*
Nugegoda 10250, Sri Lanka
[2]*Department of Export Agriculture, Uva Wellassa University,*
Badulla 90000, Sri Lanka
*avprathi8@gmail.com

Sri Lanka is a leading country for the production and export of the world's finest quality orthodox black teas. This exclusively branded Ceylon Tea represents the symbol of quality of black teas in the global market. In the meantime, unsafe food contaminated with harmful substances has driven a growing public health concern across the world. Therefore, as stakeholders, food handlers must play a vital role in assuring the safety and quality of foods throughout the value chain including tea. However, some limited and considerably low number of available studies have exhibited that food handlers are poor in handling food and acclimatizing to food safety practices. Therefore, this study was conducted to assess knowledge, attitudes and practices (KAP) of food safety among 90 food handlers in orthodox black tea manufacturing factories in the Uva Medium region (elevation between 600–1200 m *m.s.l.*) of Sri Lanka, using a questionnaire-based survey with simple random sampling technique. The findings of this study exhibited that food handlers possess a good total mean score values and mean of scores value for knowledge (16.05±2.76, 0.94), practices (86.66±9.78, 4.56) and attitudes (68.25±9.95, 4.26) concerning food safety practices such as wearing hair caps, masks, hand washing etc. However, a significant positive correlation existed only between the attitude and the practices of food safety among food handlers (0.338, $_p < 0.05$). The knowledge and practices on food safety did not show any significant correlation. Therefore, the study revealed that food safety practices of food handlers at Orthodox black tea manufacturing factories in the Uva Medium region has a linear positive relationship with their attitudes, but not with their knowledge. Hence, this study suggests improving attitudes of food handlers through education and training for enhancing food safety culture.

Keywords: Orthodox black teas, Food safety, Attitude, Knowledge, Practice

Development of *Manihot esculenta crantz* (Cassava) Starch-Based Biodegradable Food Packaging Material with Eggshell and Cellulose Fillers

U.L. Karunadhipathi and S.M.C. Himali*

Department of Animal Science, Faculty of Agriculture, University of Peradeniya, Peradeniya 20400, Sri Lanka
**smchimali@agri.pdn.ac.lk*

In recent years, biodegradable materials have attracted increasing concern due to their wide applications in food packaging. These eco-friendly polymers replace the usage of petroleum-based synthetic polymers due to their safety, inexpensiveness, and biodegradability. The main objective of this study was development of biodegradable food packaging material. At the initial stage, the best starch source was selected from Cassava root, Green taro, Eggfruit, and Jackfruit seeds. Then in the second stage, the best eggshell powder incorporation level was selected with the selected starch source in the first stage. Two types of bioplastics were developed with selected starch source and selected eggshell incorporation level with two cellulose fillers namely paper pulp (PP) and ground paddy husks (PH). Mechanical properties of water absorption and biodegradability of bioplastics were determined to select the best cellulose filler among PP and PH. According to the results obtained from the preliminary study among 4 different starch sources, Cassava starch was selected as the best starch source. Results from the second study revealed that 12% of eggshell powder incorporation was the best. According to the results obtained from the third study, thickness and tensile strength values of 2 types of bioplastics were not significantly different(P>0.05). But, PP based bioplastic showed significantly higher (P<0.05) Young's modulus value (76.833 MPa) than the PH based bioplastic (42.886MPa). The biodegradability of 2 types of bioplastics was not significantly different (P>0.05) (ASTM D6003-96 used as the standard method to measure biodegradability). However, both bioplastics totally biodegraded within 9 weeks. Then PH based bioplastic had a significantly high (P<0.05) water absorption (32.83%) than PP based bioplastic (11.47%). These results indicated that PP based bioplastic (12% Cassavastarch,12% Eggshell, 5% PP, 63% water, 3.5% Acetic acid, 4.5% Glycerol) is better than PH based bioplastic for the development of biodegradable food packaging material.

Keywords: Biodegradability, Bioplastics, Paddy husks, Young's modulus

Functional, Textural and Sensory Properties of Formulated Garlic (*Allium sativum*) Cookie

S.M. Sujath* and J.W.A. Sajiwanie

Department of Food Science and Technology, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya 70140, Sri Lanka
amanda@appsc.sab.ac.lk

Consumer preference has increased for natural food additives incorporated snacks. There is a high potential to develop cookies free from synthetic preservatives or fortified with natural preservatives. Garlic is commonly used as a natural flavoring agent and preservative due to the availability of allicin. The study has focused; to formulate garlic powder incorporated cookies, evaluate the functional, textural, and sensory properties, and select the appropriate packaging for the cookie storage. Garlic powder was prepared by grinding after oven drying. Cookies were prepared by incorporating garlic powder into wheat flour at 5, 10, and 12% (w/w) levels. The best formulation, 10% garlic powder incorporated cookie ($p<0.05$) was selected by the sensory evaluation. Cookies of the best formulation and control were analyzed for the proximate composition, total phenolic content (TPC) antioxidant activity, and textural and sensory attributes. Moreover, the effect of different packaging materials on the shelf life of the developed cookie was determined. The highest TPC (77.45 ± 0.30 mg GAE/100 mg) antioxidant activity (IC50=398.11ppm) and lower hardness (1157.10 g) resulted in the cookie with 10% garlic power incorporated. The addition of garlic powder had no significant effect ($p>0.05$) on the proximate composition of cookies, but they showed lower pH (5.82), higher moisture (2.62%) and higher L*(60.09), a*(9.69), b*(34.46) values. Shelf-life studies were carried out after packaging in paper cans, aluminum packets, and transparent LDPE packets, and stored under ambient conditions for six weeks. There was a significant effect ($p<0.05$) of selected packaging material on the moisture content (%), pH, and microbial evaluation (10^2 CFU/g) of packaged cookies, analyzed every week from the day of manufacture. All the packaged cookies had a strong positive correlation in moisture content (0.882- 0.994), pH (0.974- 0.965), total plate count (0.881- 0.934), and yeast and mold count (0.900- 0.934) with storage period, and indicated paper cans and aluminum packets are suitable for six weeks' storage of these cookies.

Keywords: Antioxidant, Correlation, Flavor, Garlic powder, Packaging material

Genetic Variability on Arsenic Accumulation and Its Impact on Yield in Rice (*Oryza Sativa* L.) under Elevated Arsenic in Soils

K.S. Manawasinghe[1,3]*, R. Chandrajith[2] and S. Seneweera[4]

[1]*Postgraduate Institute of Science* [2]*Department of Geology*
Faculty of Science, University of Peradeniya, Peradeniya 20400, Sri Lanka
[3]*Horticultural Crops Research and Development Institute,*
Gannoruwa, Peradeniya 20400, Sri Lanka
[4]*Institute of Fundamental Studies, Hantana Road, Kandy 20000, Sri Lanka*
*ksmanawasingha@gmail.com

Arsenic (As) is a human chronic carcinogenic, that occurs in soil due to natural weathering of rocks and anthropogenic activities. As (V) is taken up into rice plants through phosphate transporters owing to their chemical analogy, while As (III) uptake and translocation into grains are through the silicon transport pathway due to their similarity in molecular size. A glasshouse experiment using genetically diverse rice cultivars was carried out to investigate the accumulation of As on grains and the effect on the rice yield. In this experiment, different rice varieties were grown on natural rice soils and the same soil that spiked with As (10 mg/kg). Sodium arsenate ($Na_2HAsO_4.7H_2O$) was used for As spiking. Total As content in unpolished grains were quantified by inductively coupled plasma mass spectrometer (ICP-MS). In rice grains obtained from control pots, the As content varied from 10.6 to 44.2 µg/kg compared to the rice grown on As treated soils in which As content varied from 99.1 to 271 µg/kg. The arsenic content in rice ranked in the order of *Kalu heenati* > Bg 300 > *Beheth heenati* > *Madathawalu* > Bg 357 > *Pachchaperumal* > *Suwadel* > At 362 > *Pokkali* > *Kahawanu* that were grown on As-spiked soils, indicating the influence of genetic diversity on the accumulation. The As level in soil and varieties and also their interaction had a significant impact ($p < 0.01$) on the As accumulation in grains. The highest yield was reported in *Pokkali* under both controls and As treated soils, while *Suwadel* showed the lowest grain yield under the elevated As level followed by *Kahawanu*. The lowest yield loss was observed in *Beheth heenati* among others under As stress and followed by *Kahawanu*, *Madathawalu* and P*okkali*. The finding of this study suggested that the native cultivar, *Pokkali* is a better candidate that maintaining a lower grain As level with a higher yield under As stress in soil hence can be used to develop future rice cultivars to grown on As-contaminated soils.

Keywords: Arsenic accumulation, Genetic diversity, Rice, Yield penalties

Development of a Vegetarian Analogue of Chicken Drumstick and Determination of Its Physico-Chemical Properties and Shelf Life

M.A.N.S. Mallawaarachchi[1], R.P.A.D. Rajapakse[2] and R.P.N.P. Rajapakse[1]*

[1]Department of Food Science and Technology Faculty of Agriculture, University of Peradeniya, Peradeniya 20400, Sri Lanka
[2]HJS Condiments Limited, Export Processing Zone, Biyagama 11650, Sri Lanka
*n_rajapakse@yahoo.com

This study was aimed to develop a vegetarian analogue of chicken drumstick having authentic fibrous and tender meat texture, using locally available and potentially underutilized raw materials. Tender jackfruit (*Artoarpus heterophyllus*), *kohila (Lasia spinosa)* rhizome and chickpea flour were used as the main ingredients. Soy and wheat-based ingredients were not used since their potential allergenicity to some consumers. Four formulationswere prepared changing above main ingredients ratio,along with Sri Lankan spices to match with authentic meaty flavor. The best formulation was selected following physico-chemical tests (pH, color, water activity, shrinkage, batter pickup, oil usage, and cooking loss) compared with real chicken drumstick as control. Sensory ranking tests were performed to study the consumer preference for texture, flavor and overall acceptability of the formulations. Physico-chemical tests results revealed that all formulations were not significantly different ($P>0.05$) for before frying pH, after frying lightness (L*) and yellowness (b*) and batter pickup compared to the control. The formulation (jackfruit: *kohila*: chickpea 20:4:15) was selected depend on physico-chemical and sensory test results to prepare the final product. Real-time shelf-life determination revealed that the product was self-stable (without added preservatives) under frozen condition showing no significant impact ($p>0.05$) on a packaging system (normal sealed package and vacuum sealed package), in terms of microbial quality, color, cooking loss and pH for 15-day study period. Based on thecalculated Q_{10} value (2.06) of accelerated shelf life study, the product was self-stable for 56 days under frozen condition without added preservatives, in terms of microbial quality. Moisture, crude protein, crude fat, crude fiber and ash contents of the final product were $66.79 \pm 0.03\%$, $7.31 \pm 0.10\%$ $5.79 \pm 0.07\%$, $4.88 \pm 0.07\%$ and $2.63 \pm 0.08\%$, respectively. Further research is needed to improve the protein content similar to real chicken drumsticks.

Keywords: Chicken drumstick, Meat analogue, Physico-chemical properties, Storage stability, Composition

                                               Food, Nutrition and Livestock

Genetic Relationships of Selected Traditional and Newly Improved Sri Lankan Rice Germplasm

W.G.A.S. Sumanarathne and D.V. Jayatilake*

*Department of Agricultural Biology, Faculty of Agriculture,
University of Peradeniya, Peradeniya 20400, Sri Lanka
djayatilake@agri.pdn.ac.lk

Rice (*Oryza sativa* L.) germplasm of Sri Lanka consists of many traditional accessions (TAs) and newly improved varieties (NIVs). However, the genetic relationships between these rice accessions/varieties are not fully understood. In the current study, the genetic relationships of a panel of 64 Sri Lankan rice accessions/varieties (representing 24 TAs and 40 NIVs) were deduced using a Bayesian approach and a hierarchical cluster analysis, with 12 unlinked molecular markers representing all rice chromosomes. The Bayesian genetic assignment analysis was conducted in Structure v2.3.4. adopting an admixture model and the optimum most probable number of ancestral clusters (K) were derived based on the log-likelihood values in Structure Harvester v0.6.93. (K = 2; group-1 and group-2). Of the two genetically distinct groups recovered ($\geq$ 95% assignment probability), group 1 corresponded to 90% of the NIVs and group 2 to 79% of the TAs in the study panel. The remaining NIVs (10%) and TAs (21%) shared alleles indicating possible historical genetic admixture. The resulted two genetically isolated gene pools are indicative that the contribution of TAs in the development of NIVs has been at a minimum. Based on the hierarchical cluster analysis adopting Ward's method as the algorithm with squared Euclidian distance as the interval, two clusters (cluster 1 and cluster 2) were defined at the fifth rescaled distance cluster combine. The NIVs formed cluster-1, with the exception of Bg 357, At 311 and Bg 94-1, which were clustered with TAs in the cluster-2. Of the TAs, only *Kalu baala wee* clustered with NIVs in the cluster-1. The study clearly reflects a genetic separation in the gene pools of TAs and NIVs, warranting the need to further characterize the Sri Lankan TAs for the better use of their desirable gene alleles in future rice breeding programs.

Keywords: Bayesian genetic assignment, Genetic admixture, Hierarchical cluster analysis, *Oryza sativa*

Influence of Germination on Compositional Changes of Carbohydrate and Physicochemical Properties of Flours from Proso Millet (*Panicummiliaceum*) and Foxtail Millet (*Setariaitalica*) Available in Sri Lanka

N.N.G. Chiranthika[1*], K.D.P.P. Gunathilake[1] and A. Chandrasekara[2]

[1]Department of Food Science and Technology [2]Department of Applied Nutrition
Faculty of Livestock, Fisheries and Nutrition, Wayamba University of Sri Lanka,
Makandura, Gonawila (NWP) 60170, Sri Lanka
*chiranthika.gnn@gmail.com / nngchiranthika@wyb.ac.lk

Germination is an inexpensive and effective technique that can increase the nutritional quality and change the physicochemical properties of the cereal flour. The aim of this study was to evaluate the changes in carbohydrate composition and physicochemical properties upon germination of proso millet and foxtail millet which are being underutilized in Sri Lanka. The millet grains were germinated and standard analytical methods were followed to determine their total starch, amylose and amylopectin, dietary fiber, water holding capacity (WHC), oil holding capacity (OHC), swelling power and water solubility. Related to the results, due to germination, starch, amylose and amylopectin contents were significantly ($p<0.05$) decreased in both millet flours and dietary fiber content was significantly ($p<0.05$) increased as 8.70 to 19.01% in proso millet and 14.18 to 32.93% in foxtail millet.WHC significantly ($p<0.05$) increased due to germination in both species and it ranged from 2.77 to 3.88 g/g and 3.25 to 5.87 g/g in proso millet and foxtail millet, respectively. A similar significant ($p<0.05$) increase in OHC was also observed in germinated flours. Swelling power and water solubility which reflect the hydration capacity of flours were significantly decreased in studied two millet flour samples after germination. These findings encourage the application of germination in developing nutritionally rich proso millet and foxtail millet flours with altered physicochemical parameters to incorporate in functional food formulations.

Keywords: Germination, Millet, *Panicum miliaceum*, Physicochemical properties, *Setaria italica*

Evaluating Genetic Variations on Brown Plant Hopper (*Nilaparvata lugens* (Stål)) Resistance Gene *Os06g0125132* of Rice for Molecular Marker Development

R.M.S.D.L. Abeyrathne[1], H.M.N.N. Herath[1], E.Y. Fernando[2],
N.H.L.D.L.D. Nanayakkara[1] and D.V. Jayatilake[1]*

*[1]Department of Agricultural Biology, Faculty of Agriculture,
University of Peradeniya, Peradeniya 20400, Sri Lanka
[2]Department of Biological Sciences, Faculty of Applied Sciences,
Rajarata University of Sri Lanka, Mihinthale 50300, Sri Lanka
djayatilake@agri.pdn.ac.lk

Brown plant hopper (BPH) is the most devastating insect pest of rice (*Oryza sativa* L.). Hence, cultivation of rice varieties carrying genetic resistance to BPH is the most promising approach for mitigating its damage. BPH resistance is controlled by many genes. The expression of *Os06g0125132* was found to be significantly upregulated under BPH infection and hence, a KASP marker for marker-assisted selection (MAS) was developed targeting a SNP in the intron region. Non-synonymous sequence variations in the exons that could alter the protein structure and/or its domains could be potential target sites for the development of alternative molecular markers compatible with technology-limited setups. In the current study, to identify such genetic variations, a haplotype analysis was conducted using the coding sequence of *Os06g0125132* (177bp), retrieved from 2,804 accessions sequenced in the 3K Rice Genomes Project. The extracted sequences were aligned using UGENE and four SNPs with ≥5% occurrence frequency in the rice panel were identified (three SNPs at exon 1 and one SNP at exon 2) and three confirmed haplotypes (with ≥1% occurrence frequency) were defined using DnaSP. Given all three haplotype-defining SNPs were non-synonymous, the respective putative amino acid sequences were modeled using the *ab-initio* algorithm *TrRefineRosetta* in Robetta. The modeled output suggested that all three putative proteins would fold into alpha helical structures (confidence of ≥0.8) and with no detectable 3-D structural difference. InterPro scan of the amino acid sequences detected a TMhelix, Transmembrane, Cytoplasmic and Non cytoplasmic domain each for all three putative proteins, indicating that the three identified non-synonymous SNPs had no impact on the domains. However, given the significance of *Os06g0125132* for BPH resistance, and its potential involvement in carbohydrate metabolism *via* the tricarboxylic acid cycle, further investigation is warranted to identify alternative sites for marker development targeting users in technology limited setups.

Keywords: Resistance to brown plant hopper, *Os06g0125132,* Haplotyping, Protein domains, Protein modeling

Assessing Agronomic Nitrogen Use Efficiency of Potato Cultivated in Nuwara Eliya Using Controlled, Released and Stabilized Nitrogen Fertilizers

A.J.R.T. Dilan[1]*, P.D. Abhayathilakarathne[2] and S.P. Nissanka[1]

[1]Faculty of Agriculture, University of Peradeniya, Peradeniya 20400, Sri Lanka
[2]Agricultural Research Station, Sitha-Eliya 22200, Sri Lanka
*dilanrathanayake2@gmail.com

Groundwater pollution due to excessive use of agrochemicals especially chemical fertilizers is a major concern in the upcountry region. Potato cultivation is a key contributor to this problem in Nuwara-Eliya and Badulla districts. A pot experiment was conducted at Agricultural Research Station, Sitha-Eliya, Sri Lanka, to examine the effect of different nitrogen fertilizer sources, rates, and the use of stabilized urea on growth, tuber yield, and the agronomic Nitrogen Use Efficiency (NUE) of potato. The experiment was arranged in a completely randomized design with five replicates consisting seven treatments; T1: no nitrogen fertilizer (control), T2: Department of Agriculture recommendation (150 kg N/ha), T3: farmer practice in the region (220 kg N/ha), T4: farmer practice +10% (weight basis) nitrogen stabilizer (Dicyandiamide [DCD], and N-(n-butyl) thiophosphoric triamide [NBPT]), T5: 75% farmer practice + 10% (weight basis) nitrogen stabilizer, T6: Yara fertilizer (116 kg N/ha), T7: Yara fertilizer + 10% (weight basis) nitrogen stabilizer. Leachate and plant growth parameters were measured weekly. The results showed significant differences for plant height, tuber number, and tuber yield in T6 and T7 compared to T2 ($p<0.05$). The highest yield was recorded in Yara fertilizer + 10% nitrogen stabilizer (T7), which was 26.2 t/ha and 35.75% higher yield than the T2. T6 and T7 showed significant differences in Agronomic N use efficiency (AE_N) compared to T2 ($p<0.05$). T7 reported the highest AE_N and it was 132.46 kg tuber yield per kg of N applied compared to the control. Results showed that the application of a higher dose of N in the basal dressing increased N leaching and acidification of leachate, which exceeded WHO standards for NO_3^- N concentration in the leachate. Application of nitrogen stabilizers to inorganic fertilizers can reduce leaching of NO_3^-, while increasing yield potential of potato, AE_N, and providing significant environmental and economic benefits.

Keywords: Agronomic efficiency of nitrogen, DCD, NBPT, Potato, Urea

Impact of Different Controlled, Released and Stabilized Urea-Based N Fertilizers on Productivity and Nitrogen Use Efficiency of Maize (*Zea mays* L)

S.M.P. Senevirathne[1]*, M. Gunawardena[2] and S.P. Nissanka[1]

[1]Department of Crop Science, Faculty of Agriculture, University of Peradeniya, Peradeniya 20400, Sri Lanka
[2]SLINTEC, Nanotechnology and Science Park, Pitipana, Homagama 10200, Sri Lanka
*prabaath92@gmail.com

Nitrogen use efficiency (NUE) of irrigated maize ranges from 25-50% due to the heavy losses of applied nitrogen (N). These losses raise significant threats to the environment as well as to the human health. Hence, mitigation of these losses and enhancing the NUE of maize is vitally important. Use of controlled released fertilizers (CRF) and urea stabilizers are commonly adopted methods to enhance the NUE. A field experiment was conducted at the Dodangolla Field Experimental Station (soil type – Reddish Brown Earth [RBE]), Sri Lanka to evaluate the performance of 2 CRFs types with respect to the agronomic efficiency of N (AE_N) in irrigated maize (variety – Pacific 984). A total of 10 fertilizer treatment combinations were used in the study. They were, two CRFs (single polymer coated and double polymer coated), used with and without DCD (Dicyandiamide) and NBPT ([N-(n-butyl) thiophosphorictriamide]), under 2 rates of urea (100% [325 kg/ha] and 50% [162.5 kg/ha] of Department of Agriculture [DOA] recommendation, and a no nitrogen applied control. DCD and NBPT rates were 10% and 1% of urea nitrogen amount (weight basis), respectively. Experimental design was randomized complete block design (RCBD) with three replicates per treatment. Plant height, leaf area, leaf chlorophyll level and yield components were measured. Results showed a 31.5% increase in AE_N of coated, 50% N + stabilizer treatments compared to 100% N treatments. Yields of the 50% N treatments were 20.3% lower compared to 100% N treatments ($P \leq 0.05$). There was no significant difference among the 2 CRF types regarding the yield and AEN. In conclusion, compared to uncoated urea, the use of CRFs in combination with urea stabilizers could improve the NUE of maize. The findings show a promising way of reducing urea application for Sri Lankan maize cultivations resulted by less N losses.

Keywords: Agronomic efficiency of nitrogen, Controlled released fertilizer, DCD, NBPT, Urea stabilizers

Food, Nutrition and Livestock

Phenotypic Evaluation of a Core Rice Panel for Sheath Blight Resistance

K.I.S. Thamali[1], N.H.L.D.L.D. Nanayakkara[1], L.D.B Suriyagoda[2],
W.D.P. Weerasinghe[3] and D.V. Jayatilake[1]*

*[1]Department of Agricultural Biology [2]Department of Crop Science
Faculty of Agriculture, University of Peradeniya, Peradeniya 20400, Sri Lanka
[3]Regional Rice Research and Development Centre, Bombuwala 12024, Sri Lanka
djayatilake@agri.pdn.ac.lk

Sheath blight (SB) caused by *Rhizoctonia solani* Kühn is a major rice (*Oryza sativa* L.) disease, second only to rice blast. Host plant resistance is the most economical and environmentally-friendly approach for SB disease mitigation. However, there is limited knowledge on resistance donors for the use in rice breeding programs. Hence, the current study is the first to report the screening of 60 rice accessions including traditional and newly improved Sri Lankan rice germplasm and exotic lines for SB resistance. The study was conducted in a replicated field trial, during the *yala* season of 2019. At early booting stage, rice plants were artificially inoculated by placing cultured *R. solani* mycelia at leaf bases and three weeks after inoculation, disease progression was scored following the IRRI standard evaluation system (SES; 0 to 9 scale) derived based on percentage vertical spread of the lesion (VSL) along the plant. The Friedman test carried out using SES scores revealed three significantly different groups ($p \leq 0.05$). Rice accessions *Kaluheenati*, Bw267-3 and *Kalundai samba* were identified as resistant to SB (SES scale 0 to 1) and were reported as similar to each other ($p > 0.05$). Of these, *Kaluheenati* could be identified as a resistant accession reporting a median SES (mSES) score of 0, indicating no VSL upon inoculation. Further, 23 rice accessions were identified as susceptible to SB (SES scale 7 to 9) and were similar to each other ($p > 0.05$). Of these, the ten accessions (*Gonabaru*, *Pachchaperumal*, *Dikwee*, *Halsuduwee*, *Moraberakan*, *Wannidahanala*, *Yakadawee*, Bg250, Bg251 and Ld99-12-38) reported a mSES score of 9 with a VLS of 65-100%. The remaining 34 accessions expressed intermediate SB disease responses (SES scale 3 to 5) and were similar to each other ($p > 0.05$). We recommend the use of *Kaluheenati*, Bw267-3 and *Kalundai samba* as SB resistance donors for QTL mapping and future rice breeding programs.

Keywords: Sheath blight, *Rhizoctonia solani,* Sri Lankan rice accessions, Resistance donors, Rice breeding

Effect of Scheduled Irrigation and Fertilizer Application on Growth and Fruit Quality of Mandarin (*Citrus reticulate* Balanco) Variety Ehime

U.D.D. Namamuni[1]*, K.P. Somachadra[2] and P.K. Dissanayake[1]

[1]Department of Export Agriculture, Faculty of Agricultural Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya 70140, Sri Lanka
[2]Regional Agricultural Research and Development Centre, Bandarawela 90100, Sri Lanka
*upalinamamuni@gmail.com

Mandarin (*Citrus reticulate.* Blanco) production in Sri Lanka is very low while the fruit quality is highly variable. As a solution, the Department of Agriculture introduced an improvedmandarin variety "Ehime", which is highly responsive to water and nutrients and having a high production capacity. The objective of this study was to evaluate efficiency of different fertilizer mixtures under proper moisture conditions of soil on plant growth and fruit quality of Ehimemandarin variety under Sri Lankan field conditions.Two Irrigation levels; Rain-fed as control (Ir_1), Scheduled irrigation (50L water in five days interval) (Ir_2), were tested with four fertilizer treatments; Department of agriculture (DOA) recommendation (F_1), DOA+Micro nutrients (F_2), DOA+Organic manure (F_3), DOA+Micronutrients+Organic manure (F_4),in a Split Plot design using 4 replicates. Leaf chlorophyll content (SPAD readings), width and height of plant canopy, fruit quality (fruit length, breath, hardness, peel to flesh ratio, brix value, juice content and acidity) were measured. Drastic reduction of leaf yellowing was found in F_4 and F_2 in both irrigation levelsafter two weeks of treatment, and yellowing was completely disappeared after two months with increasing leaf chlorophyll content. Significant increments of plant height and canopy width wereobserved, irrespective of the irrigation level in F_4. Heavier fruits were found in F_4 and F_2 irrespective of the irrigation. Hardest fruits were found in $F_4$with Ir_2. Except F_1, all other treatments showed an equal juice content irrespective of irrigation. High brix values were recorded in F_2 and F_4 with Ir_2. Peel to flesh ratio was highest in F_2 and F_4 with Ir_2. Proper plant growth and heavier fruits could be achieved when DOA fertilizer recommendation was amended with micro nutrients while supplementary irrigation with micro nutrients and organic manure amendment further improved the fruit quality.

Keywords: Irrigation systems, Lower production, Mandarin, Micro nutrients, Poor quality

Comparison of Physicochemical Properties of Twelve Iced Teas in Sri Lanka

D. Wettimuny[1,2]* and I. Wickramasinghe[1]

[1]*Department of Food Science and Technology, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda 10250, Sri Lanka*
[2]*Department of Biosystems Technology, Faculty of Technology, University of Sri Jayewardenepura, Homagama 10206, Sri Lanka*
*deviniwettimuny@sjp.ac.lk

Tea is the second most consumed beverage in the world and there are many variations of tea that are manufactured around the world. Iced tea is one such beverage and the industry has grown tremendously over the past few years. But the data available on the quality of the Sri Lankan iced tea products are scarce. Therefore, the aim of this study was to analyse the physicochemical properties of different iced teas available in the Sri Lankan market in order to assess their quality. Twelve different iced teas were tested; they were aqueous extracts of green (G) and black tea (B) iced concentrates, three peach flavoured teas (P_1, P_2, P_3), two strawberry flavoured teas (S_1, S_2), ginger (G_2), lemon (L) and apple (A) flavoured tea, unflavoured iced tea of black tea (B_1) and green tea (G_1). The physicochemical parameters polyphenol content (TPC), antioxidant activity (AA), titratable acidity (TA), total soluble solids (TSS) and turbidity were measured using standard protocols. The free radical scavenging ability was analysed using the DPPH assay and TPC was examined employing the Folin-Ciolcalteu method. TA was determined as per AOAC methods, and TSS was measured using ATAGO Hand Held Refractometer MASTER-53T. The turbidity was assessed by using Thermo Scientific Eutech TN-100 Waterproof Turbidimeter. The highest level of AA was recorded in G_2 and the lowest in B_1 as 32.5 μg/ml and 3.65 μg/ml, respectively. Whereas the greatest amount of TPC was noted in G_2 at 20.08 μg/ml and the least was found in B_1 at 1.45 μg/ml. The highest level of TA was found in B_1 at 2.56 g/l and lowest level of TA was noted in both P_1 and L at 1.28 g/l. The highest was reported in B_1 at 13.2 °Bx and lowest level of TSS was showed in G_2 at 6.4 °Bx. At 3.35 NTU, the least amount of turbidity was documented in L and the greatest in B_1 at 57.9 NTU. Out of the twelve types, ginger flavoured tea showed the best quality whereas the unflavoured iced tea of black tea demonstrated the poorest quality.

Keywords: Iced tea, Sri Lanka, Black tea, Green tea

Mining Resistance Alleles of Gene *Xa38* for Bacterial Blight Resistance in Sri Lankan Rice Accessions

I.K. Edirisingha[1], S.A.C.N. Perera[2] and D.V. Jayatilake[2]*

[1]Postgraduate Institute of Agriculture
[2]Department of Agricultural Biology
Faculty of Agriculture, University of Peradeniya, Peradeniya 20400, Sri Lanka
*djayatilake@agri.pdn.ac.lk

Bacterial Blight (BB) caused by *Xanthomonas oryzae* pv. *oryzae* is one of the devastating rice diseases in Sri Lanka. Currently, 42 genes have been identified as important for conveying BB resistance, out of which *Xa38* (*Os04g53030*) is considered as a gene with major importance. For marker-assisted selection of *Xa38* resistance allele, a co-dominant linked-marker (*Os04g53050-1*) designed based on an adjacent gene (*Os04g53050*), co-segregating with *Os04g53030* is recommended. Among Sri Lankan germplasm, the *Xa38* resistance allele carrying rice accessions have not been identified to-date. In the current study, a panel of 48 rice accessions was genotyped using the marker *Os04g53050-1* and 12 traditional Sri Lankan rice accessions (*Batapola el*, *Dik wee*, *Halsuduwee*, *Herath banda*, *Sudu goda wee*, *Kuru wee*, *Suwadel*, *Katteyaran*, *Mada el*, *Pachchaperumal*, *Gonabaru* and *Mahakuru wee*) and 21 newly improved Sri Lankan varieties were identified as resistance allele carriers for *Xa38*. These accessions can be used as *Xa38*-mediated resistance donors in future rice breeding programs. Further, the present study focused on the development of an intragenic marker for the *Xa38* gene as an alternative to the currently used linked-marker. Haplotypes were defined to identify a potential site for designing an intragenic molecular marker. Haplotyping was carried out using the coding sequence of *Os04g53030* from 2,395 rice accessions sequenced in the 3K Rice Genomes Project. Based on the multiple sequence alignment, haplotype-defining polymorphisms with ≥5% occurrence in the panel of accessions (64 single nucleotide polymorphisms and 13 insertion/deletion sites) were identified and was used to define 20 confirmed haplotypes (H1 to H20; ≥1% occurrence frequency in the panel of accessions). Further investigation is underway to develop an intragenic molecular marker based on the identified polymorphic target sites.

Keywords: *Xa38*-mediated bacterial blight resistance, *Os04g53030,* Intragenic marker, Haplotyping, Marker-assisted selection

Properties of Instant Beverage Developed by Unfermented Coconut Sap Collected through a Novel Sap Collection Method

H.P.D.T.H. Pathirana[1]*, W.M.K. Lakdushighe[1], C.N. Hitigedera[2],
L.L.W.C. Yalegama[1] and L.M.I. Senarathna[1]

[1]*Coconut Processing Research Division, Coconut Research Institute,
Lunuwila, 61150, Sri Lanka*
[2]*Food Research Unit, Department of Agriculture,
Gannoruwa, Peradeniya 20400, Sri Lanka*
*dilthihewa@gmail.com

Coconut (*Cocos nucifera*) sap is a nutritive liquid which oozes from the phloem vessels of coconut inflorescence. A novel sap collection (NSC) method provides a seal and cooler environment to retard the fermentation process of coconut sap. The aim of this research is the development of instant beverage from unfermented coconut sap collected using a novel sap collection device and evaluation of physicho-chemical, nutritional, and sensory properties of the developed product. The sap was mixed with maltodextrin (DE-10) (Treatment 1: 3%, Treatment 2: 4%, Treatment 3: 5% and Treatment 4: 6%) and solution was fed to a spray dryer (L-8 NO 7084). The powder of sap was packed in a triple laminated aluminum pouch and stored at 4 ± 2 ^{o}C. The physico-chemical, nutritional and sensory analysis (five-point hedonic scale) of dehydrated sap powder was analyzed. The data was analyzed through Minitab 16 software. The recovery percentage of powder was 17.05 ± 2.45 % and it showed good quality parameters for moisture (0.80 ± 0.20 %), bulk density (0.51 ± 0.00 g/ml), tapped density (0.68 ± 0.00 g/ml), hygroscopicity (19.05 ± 0.34 %), solubility (96.72 ± 0.87 %), 13.53 ± 0.00 of the browning index, 1.54 ± 0.05 of hue angle and 86.75 ± 2.17 of lightness. Scanning electron microscopic (SEM) view showed an even distribution of particles. Dilution ratio (D1:8 %, D2: 10 %, D3: 12 %) of powder was analyzed through sensory evaluation. Appearance and odor of beverage were not affected significantly ($p>0.05$) with the level of dilution. The analysis showed that it contained protein (1.44 ± 0.11%), ash (0.99 ± 0.01%), minerals (Na: 1.54 ± 0.13 mg/100g, K: 36.94 ± 0.87 mg/100g, Ca: 4.68 ± 0.89 mg/ 100g, Mg: 0.77 ± 0.52 mg/100g), crude fiber (0.08 ± 0.01 %), total sugar (90.67 ± 2.66 %), maltodextrin (24.40 ± 2.55 %), sucrose (31.47 ± 2.77%), glucose (16.04 ± 0.23%), fructose (18.76 ± 1.25%) and total phenol (138.69 ± 0.17 mg GAE/ 100 g). One cup (100 mL) of sap contains higher content of sugar natural minerals and it is one of the alternatives for the instant beverage market to achieve a higher consumer demand.

Keywords: Instant powder, Novel sap collection, Unfermented coconut sap

Nutritional and Functional Properties of Defatted Desiccated Coconut Flour of Different Coconut Varieties

H.P.D.T.H. Pathirana[1]*, W.M.K. Lakdushighe[1], L.L.W.C. Yalegama[1],
C.A.T.D. Chandrapeli[1], K.P. Waidyarathne[2] and J.M.N. Marikkar[3]

[1]*Coconut Processing Research Division* [2]*Plant Physiology Research Division Coconut Research Institute, Lunuwila 61150, Sri Lanka*
[3]*National Institute of Fundamental Studies, Hanthana Road, Kandy 20000, Sri Lanka*
*dilthihewa@gmail.com

Defatted desiccated coconut flour (DCF) is a by-product of dry processing of virgin coconut oil (VCO). Processing of VCO is limited to commercially available coconut varieties but the varietal effect is not considered. Therefore, aim of this research was to evaluate the nutritional and functional properties of DCF extracted from four types of coconut varieties, namely Tall×Tall (TT), Gon Thambili (GT), Ran Thambili (RT) and San Ramon (SR). Whole wheat flour (WWF) was used as the control. Fifty fully matured coconuts from each variety were collected from Bandirippuwa Estate of Coconut Research Institute, Lunuwila, Sri Lanka to produce VCO and by-product of residue was collected and converted into flour. The functional and nutritional properties of each flour were evaluated using standard methods. Experiment was arranged as a complete randomized design (CRD) with three replicates and each parameter was analyzed using one-way ANOVA. Analysis confirmed that there was no significant ($p>0.05$) varietal effect for the amount recovery of DCF ($15.33 \pm 0.41\%$). About 23.16% of DCF has less than 250 μm size particles and very low moisture contents ranging from 2 - 4% without showing significant difference between varieties. The variety GT showed significantly higher swelling capacity (49.00 ± 0.00 ml) and wettability (27.46 ± 0.00 s) while showing significantly lower bulk density (0.48 ± 0.00 g/ml) and tapped density (0.56 ± 0.00 g/ml). GT and TT varietal flour has lower hygroscopicity (11.65%) while retaining lower fat ($13.74 \pm1.84\%$) content in GT flour. Significantly high protein (22.07 ± 0.63 %) and ash ($6.81\pm0.67\%$) could be observed in both SR and TT. Four types of DCF can be used as a fiber supplement (between $16.72\pm0.94\%$ to $18.70\pm0.17\%$) whereas WWF is rich in carbohydrate ($69.84\pm0.30\%$). GT flour has higher functional properties while SR and TT showed higher protein and fiber. Therefore, DCF can be used as a nutritive and functional supplement.

Keywords: Defatted desiccated coconut flour, Functional, Proximate, Variety

Teaching and Learning Approaches in
Current Secondary School Food Literacy Curricula

S. Dimalini[1], T. Perera[1]*, J. Nanayakkara[2] and K.D.R.R. Silva[1]

[1]Department of Applied Nutrition, Faculty of Livestock, Fisheries & Nutrition, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP) 60170, Sri Lanka
[2]School of Exercise and Nutrition Sciences, Deakin University, Victoria, Australia
*thushiperera@wyb.ac.lk

Food literacy is a new and emerging concept that helps understand the impact of food choices on individual well-being. The purpose of this qualitative study was to explore the importance of food literacy education, teaching and learning approaches used in the classroom, and the challenges and barriers faced by teachers in teaching the food literacy curriculum in secondary schools. The teachers who teach the subjects Health and Physical Education, Agriculture and Food Technology, Home Economics, Practical and Technical Skills, and Science in the Northern Province were selected using the maximum variation sampling technique. A total of 96 teachers participated in 11 focus group discussions. The discussions were analyzed using the template analysis technique using the NVivo 12 qualitative data analysis software and six major themes related to teaching and learning approaches were identified. All teachers approved of the importance of food literacy. Most teachers indicated that they use textbooks, blackboard and school gardens as the main teaching tools. Practical sessions, group discussions, and field visits were identified as the main methods of teaching. Most teachers perceived textbooks and practical sessions as the most effective teaching tools and methods. Student assignments and school term examinations were considered as the major evaluation methods. Though the majority of teachers were generally positive and understood the importance of food literacy education, they face certain barriers and challenges such as lack of support from parents and school administration and shortages in resources including funds, tools, equipment, and teacher training in food and nutrition. Hence, more resources and training to facilitate the delivery of food literacy education is needed. The findings of this study help understand the strengths, drawbacks, and potential areas for improvements in secondary school food literacy education in Sri Lanka.

Keywords: Food literacy, Focus groups, Secondary school students, Teaching and learning approaches, Individual well-being

Association of Patterns of Food Intake and Physical Activity with Weight-for-Height Measures among Preschoolers in Galigamuwa Division

W.S.C. Chandrasiri[1]* and K.N. Marambe[2]

[1]*Department of Nursing, Faculty of Allied Health Sciences*
[2]*Depatment of Medical Education, Faculty of Medicine*
University of Peradeniya, Peradeniya 20400, Sri Lanka
*sumedhachandrasiri352@gmail.com

Childhood malnutrition is a major health problem in the developing countries in South Asia. This study attempted to determine the associations of patterns of food intake and physical activity with weight-for-height measurements among preschoolers in a rural area in Sri Lanka. This is a preschool-based cross-sectional study involving 250 preschoolers aged three to five years from Galigamuwa Divisional Secretariat area, Sri Lanka. Anthropometric data including height and weight were measured. Data on dietary pattern, duration of watching television and physical activity were obtained through a tailor made, validated, self-administered questionnaire filled by parent or guardian. Chi square test was performed to determine associations. The prevalence of overweight/obesity, moderate acute malnutrition and severe acute malnutrition was 3%, 15% and 8% respectively. Daily intake of breakfast was observed only in 59%. Most of the preschoolers consumed three meals a day (57%). The findings revealed that breakfast consumption (p=0.000), number of meals per day (p=0.000) were significantly associated with weight-for-height. Acute malnutrition showed a positive association with skipping breakfast and negative association with number of meals per day. Overall, 60% of the preschoolers reported to be engaged in outdoor playing activities >3 hour/day while 46% reported watching television >1 hour/day. However, all obese/overweight preschoolers reported to have spent >1 hour/day, watching television. The results revealed nearly 23% of the preschoolers were malnourished in the selected rural population. Skipping breakfast and reduced number of meals were predictors of acute malnutrition while time spent on watching television >1 hour/day and physical activity <3 hours/day were predictors of overweight/ obesity among preschoolers. It is emphasized that the parents and care givers be made aware of their role to prevent overweight/obesity and malnutrition by restricting unhealthy food intake patterns and encouraging physical activities. Further research using a large sample is required to confirm these findings.

Keywords: Food intake, Physical activity, Weight-for-height measures, Malnutrition, Obesity/overweight

A Health Risk Assessment and Evaluation of Sugar Levels in Soft Drinks

I.J.A. Ruhunuge[1]*, A.W. Wijeratne[2] and R.D.R. Ruhunuge[3]

[1]*Aquinas College of Higher Studies, Colombo 00800, Sri Lanka*
[2]*Department of Agribusiness Management, Faculty of Agricultural Sciences,*
Sabaragamuwa University of Sri Lanka, Belihuloya 70140, Sri Lanka
[3]*Food Technology Section, Industrial Technology Institute,*
Colombo 00700, Sri Lanka
*isuriruhunuge999@gmail.com

There is a rising tendency among early adults of consuming natural drinks over soft drinks. Because of some practical limitations, still they consume unhealthy instant drinks which contain excessive added sugar. Yet, the upper and lower exposure limit of added /sugar of soft drinks has not been scientifically assessed in comparison to the accepted limits of the American Heart Association (AHA). Therefore, this study was conducted with a social survey and laboratory analysis to evaluate sugar levels of soft drinks to ascertain health risks. Seven soft drink brands were selected at the local market and total and reducing sugar contents were evaluated by the Lane-Eynon method. The survey results showed that the exposure level for males was 0.8 to 7 g/day, whereas the same for females was 0.8 to 12 g/day. In this population about 11% of women and 4% of men are at the risk of lower exposure limit while 52% of women and 23% of men are at risk of upper exposure limit where the recommended maximum daily exposure to added sugar is 2.93 g/day for females and 4.23 g/day for males. This exposure level of the selected population ranged from 0.8 to 12 g/day. All samples considered in this study have the potential for enamel dissolution since their pH values considerably lower the critical level of 5.5. The outcomes of the study indicated that young adults must be watchful towards excessive added sugar from instant drink. Furthermore, as a suggestion, it must be required to promote natural drinks to ensure a healthy generation in the future.

Keywords: American Heart Association, Early adults, Health risk, Natural drinks, Soft drinks

Molecular Detection of Lumpy Skin Disease Virus in Sri Lanka-First Report

R.M.I.M. Rathnayake* and A.W. Kalupahana

Department of Veterinary Pathobiology, Faculty of Veterinary Medicine and Animal Science, University of Peradeniya, Peradeniya 20400, Sri Lanka
*iresha9696@gmail.com

Lumpy skin disease (LSD) is a notifiable disease caused by lumpy skin disease virus (LSDV) in the Genus *Capripoxvirus* of the Family *Poxviridae*. Although cattle are the main natural host, it is observed in water buffalo and Arabian oryx. LSDV is transmitted by hematophagous insects. Initially, LSDV causes fever with enlarged superficial lymph nodes. Within 7-9 days, characteristic multiple, circumscribed to coalescing, firm nodules appear mainly on the head, neck, udder, scrotum, vulva, and perineum. A necrotic plug ("sit-fast") develops by two weeks. Nodules may also develop in mucous membranes and internal organs. LSD cause reduced milk and meat production, temporary infertility, reduced hide quality and trade losses due to movement restrictions. The disease severely affects young animals and cows in peak lactation. LSD was endemic to Africa, that gradually spread to the Middle East and Eastern Europe, before spreading to Asia recently. LSD was exotic to Sri Lanka until early 2020. However, in October 2020, cattle manifesting clinical signs suggestive of LSD were reported from North and Eastern provinces of the country. More recently, animals showing similar signs were reported from Anuradhapura, Polonnaruwa, Puttalam, Kurunegala, Galle, Colombo and Rathnapura districts. Skin nodules were collected from affected cattle in Udahamulla veterinary range. Total DNA was extracted using Qiagen DNeasy blood and tissue kit according to manufacturer's protocol. A conventional PCR was performed on 5 samples to detect the coding region of viral attachment protein of LSDV using modified OIE recommended primers, LSDF 5'TCCGAGCTCTTTTCTTACTAT3' and LSDR 5'TATGGTACCTAAATTATATACGTAAATAAC3'. Based on the history, clinical signs, and the PCR results of 192 bp band, it was confirmed that the cattle were affected with LSDV. This study is the first report of local laboratory confirmation of the presence of LSDV within Sri Lanka. Further molecular characterization of the aetiological agent is ongoing.

Keywords: LSD, Molecular detection, PCR, Sit-fast, *Capripoxvirus*

Study on Physico-Chemical and Microbial Quality during Thermal Processing of King Coconut Water (*Cocos nucifera* var. aurantiaca) under Different Process Conditions in Sri Lanka

M.D. Jayasinghe[1]*, S.S.K. Madage[1], A.P. Halmillawewa[2] and D.M.W.D. Divisekera[1]

[1]Food Technology Section, Industrial Technology Institute, Malabe 10115, Sri Lanka
[2]Department of Microbiology, Faculty of Science, University of Kelaniya,
Kelaniya 11600, Sri Lanka
*maheshika@iti.lk

King Coconut Water (KCW) is thermally processed as "acidified foods" targeting an extended shelf life. This study investigated the physico-chemical and microbial quality along processing steps in selected KCW processing facilities in the aim of evaluating existing processing conditions. KCW samples (n= 90; triplicated trials) were collected from three factories: FI (semi-automated, 500 l/batch), FII (automated, 2000 l/batch), FIII (manual, 100 l/batch), where pasteurization (100 ^{o}C, 12.5 min), UHT sterilization (140 ^{o}C, 3s) and pasteurization (100 ^{o}C, 20 min) were practiced, respectively. Five critical processing steps (P_1; nut-water extraction, P_2; bulk-collection, P_3; standardization/acidification, P_4; pre-heating prior to hot-filling, P_5; pasteurization/sterilization) were identified as sampling points. Physico-chemical changes; colour (ΔE), pH, Total Soluble Solids (Brix) and total sugars (g/100 ml) were measured at P_1-P_5 in each premise. Microbial quality was evaluated as Aerobic Plate Counts (APC), Yeast and Moulds (Y&M), Coliforms and *Escherichia coli* according to ISO standards. All tested physico-chemical parameters at FI and FII were significantly different ($p < 0.05$) among P_1-P_5, while only pH and colour were significantly differed ($p < 0.05$) among P_1-P_5 in FIII. Significantly higher ($p < 0.05$) Y&M counts were detected at P_1 in FII due to nut-water extraction at an open-area. Coliforms and *E. coli* counts, exceeding permissible limits (0.0 MPN/ml) were detected in P_5 at FI, which may govern by prolonged handling-time during P_1-P_2. However, no APC counts were detected in P_5 at all premises. Quality deterioration in processed KCW at FIII was significantly lower ($p < 0.05$), led by immediate thermal processing with minimum handling-time. In conclusion, physico-chemical and microbial quality of KCW have been greatly influenced by the method of operation at each processing step. Therefore, current practices should be upgraded according to revealed knowledge on existing microbial loads and physico-chemical changes, while adhering to Good Manufacturing and Hygienic Practices.

Keywords: King coconut water, Physico-chemical changes, Microbial quality

Food, Nutrition and Livestock

Herbage Yield and Nutritional Potential of Three Fodder Grass in Low-Country Wet Zone Sri Lanka: A Preliminary Study

I.J.A. Ruhunuge[1]*, A.N. Weligamage[1], A.W. Wijeratne[2],
E.M. Wimalasiri[3] and K.P.J.C. Perera[4]

[1]*Faculty of Agriculture, Aquinas College of Higher Studies,
Colombo 00800, Sri Lanka*
[2]*Department of Agribusiness Management* [3]*Department of Export Agriculture
Faculty of Agricultural Sciences, Sabaragamuwa University of Sri Lanka,
Belihuloya 70140, Sri Lanka*
[4]*Department of Forestry and Environmental Science, Faculty of Applied Sciences,
Sri Jayawardhanepura University, Gangodawila 10280, Sri Lanka
isuriruhunuge999@gmail.com

Growing of improved fodders is needed to be popularized among farmers to strengthen the dairy sector in Sri Lanka. For smallholder farmers with limited production capacity, finding enough feed during the seasonal fodder deficit is always a problem. One of the solutions to mitigate the short supply during off-season is the conservation of surplus production as silage or hay. A field experiment was conducted to evaluate the growth, pasture yield and chemical composition of three fodder grasses and evaluate the silage quality. This study was conducted at AQUINAS farm from March to September, 2019 with three treatments consisted of sorghum (variety Sugar graze), maize (variety Pacific 984), and hybrid Napier (variety CO-3), with three replicates under randomized complete block design (RCBD). Growth parameters were evaluated and crops were harvested at the 10th week after planting to prepare wilted silage. The silages were prepared by adding 3% rice bran, 15% molasses and 2% urea (w/w) while physical and pH evaluation was performed. The highest fresh yield (50.6±1.17 t/ha) was in maize with a dry matter yield of 15.2±0.52 t/ha whereas the lowest fresh yield (32.8 ±1.5 t/ha) was in CO-3. The highest values for crude protein (13.4±0.56 %) and crude fiber (36 ± 0.04%) were observed in sorghum whereas, maize reported the lowest amount of crude protein (6.92±0.15%) while the lowest crude fiber content (31±0.17%) was in CO-3 at the time of harvesting. The highest ash content (15.8 ± 0.2%) was recorded in CO-3. The pH value of the silages of maize and sorghum were significantly lower ($p < 0.05$) compared to hybrid Napier. Maize and sorghum performed better than Napier in terms of growth, yield, and nutrient composition. The results revealed that the variety Pacific 984 and Sugar graze are potential feed resources to prepare silage to feed dairy cattle in smallholder farms.

Keywords: Hybrid Napier, Maize, Silage, Smallholder-farms, Sorghum

Development of a Water Treatment Filter Bag Using Bael (*Aegle marmelos* L.) and Coconut (*Cocos nucifera* L.) Shell Active Carbon for Removal of Hardness and *Escherichia coli* in Groundwater

G.H.Dilhani* and A.M.M.U. Adikari

Department of Food Science and Technology, Faculty of Livestock, Fisheries and Nutrition, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP) 60170, Sri Lanka
*hansanigangodawila@gmail.com

Consumption of hard water and *Escherichia coli* contaminated water cause severe health problems. This study focuses on introducing a portable and user-friendly filter bag to remove hardness and *E. coli* in drinking water using bael and coconut shells active carbon. Alkaline activated bael shell active carbon (BSAC) and coconut shell active carbon (CSAC) were characterized using Fourier-Transform Infrared Radiation (FTIR) spectroscopy and Scanning Electron Microscope (SEM) techniques. The effects of initial hardness, adsorbent dose, pH, temperature, and contact time were determined using batch experiments. The analysis was done by EDTA titrations using AOAC: 973.52B method. F1001 grade filter paper bags with 4.0 g of active carbon were applied to water samples collected from Gonawila. The effect of active carbon on *E. coli* count was analyzed using the most probable number (MPN) test method. Hydroxyl groups were observed in the FTIR analysis of active carbon. BSAC gave SEM images with high porosity. Removal efficiencies at pH 6.3 for BSAC and CSAC were 33% and 25%, respectively. The thermodynamic studies showed that the softening process in BSAC and CSAC is endothermic as removal efficiency increased from 32% and 19% at 303 K to 60% and 47% at 333 K, respectively. Removal efficiency enhanced when increasing contact time and adsorbent dose up to 15 hours and 1.00 g/mL, respectively. The maximum removal efficiency was reported with the initial hardness of 200 mg/L. BSAC showed significantly higher efficiency than CSAC in all optimizations except the pH. Field water samples reported an average hardness reduction of 39% and 36% by BSAC and CSAC, respectively. The microbial analysis resulted *E. coli* counts of 11 MPN/100 mL and <2 MPN/100 mL with 63% and >93% efficiencies for BSAC and CSAC, respectively. The results indicated that filter bags developed using BSAC perform better in water softening while CSAC removes *E. coli* more efficiently.

Keywords: Adsorption, Agricultural waste, Hardness, *Escherichia coli*

Food, Nutrition and Livestock

Effect of *In-Vitro* Digestion on Antioxidant and Anti-Inflammatory Properties of Three Species of Edible Flowers

G. Janarny[1]*, K.D.P.P. Gunathilake[2] and K.K.D.S. Ranaweera[1]

[1]Department of Food Science and Technology, Faculty of Applied Sciences, University of Sri Jayewardenepura, Gangodawila, Nugegoda 10250, Sri Lanka
[2]Department of Food Science and Technology, Faculty of Livestock, Fisheries and Nutrition, Wayamba University of Sri Lanka, Makandura, Gonawila 60170, Sri Lanka
*gjanarny3@gmail.com

Increasing risk of chronic diseases in the recent past is associated with the dietary patterns of individuals. Oxidative stress is the major cause for the development of these diseases, and inclusion of natural sources of antioxidants in the diet could reduce the risk of chronic diseases. Currently, edible flowers are regaining popularity as sources of antioxidants due to their phytochemical composition. However, there are not many studies reporting the changes in the phytochemical content and bioactivities of edible flowers subjected to *in vitro* digestion. The present study investigated the effect of *in vitro* digestion on the total phenolic content (TPC), total flavonoid content (TFC), total anthocyanin content (TAC), antioxidant and anti-inflammatory properties of *Sesbania grandiflora* (KM), *Clitorea ternatea* (NK) and *Cassia auriculata* (RW) flowers. Antioxidant property was assessed using hydrogen peroxide scavenging assay and nitric oxide radical scavenging assay. Anti-inflammatory property was evaluated using assays for inhibition of heat induced haemolysis and inhibition of egg albumin denaturation. The outcomes indicated that the highest TPC and TFC among the methanolic extracts were in RW whereas the highest TAC was in NK. After the gastric phase, in all the flowers TPC decreased significantly whereas TFC increased. Though methanolic extracts of KM expressed lowest percentage in inhibiting egg albumin denaturation (27.48%) there was no significant reduction in the activity after digestion and dialysis. Highest percentage of scavenging nitric oxide and hydrogen peroxide after dialysis was noted in RW. Ability to inhibit heat induced haemolysis decreased in all the phases of digestion in RW and NK whereas in KM it increased in the gastric and intestinal phases. In general, though digestion and dialysis decreased the antioxidant and anti-inflammatory properties of the flowers, digested fractions of RW flowers expressed higher antioxidant and anti-inflammatory properties compared to NK and KM flowers.

Keywords: Edible flowers, Antioxidant, Anti-inflammatory, *In vitro* digestion

Comparison of Nutritional and Some Biochemical Properties of Locally Grown Four Mushroom Species

M.A. Wickramasinghe[1], T.C. Kananke[1], S.M. Sewwandi[2] and R. Liyanage[2]*

[1]*Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya 70140, Sri Lanka*
[2]*National Institute of Fundamental Studies, Hanthana Road, Kandy 20000, Sri Lanka*
*ruvini.li@nifs.ac.lk

Although mushrooms are consumed preferably as a delicacy, little knowledge is existing on the nutritional and biochemical properties of locally grown four mushroom species; Button (*Agaricus bisporus*), Oyster (*Pleurotus ostreatus*), MK-white (*Calocybe sp.*), and Ganoderma (*Ganoderma lucidum*). Mushroom samples were collected from the Regional Agriculture Research and Development Center, Makandura. This study investigated the proximate composition, antioxidant activity (AA), total phenol content (TPC) and, total flavonoid content (TFC), and antidiabetic properties of mushrooms by previously described methods. Proximate composition was determined by Association of Official Agricultural Chemists (AOAC) method and AA was measured by 2,2-diphenyl-1-picrylhydrazyl (DPPH), Ferric Reducing Antioxidant Power Assay (FRAP), and 2,2′-Azinobis- (3-Ethylbenzothiazoline-6-Sulfonic Acid Assay (ABTS) methods. TPC and TFC were measured by Folic Ciocalteau and Aluminium chloride colorimetric method, respectively. Antidiabetic properties of mushroom were analysed against α-amylase and α-glucosidase enzyme inhibitory activities. Crude content of all four mushroom were taken for three different solvents (water, 65% ethanol and 80% ethanol) for biochemical assays. According to the results, proximate composition was in the following ranges of; moisture (73.78-92.66%), carbohydrate (1.13-23.75%), protein (0.69-5.36%), fat (0.21-1.15%), and ash (0.74-1.50%). The highest protein content was observed in Button mushrooms while the highest fat and carbohydrate contents were in Ganoderma. Water extract and 65% ethanolic extract of oyster mushroom had the highest TPC (3.95±0.05 mg GAE/g DW) and TFC (2.17±0.06 mg CE/g DW), respectively. Ethanolic extract of oyster and water extract of button mushroom showed the highest AA measured by FRAP (53177±634 µmol Fe^{2+}Eq/g DW) and ABTS (422.48±7.56 µmol TE/g DW), respectively. Ethanol extracts of Ganoderma showed highest AA (IC_{50} = 283.1±70.3 µg/ml) measured by DPPH, and highest α-amylase (IC_{50}=77.51±6.80 µg/ml) and α-glucosidase (IC_{50}=0.4113± 0.08 µg/ml) inhibitory activities. According to results button and oyster mushrooms are comparatively rich in both proteins and antioxidants and Ganoderma has a potential for antioxidative and antidiabetic therapeutic uses.

Keywords: Mushrooms, Proximate composition, Antioxidant, Antidiabetic

A Comparative Analysis on Presence of Pesticide Residues in Selected Vegetables Grown in Conventional Agricultural Fields and Good Agricultural Practices (GAP) Certified Fields

B.V.C.R. Batugedara[1], B.E.P. Mendis[1], P.W.Y. Lakshani[2]* and C. Magamage[2]

[1]Department of Food Science and Technology, Faculty of Agriculture, University of Peradeniya, Peradeniya 20400, Sri Lanka
[2]Horticultural Crops Research and Development Institute, Department of Agriculture, Gannoruwa 20400, Sri Lanka
*jayayoshil@yahoo.com

"Sri Lanka Good Agriculture Practices" was launched in 2016, aiming to supply safe production to consumers. The main objective of this study was to compare between GAP certified agricultural production, and conventionally farmed agricultural production, mainly the vegetables for the presence of pesticide residues for a selected number of pesticides. Simple random sampling was performed at ten selected sites belonging to Nuwara-Eliya and Puttalam districts in order to collect samples. Sample extraction was performed according to the Association of Analytical Communities Official Method 2007.01 and analysis was done using Liquid Chromatography-tandem Mass Spectrometry. At the initial stages of the study, a field survey was conducted and following results were obtained. The percentage of samples with any detection (34.09%), out of the total number of samples (44), was lower than the percentage of samples without any detection (65.09%). Out of 26 pesticides, 16 pesticides were absent in any of the samples tested. Moreover, there was no association (p>0.05) between, the type of farming system vs. presence of any pesticide residue and selected district vs. presence of any pesticide residue. Statistical tests performed, include a continuity correction of 0.5. However, presence of residues of Carbendazim was significantly different (p<0.05) between samples collected from GAP fields and conventionally farmed fields where the presence of Carbendazim residues in conventional farming system was higher than that of GAP certified fields. Mean concentration values obtained for Carbendazim were 8.39, 7.54, 7.57 in ppb for GAP certified vegetables while 8.70, 8.35 and 8.70 in ppb for conventionally farmed vegetables. Any of the observed levels of tested pesticide residues in production obtained from both farming systems did not exceed the Maximum Residue Levels (MRLs) specified by the Codex Alimentarius Commission and the MRLs issued by the Gazette Extraordinary, No. 2023/34, 14.06.2017 issued by the Government of Sri Lanka.

Keywords: Good agricultural practices, Liquid chromatography-tandem mass spectrometry, Maximum residue levels, Pesticide residues

Changes of Selected Phytochemical Contents in Tomato (*Solanum Lycopersicum* L.) Fruits in Response to Postharvest Hot Water Treatments

M.N.F. Zaina and P.K. Dissanayake*

*Department Export Agriculture, Faulty of Agricultural Sciences,
Sabaragamuwa University of Sri Lanka, Belihuloya 70140, Sri Lanka
kapila@agri.sab.ac.lk

Tomato (*Solanum lycopersicum* L.) is one of the major fruits that contain high amount of lycopene, an important intermediate in the biosynthesis of many carotenoids including β-carotene. Lycopene shows the highest antioxidant activity among phytochemicals present in tomato fruit. Aims of this study were to evaluate the effect of hot water treatments (dipping in hot water bath) on phytochemical properties of tomato fruits and to find the relationship between heat and lycopene development in tomato fruits. pH (using pH meter), total soluble solids (brix value) content (using refractometer), vitamin C (by titrimetry), total polyphenolic content (TPC), and total flavonoid content (TFC), lycopene, total carotene (using spectrophotometer) were measured at three different colour development stages (Colour break, Orange, Red) of fruit after imposing to different hot water treatments (control, 40 ^{0}C, 60 ^{0}C, 80 ^{0}C) for 10 minutes. Experiment was conducted in Complete Randomized Design with four replications. Upon hot water treatments pH and brix values of fruit increased in all three colour development stages. Lycopene and total carotene contents also increased with increasing temperature of hot water treatments and higher contents of those two components were observed in red colour stage than in other stages. The highest vitamin C content was observed in control treatment and it reduced gradually with increasing temperature. Highest TPC and TFC contents were recorded in the tomatoes which were subjected to hot water treatments than the control. However, a consistent relationship between the hot water treatment & TPC & TFC contents in different ripening stages of fruit could not be found. Overall results indicated that heat imposed by hot water differently affected phytochemicals in ripening tomato fruits while conserving some phytochemicals with increasing temperature such as lycopene.

Keywords: Lycopene, Carotene, Antioxidant, Flavonoid, Phenolic, Phytochemicals

Analysis of Genomic Data of *Pyricularia Oryzae* Species Causing Rice Blast

A.C. Samuel[1]*, L.S. Nawarathna[1] and H.A.C.K. Ariyarathne[2]

[1]Department of Statistics and Computer Science
[2]Department of Botany
Faculty of Science, University of Peradeniya, Peradeniya 20400, Sri Lanka
*s15448@sci.pdn.ac.lk

Blast, caused by the fungus *Pyricularia oryzae* (*P. oryzae*), is the most destructive disease of rice prevalent globally. The rice quantity lost annually to this disease, which is over 30% of its annual production, could sustain approximately 60 million people. Fungicides and other means for disease control are ultimately futile due to the development of fungicidal resistance and adaptation among pathogen populations. Computational methods have been increasingly applied to design accurate and affordable biological experiments. This analysis identified regions of the genome that are discriminative for the selected fungus and hence can be used for pathogen diagnosis. Comparative analysis was performed with four other fungal pathogens that cause the most economically harmful rice diseases in Sri Lanka, namely; *Rhizoctonia solani, Cochiobolus miyabeanus, Ustilaginoidia virens* (*U. virens*) and *Sarocladium oryzae* (*S. oryzae*). This study used bioinformatics techniques such as pairwise alignments to enumerate mutations. The study was restricted to the 1st chromosome of the genome due to limited processing storage. Markov-models and the Needleman-Wunsch algorithm were employed extensively. Based on the Kruskal-Wallis test, there was no difference in the distributions of proportions of each of the four nucleotides within the genome of *P. oryzae* at 5% significance level. However, the regions from the 300,001bp to 400,000bp; 1,400,001bp to 1,500,000bp and 4,100,001bp to 4,200,000bp contained high proportions of adenine and thymine (AT rich) and low proportions of guanine and cytosine (GC poor) relative to the rest of the genomic divisions. Pairwise alignments between the 1st chromosome of *P. oryzae* and randomly selected regions of *U. virens* and *S. oryzae*, identified distinctive regions in *P. oryzae* from the 720,001bp to 730,000bp pointing to unique genomic sections in comparison to other rice pathogenic fungi. Further analysis of these *P. oryzae* genomic regions will enable developing molecular tools to distinguish and diagnose the pathogen.

Keywords: Markov models, Needleman-Wunsch algorithm, Pairwise alignment, *Pyricularia oryzae*, Rice blast

Variation of Catechins and Caffeine in a Bi-Parental Progeny of Tea [*Camellia sinensis* (L.) O. Kuntze]

J.D. Kottawa-Arachchi[1]*, G. Ekanayake[1], M.A.B. Ranatunga[1], A.M.T. Amarakoon[2], M.T.K. Gunasekare[3], R.K. Sharma[4] and R.N. Attanayake[2]

[1]*Plant Breeding Division, Tea Research Institute, Talawakelle 22100, Sri Lanka*
[2]*Faculty of Science, University of Kelaniya, Kelaniya 11300, Sri Lanka*
[3]*Ministry of Plantations, Battaramulla, Sri Lanka*
[4]*CSIR-Institute of Himalayan Bioresource Technology, Palampur,
Himachal Pradesh, India*
*jeevan1188@yahoo.com / jeevank@tri.lk

Tea [Camellia sinensis (L.) O. Kuntze], the second most consumed beverage in the world, is a rich source of polyphenolic compounds**.** The characteristic properties of tea depend on the biochemical compounds present in tea leaf. Hybridization of tea aims at developing new cultivars with more favorable levels of biochemicals for commercial exploitation. Early screening of putative hybrid populations would facilitate selection of elite genotypes with desirable biochemical properties. Tea with naturally low caffeine content is highly demanded while, high catechin content ensure better quality. Current study estimated the catechins and caffeine contents in 126 hybrids generated by two diverse parental tea cultivars; TRI 2043 and TRI 3055 to screen hybrids with high catechin and low caffeine content. Three sets of finely ground freeze-dried fresh leaf samples of direct and reciprocal crosses were extracted with 70% methanol and used to determine Caffeine, (+)-catechin (C), (-)-epicatechin (EC), (-)-epicatechin gallate (ECg), (-)-epigallocatechin (EGC), (-)-epigallocatechin gallate (EGCg) and gallic acid using high performance liquid chromatography (HPLC) protocols. A significant variation was observed in these compounds. Among major catechins, EGCg was the highest (mean 70.28 ± 15.24 mg g^{-1}) followed by ECg, EGC, EC and C. Genotypes no. 129 and 138 recorded highest total catechin content (192.80 mg g^{-1}) and lowest caffeine content (19.34 24 mg g^{-1}) respectively. Mid-parent heterosis for EGC was 18.43% and 11.01% in direct and reciprocal crosses respectively. Majority of the crosses exhibited positive better parent heterosis for EGC implying that they were superior to both parents TRI 2043 and TRI 3055. Mid-parent heterosis for caffeine was -7.09% and 7.19% in direct and reciprocal crosses respectively. Negative mid-parent heterosis for caffeine indicated the existence of genotypes in the population which can be utilized to develop low caffeine and high catechin tea cultivars.

Keywords: Black tea, Caffeine, Catechins, Mid-parent heterosis

Optimization of *In Vitro* Proliferation Assay for *Haemonchus contortus* Antigen Sensitized Lymphocytes in Goats

W.RH. Mendis[1,2], T.A.N. Mahakapuge[1]*, V. Wijewardana[3] and R.P.V.J. Rajapakse[1]

[1]*Department of Veterinary Pathobiology, Faculty of Veterinary Medicine and Animal Science, University of Peradeniya, Peradeniya 20400, Sri Lanka*
[2]*Faculty of Research, Sri Lanka Technological Campus, Ingiriya Road, Padukka 10500, Sri Lanka*
[3]*Animal Production and Health Section, International Atomic Energy Agency, Austria*
*thilinianupama@vet.pdn.ac.lk

The cell-mediated immune responses generated in the host could be measured by using i*n vitro* lymphocyte proliferation assay. Once the lymphocytes are sensitized *in vivo* for a specific antigen, *in vitro* antigenic stimulation causes exponential antigen specific lymphocyte proliferation. *Haemonchus contortus*, an abomasal blood sucking parasite, induces cell-mediated immune responses in goats. Current study was conducted to optimize the methodology of *in vitro* proliferation at different antigen concentrations and to evaluate the cell proliferation using flow cytometer. Blood was collected from four goats (Saanen breed, aged less than 6 months) that were infected with *H. contortus.* Peripheral Blood Mononuclear Cells (PBMC) were isolated using the standard Pancoll-hypaque technique. Cells were cultured in complete RPMI media (RPMI 1640 supplemented with 2.05 mM L-glutamine, 2 g/L sodium bicarbonate, penicillin (100 IU/mL) and streptomycin (100 µg/ml) and 10% FBS) for 3 days at 37°C with 5% CO_2. Well known lymphocyte mitogen, Concanavalin A was used as a positive control at 5, 10 and 20 µg/mL, and *H. contortus* L3 somatic larval antigen was used at 200, 100, 50, 25, 10, 8, 6, 4 and 2 µg/mL concentrations. Concanavalin A at 5 µg/mL and the somatic larval antigen at 25 µg/mL yielded maximum *in vitro* lymphocyte proliferation. The results confirmed the basic requirements essential for goat *in vivo* sensitized lymphocyte proliferation.

Keywords: *Haemonchus contortus*, Lymphocyte proliferation assay, Flow cytometer, Goats

Chronic Kidney Disease in Animals: A Study on Kidney and Liver Pathology of Cattle from CKDu-Prevalent North Central Province of Sri Lanka

S.A.C.H. Rodrigo*, P.G.A.S. Palkumbura, W. Jayaweera and R.R.M.K.K. Wijesundera

Department of Veterinary Pathobiology, Faculty of Veterinary Medicine and Animal Science, University of Peradeniya, Peradeniya 20400, Sri Lanka
*chathuri.rodrigoask@gmail.com

Chronic Kidney Disease of unknown aetiology (CKDu) is a major health issue in Sri Lanka. Several studies have identified renal histopathologies in humans with CKDu. To the authors' knowledge, there are no reports of pathology of animal tissues in CKDu-prevalent areas globally or locally to date. This study investigates whether similar lesions prevail in animals and establishes the gross and histopathological morphology of renal and hepatic tissues of cattle from CKDu-endemic North Central Province (NCP). Forty (n=40) kidney and liver samples of Jersey cattle from NCP were collected mainly from abattoirs. Control samples (n=40) were collected from Jersey cattle of non-CKDu-endemic Kandy area. Forty percent (40%) of kidney samples showed multifocal petechial haemorrhages as the sole gross pathological lesion. However, gross liver lesions were not observed. The most common histopathological lesion in the kidney was tubular degeneration; observed in all test samples (100%). Other conspicuous lesions were lymphocytic infiltration (80%), interstitial fibrosis (55%), and glomerulosclerosis (50%). Common hepatic lesions were lymphocytic infiltration (70%) along with centrilobular necrosis (70%). These lesions were moderate to severe in severity and multifocal to diffuse in distribution. Only 15% of control samples showed mild focal lymphocytic aggregates as the sole lesion in both renal and hepatic tissues. Current literature on human CKDu reports similar tubulointerstitial morphology in renal tissues; however hepatic lesions have not been investigated. The renal and hepatic lesions were comparatively extensive in test samples than in controls. Renal lesions of cattle showed high similarity with those of humans. Liver lesions could not be compared since hepatic histopathology of CKDu patients is still unknown. Our findings are probably indicative of the effects of environmental risk factors common to humans and animals in this area. Since age and clinical history of these animals are unknown, further studies should investigate the exact causes of these lesions.

Keywords: Chronic kidney disease, Cattle, Histopathology, North Central Province

Colostrum is a Novel Source of Probiotics: A Study on Potential Probiotic Properties of Bacteria Isolated from Colostrum of Sri Lankan Dairy Cattle

R.M.S.P. Rajapaksha[1]*, J.K. Vidanarachchi[1], K.K.S.P. Kodithuwakku[1],
P.H.P. Prasanna[1] and J.A.M.S. Jayathilake[2]

[1]Department of Animal Science, Faculty of Agriculture
[2]Division of Microbiology, Faculty of Dental Sciences
University of Peradeniya, Peradeniya 20400, Sri Lanka
*shanirajapaksha95@gmail.com

The development of functional foods that contain probiotics are popular in the world due to their health benefits. Instead of consuming medicinal drugs, many people tend to use these functional foods to prevent them from diseases. Many sources of probiotics are used in the food industry. Rather than using traditional sources of probiotics, scientists tend to identify novel sources of probiotics. The current study was conducted with the aim of identifying the lactobacilli species present in the colostrum of Sri Lankan dairy cattle as a source of probiotics. Cow colostrum samples were collected from ten selected dairy cattle farms under sterile conditions in order to isolate lactobacilli species. The identities of the isolates were confirmed by cultural, biochemical and physiological tests. Grouping of lactobacilli isolates were carried out using five biochemical tests and two physiological tests. Evaluation of the probiotic properties were studied by bile tolerance, acid tolerance and antibiotic sensitivity tests. Of the total isolates, 43% were confirmed as lactobacilli. Among the lactobacilli isolates, 93% were able to grow vigorously at 45 °C, while 47.5% tolerated NaCl up to 6.5% (w/v). All the lactobacilli isolates shown acid (pH =3.00 for 3 hours) and bile (0.3% for 4 hours) tolerance and none of the isolates had shown resistance against selected antibiotics, such as amoxicillin, chloramphenicol, gentamicin, tetracycline and erythromycin. It can be concluded that the lactobacilli isolated from cow colostrum from Sri Lankan dairy cattle are a good source of probiotic bacteria and further studies are needed to identify their ability to exert clinically documented health benefits.

Keywords: Probiotics, Cow colostrum, Lactobacilli, Sri Lankan dairy cattle

Development of a Dog Treat Incorporated with Pharmaceutical Gelatine By-Product and Poultry By-Product Meal

P.R. Hegoda, T.I.G. Prabashwari and S.M.C. Himali*

Department of Animal Science, Faculty of Agriculture, University of Peradeniya, Peradeniya 20400, Sri Lanka
*smchimali@agri.pdn.ac.lk

The gelatine residues resulting from soft gelatine capsule manufacturing in the pharmaceutical industry (pharmaceutical by-product gelatine (PBG)) has not been effectively utilized. This study was aimed to formulate a palatable and low-cost dog treat using PBG, poultry by-product meal (PBM) and *Gotu Kola* (*Centella asiatica*) as a nutritious and healthy plant source. Eight different dog treat formulations were prepared by using different percentages of the above mentioned raw materials to select the most suitable gummy textured dog food. The selected dog food formulation composed of 90% of PBG, 8% of PBM and 2% dried powder of the whole *Gotu Kola* plant. Physiochemical and microbiological qualities of the selected dog treat were analysed at weekly intervals during one month of the storage period and the proximate analysis of the selected dog treat was analysed after one week of manufacturing. A feeding trial was conducted using eight (4 to 5 months old) local crossbred dogs to assess the palatability of the prepared dog treat and control diet (rice with minced broiler meat) by measuring the feed intake within a given time. Results of the proximate analysis of the selected dog treat revealed that the moisture content, crude protein and crude fat were 16.27±0.14%, 75.33±0.12% and 3.51±0.55%, respectively. As the pH and total viable aerobic plate counts changed during the storage period ($P<0.05$), this semi-moist dog treat should be stored in vacuum packaging during the storage period. The dog food was free of coliforms. The dogs showed ($P<0.05$) high preference to the treat indicating high palatability of the prepared dog treat over the control. The digestible crude protein value of the selected dog food was 82.64±1.76%. This study reveals that the developed dog treat is nutritious, highly palatable and highly digestible.

Keywords: Dog treat, Gelatine, Gummy, Palatability, Poultry by-product

Microbiological Quality Assessment of Poultry Broiler Feed and Major Raw Materials Collected from Commercial Feed Distributors in Kurunegala District

H.C. Gallage[1], L.A.D.E. Weerasinghe[3], S. Samitha[2], R.S. Kalupahana[1], H.M.T.K. Karunarathna[1] and K.S.A. Kottawatta[1]*

[1]*Department of Veterinary Public Health and Pharmacology, Faculty of Veterinary Medicine and Animal Science*
[2]*Department of Crop Science, Faculty of Agriculture*
University of Peradeniya, Peradeniya 20400, Sri Lanka
[3]*Hayleys Agriculture Holdings Limited, Colombo 01000, Sri Lanka*
**sarunika@yahoo.com / sandavphp@gmail.com*

Quality of poultry feed is pivotal as it affects quality of fowls and resulting products. Microbiological quality of the feed is usually assessed by enumerating Enterobacteriaceae (ENT) and determining the presence of *Salmonella.* According to EU standards, products should have less than 300 cfu/g of ENT and should be free from *Salmonella*. The objectives of this study were to enumerate ENT and test the presence of *Salmonella* in broiler feed and raw materials and to understand the antimicrobial profile of isolated *Salmonella.* Commercially available starter (n=33) and finisher (n=33) broiler-feed and raw materials, such as fishmeal (n=126) and maize (n=69), were sampled from feed distributors in Kurunegala district. Each sample was tested for ENT and *Salmonella* using ISO 21528:2017 and ISO 6579:2000 standards, respectively. Accepted quality control bacterial strains were also used. All *Salmonella* isolates were subjected to antimicrobial susceptibility testing for ten antimicrobials. The commercial broiler feed samples were negative for *Salmonella.* However, 5.55% (7/126) of fishmeal, and 5.79% (4/69) of the maize samples were positive for *Salmonella*. Further, 3.03% (1/33) of the broiler starter, 3.17% (4/126) of the fishmeal, and 4.34% (3/69) of the maize samples had exceeded 300 cfu/g of ENT limit. All *Salmonella* isolates were susceptible for ceftazidime, imipenum, gentamicin, tetracycline, sulfamethaxozole/trimethoprime and chloramphenicol. *Salmonella* isolates showed 3.13%, 6.25% and 18.75% of intermediate susceptibility to ceftriaxone, ciprofloaxacin and streptomycin, respectively. Around 6.25% of isolates were resistant to ampicillin. Majority of the commercial broiler feeds were at an acceptable microbial quality that could be due to high thermal treatments applied at processing. The study revealed information on the microbiological quality of locally available broiler feed and highlights the possible introduction of pathogenic and antibiotic resistant bacteria to the food chain through contaminated raw materials.

Keywords: Enterobacteriaceae, *Salmonella*, Commercial broiler feed, Fish meal, Maize

Polymorphisms in LHCGR and FSHR Genes, and Their Association with Fertility Traits and Average Milk Yield of Crossbred Dairy Cows in Sri Lanka

D.I. Abeygunawardana[1], R.M.S.B.K. Ranasinghe[2]*, S.N.T. de Silva[3],
R.M.C. Deshapriya[4], G.A. Prathapasinghe[1] and R.P.V.J. Rajapakse[5]

*[1]Department of Livestock and Avian Sciences, Faculty of Livestock, Fisheries and Nutrition, Wayamba University of Sri Lanka, Makandura, Gonawila 60170, Sri Lanka [2]Department of Basic Veterinary Sciences, Faculty of Veterinary Medicine and Animal Science, University of Peradeniya, Peradeniya, 20400, Sri Lanka, [3]Department of Nano Science Technology, Faculty of Technology, Wayamba University of Sri Lanka, Kuliyapitiya, 60200, Sri Lanka, [4]Department of Animal Science, Faculty of Agriculture, University of Peradeniya, Peradeniya, 20400, Sri Lanka, [5]Department of Veterinary Pathobiology, Faculty of Veterinary Medicine and Animal Science, University of Peradeniya, Peradeniya, 20400, Sri Lanka
bimalkarana@pdn.ac.lk

Single nucleotide polymorphisms (SNP) analyses of selected hormone receptor genes are useful in improving the genetic potential of dairy cows in Sri Lanka. This study was aimed to screen a population of 153 cross-bred dairy cows from three National Livestock Development Board farms, for SNPs in exon 11 region of luteinizing hormone choriogonadotropin receptor (LHCGR) gene and 5' upstream regulatory region of follicle stimulating hormone receptor (FSHR) gene by target sequencing method. SNPs were detected by Mega 7 software and visual inspection of electropherograms obtained from Chromas software and respective allele and genotype frequencies were calculated. Associations between different genotypes and selected fertility traits (average calving interval, number of services per conception and age at first calving) and average milk yield were determined using General linear Model of SPSS version 26.0. The fixed factors considered were genotype and farm. Parity was included as a covariate. Altogether six SNPs, four in exon 11 region of LHCGR gene (rs41256848, rs41256850, rs465790244 and rs45463781) and two in 5' upstream region of FSHR gene (rs43676359 and G-278-A (GU253337) were detected. Totally different minor alleles were reported for the SNPs in FSHR gene in this population compared to other studies. The SNP, rs45463781 found at LHCGR exon 11 region was significantly associated with the average milk yield (*P*=0.036), while the minor allele A had a negative effect. The other SNPs did not show any association with any of the traits tested in this study. The results of this study indicate the possibility of developing rs45463781 as a marker for milk yield related traits. Further analysis is necessary with a larger population to confirm the effect of detected specific LHCGR and FSHR haplotypes on fertility traits and milk yield of crossbred dairy cows reared in Sri Lanka.

Keywords: Dairy cows, Fertility, Milk yield, LHCGR, FSHR, SNP

Food, Nutrition and Livestock

Effect of Parity and Breed on Postpartum Body Condition Score, Milk Yield and Calving to First Service Interval of Dairy Cows in Dry Zone of Sri Lanka

D.P. Marasinghe[1], M.A.L.S.S. Munasinghe[1],
D.I. Abeygunawardana[1]* and R.M.S.B.K. Ranasinghe[2]

[1]*Department of Livestock and Avian Sciences, Faculty of Livestock, Fisheries and Nutrition, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP) 60170, Sri Lanka*
[2]*Department of Basic Veterinary Sciences, Faculty of Veterinary Medicine and Animal Science, University of Peradeniya, Peradeniya 20400, Sri Lanka*
*dameesha098501@gmail.com

Early postpartum dairy cows experience a rapid increase in milk yield and mobilization of body fat reserves. Therefore, early postpartum period is considered as a crucial period for the sustainability and productivity of dairy management. The aim of this study was to compare the postpartum body condition score (BCS), milk yield and calving to first service interval (CFSI) in multiparous (n=15) and primiparous (n=17) cows and Jersey (n=14) and Jersey-Friesian crosses (n=18). Altogether thirty-two (n=32) intensively managed cows with parities ranging from 1 to 5 were selected from a large-scale National Livestock Development Board (NLDB) farm located in the dry zone of Sri Lanka. BCS was determined at the time of parturition and every two weeks until two months after parturition. All tested parameters were compared using independent-samples t-test. The BCS was significantly different ($P<0.05$) between the two parity groups from parturition to 8 weeks postpartum. Primiparous cows showed a significantly lower BCS (average BCS from parturition to 8th week: 2.76±0.44, 2.82±0.39, 2.71±0.47, 2.59±0.51, 2.59±0.51) compared to multiparous cows (average BCS from parturition to 8th week postpartum: 3.27±0.59, 3.33±0.62, 3.20±0.68, 3.13±0.64, 3.07±0.59). Meanwhile, the effect of parity was significant for CFSI ($P<0.05$) where multiparous cows showed shorter CFSI (52.88±24.01 days) than primiparous cows (75.59±15.24 days). No significant difference was observed in BCS and CFSI between the two breeds. and no significant effect of breed was detected on milk yield in tested animals. Average daily milk yield of multiparous and primiparous cows from 2nd to 8th week were 14.60±3.15, 14.69±4.90, 16.85±4.97, 15.16±4.74 and 13.97±3.25, 13.87±2.69, 13.70±1.82, 11.82±2.48, respectively; and were not significantly different. These results from a limited number of animals suggest that the postpartum BCS change could be a breed-independent and a parity-dependent indicator and extra attention should be given to primiparous dairy cows during the early lactation period.

Keywords: Body condition score, Dairy cows, Parturition, Parity, Breed

Reproductive and Production Performances of Exotic Dairy Cows Managed under Intensive System in Dry Zone, Sri Lanka

H.K.H.M. Premantha[1], M.A.L.S.S. Munasinghe[1],
D.I. Abeygunawardana[1] and R.M.S.B.K. Ranasinghe[2]*

[1]Department of Livestock and Avian Sciences, Faculty of Livestock, Fisheries and Nutrition, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP) 60170, Sri Lanka
[2]Department of Basic Veterinary Sciences, Faculty of Veterinary Medicine and Animal Science, University of Peradeniya, Perdeniya 20400, Sri Lanka
*bimalka58@yahoo.com

This study was conducted to assess the reproductive and production performances of exotic pure and crossbred dairy cows managed under intensive management system in the dry zone of Sri Lanka. A total of 436 Jersey and 664 Jersey × Friesian cows were selected from a large-scale National Livestock Development Board (NLDB) farm. Reproductive and productive parameters were determined using data obtained for the period from 2015 to 2020. Age at first calving (AFC), average calving interval (ACI), number of services per conception (NSC) and calving to first service interval (CFSI) were the reproductive parameters considered. Meanwhile, total milk yield per lactation (TMYL), average daily milk yield (ADMY) and lactation length (LL) were tested under production parameters. The data were analysed using General Linear Models (GLM). The results indicated that AFC was influenced by breed and age ($P<0.05$). The AFC values were significantly higher in crossbred cows (25.80 ± 0.60 months) compared to purebred cows (24.44 ± 0.22 months). There was a significant effect on both breed and parity ($P<0.05$) for ACI and NSC, while CFSI was independent from both breed and parity. Jersey cows had significantly higher ACI and NSC (634.78 ± 14.06 days, 5.29 ± 0.11) than crossbred cows (505.25 ± 4.44 days, 4.04 ± 0.15). Except ADMY, all milk production related parameters were significantly associated with breed and parity. Jersey cows showed significantly higher LL and TMYL (418.91 ± 10.38 days, 5116.66 ± 211.69 L) compared to crossbred cows (353.11 ± 3.35 days, 4312.07 ± 68.20 L). The highest LL and TMYL were recorded in cows at 2nd parity. The findings of the present study indicate that purebred Jersey cows are superior to Jersey x Friesian cows with respect to TMYL and LL, while crossbreds are superior to purebred Jerseys with respect to ACI and NSC in the context of the cow population studied at the particular dry zone dairy farm of Sri Lanka.

Keywords: Exotic dairy cows, Milk yield, Reproduction, Breed, Parity

HEALTH AND SOCIETY

Incidence of Occupational Pesticide Poisoning Symptoms among Farmers in Naula Divisional Secretariat Area, Sri Lanka

H.S. Fernando[1], P.V.R. Kumarasiri[2], S. Dharmarathne[2], R. Sivakanesan[3], L. Nugaliyadde[4] and W.M.R.R. Wijethunga[5]*

[1]Provincial Department of Health Services, Central Province, Kandy 20000, Sri Lanka
[2]Department of Community Medicine [3]Department of Biochemistry Faculty of Medicine, University of Peradeniya, Peradeniya 20400, Sri Lanka
[4]Member Board of Study (Plant Protection), Postgraduate Institute of Agriculture, Peradeniya 20400, Sri Lanka
[5]Vitebsk State Medical University, Vitebsk, 210009, Belarus
*rrwijethunga@gmail.com

The use of agrochemicals particularly pesticides, has been increasing for the last few decades. Parallel to this increment, the risk of occupational pesticide poisoning (PP) has also been increased. According to the recent statistical data, there is an increased morbidity due to occupational PP. This descriptive cross sectional study was designed to assess the incidence of occupational pesticide poisoning symptoms among farming community. Total of 2303 participants were chosen from Naula divisional secretariat area, Sri Lanka, based on criteria checklist. The participants were subjected to a survey on monthly basis over a period of six months to identify the sociodemographic differences and the symptoms associated with occupational PP which manifested within 24 hours of pesticide application. Statistical analysis was done using the software IBM SPSS 16th version. The adjusted incidence rate for symptoms of occupational PP was 64.6% for six months study period. The cumulative number of reported symptoms associated with occupational pesticide poisoning was 13047 during the six months period. The commonest reported symptom (19%) was severe headache. In addition, vertigo and faintishness (16%), and burning sensation and irritation of skin (11%) were the other common reported symptoms whereas, shivering (0.6%) and chills (0.3%) were the least common symptoms. The ethnicity other than Sinhalese (p <0.001), use of Trellis for farming (p <0.001), more than 200 working hours per month (p = 0.02), more than 0.5 acres extent of land area spraying at a time (p = 0.03) and spraying session of more than 2 hours of duration (p <0.001) showed statistically significant association with symptoms of occupational pesticide poisoning. More studies are required to test the methods of reducing the level of occupational pesticide exposure.

Keywords: Pesticide poisoning, Sri Lankan agriculture, Symptoms, Occupational hazards

Microbiological Quality of Street Vended Ready-to-Eat Foods in Gangodawila, Nugegoda Area

G.G.N.T. Dharmarathne* and P.D.A. Abeysundara

[1]Department of Food Science and Technology, Faculty of Applied Sciences, University of Sri Jayewardenepura, Gangodawila, Nugegoda, 10250, Sri Lanka
**ganganidharmarathne@gmail.com*

Street foods are very popular among people, mainly the tenants and borders who live in Gangodawila, Nugegoda area, due to the low price and convenience. However, the microbiological quality of these street foods is questionable because of seemingly poor adherence to good manufacturing practices by street food vendors. Therefore, the main objective of this study was to investigate the microbial quality of five popular ready-to-eat (RTE) street food types sold in Wijerama junction area, Gangodawila, Nugegoda. Total of 19 food samples (5-fruit juice, 4-wade, 4-Dosai, 3-fruit salad and 3-string hopper) were tested for total plate count (TPC), total yeast and mold count (TYMC), total coliform count (TCC), presence of fecal coliform, *E.coli*, and *Staphylococcus aureus* using the standard microbiological procedures. TPC and TYMC values in all the samples varied between 3.4 – 6.3 log CFU/ml and 3.8 – 6.4 log CFU/ml, respectively while the highest TPC (6.3 log CFU/ml) and TYMC (6.4 log CFU/ml) values were detected in fruit salad and Dosai samples, respectively. Seven food samples (36.8%) were recorded having TCC higher than 10 MPN/ml. Of the samples tested, 84.2%, 47.4%, and 33.3% were found positive for fecal coliform, *E.coli*, and *S.aureus,* respectively. The results showed that the street vended foods in Gangodawila, Nugegoda area are of poor microbial quality. Moreover, the presence of fecal coliform, *E.coli,* and *S. aureus* indicated that fecal contamination and inappropriate handling of these foods during processing and vending. Therefore, there is an emerging need for imposing monitoring measures to improve the microbial quality of street foods sold in this area by the relevant authorities.

Keywords: Microbial quality, Food contamination, Food quality, Hygiene, Street foods

Evaluation of Food Safety Knowledge and Perceptions of School Children in Colombo, Sri Lanka: Implications for Food Safety Education

P.C. Wanniarachchi[1]*, P.D.A. Abeysundara[1] and K.G.H.S. Peiris[2]

[1]Department of Food Science and Technology [2]Department of Mathematics
Faculty of Applied Sciences, University of Sri Jayewardenepura,
Gangodawila, Nugegoda 10250, Sri Lanka
*piyumichathurangi2@gmail.com

Thorough knowledge on food safety among school children can make them more confident when facing food safety related risks. The present study focuses on evaluating food safety knowledge and perception of school children, identifying gaps in knowledge on food safety related aspects and recognizing key parties that should take responsibility in their food safety education. A cross sectional study was carried out using 14-16 years old students (n =380) in selected schools in Colombo Education Zone using a self-administered questionnaire. Descriptive statistics, Pearson-correlation, Mann-Whitney U test and Kruskal-Wallis test were performed at 0.05 level of significance. Food safety knowledge and perception of students were evaluated separately. The mean food safety knowledge score of students was 59.94 ± 0.83 where male students showing higher median score than female students. The mean food safety perception score was 84.33 ± 0.44 with no significant difference between male and female cohorts. The food safety perception score increased with the food safety knowledge score of the students. Lack of knowledge on the importance of proper temperature control on microbial safety of foods (41.2%) was evident. Parents, teachers and doctors were identified as the three major parties disseminating food safety education to students. Vast majority of students (92.4%) believed that their food safety knowledge could be further improved through proper education. In conclusion, this study indicates that school children of 14-16 year age category has an average knowledge on food safety and excellent positive food safety attitude. However, their knowledge needs to be enhanced on importance of correct temperature control during food processing and storage. Finally, the strong willingness of students to learn more on food safety leaves a positive insight on future educational attempts.

Keywords: Food safety, Knowledge, School children, Education, Perceptions

Job Satisfaction among Physiotherapists in Sri Lanka

P. Cinthuja

Department of Allied Health Sciences, Faculty of Medicine, University of Colombo,
Colombo 00800, Sri Lanka
cinthuja@med.cmb.ac.lk

Employee's performance and productivity is higher when they are satisfied with their job. Job satisfaction among physiotherapy professionals was not studied yet in Sri Lanka. This study was aimed to study job satisfaction among physiotherapists in Sri Lanka, and factors that influence their job satisfaction. A cross-sectional descriptive study was conducted online using self-administrative 31 item job satisfaction questionnaire. A pilot study was conducted among randomly selected physiotherapists from different sectors to check the validity of the questionnaire. A Likert scale was used to measure the responses. The questionnaire was converted to "Google form" format and sent to participants via emails and messenger. Participants from different settings and districts in the island were recruited. Convenient sampling method was used. Descriptive statistics were performed using SPSS software. Eighty-eight physiotherapists (age range was 25-30 years (48%) and male (52.3%), 1-10 years of experience (70%)) participated. The majority of the participants were from government (77%) sector. The percentage of participants from private and other sectors were 11% and 12% respectively. Only 8% of participants had postgraduate qualifications. Different criteria of satisfaction level were analyzed. Out of those, 43% were satisfied for overall satisfaction, 25% for adequate resource, 41% for job description accuracy, and 43% for defined performance criteria, 40% for recognition of service, 26% for salary, 24% for career development opportunities and 15% for research opportunities. Interpersonal relationship and working condition were identified by the participants (15%) as most important factors for their job satisfaction. The results suggest that physiotherapists' satisfaction rate on selected job satisfaction criteria is very less. Also, it indicates that many physiotherapists do not have their post graduate qualification, opportunities for their career development and research.

Keywords: Physiotherapists, Job satisfaction, Sri Lanka

A Study on Knowledge and Perception about Antimicrobial Stewardship Programmes among Bachelor of Pharmacy Students in Sri Lankan Universities

W.G.R. Chathuranga* and M.H.F. Sakeena

Department of Pharmacy, Faculty of Allied Health Sciences,
University of Peradeniya, Peradeniya 20400, Sri Lanka
*ruwanchathuranga.infor@gmail.com

Antimicrobial resistance (AMR) is a global health challenge. Inappropriate prescribing, dispensing and consumption promote the development and spread of AMR. Implementation of antimicrobial stewardship (AMS) is an important strategy to control the spread of AMR. Pharmacists are important members of the healthcare team and essential components of AMS programmes. Current study aimed to investigate knowledge and perception regarding antimicrobial resistance and AMS concepts among Pharmacy undergraduates in Sri Lanka. It was conducted in five universities in Sri Lanka that offer a Bachelor of Pharmacy (B. Pharm) degree program. All 3rd and 4th year B. Pharm students in each university were included. Ethics approval was obtained before the data collection. This study used a self-administered questionnaire with descriptive data analyses-to explore associations between different variables and level of knowledge on AMR and AMS. Among the respondents, 51% felt familiar with the term AMR. Interestingly, no one reported that they never heard about AMR. On the other hand, more than half of the students (53%) reported that they were not familiar with the AMS concepts. Additionally, there were 17% of respondents who had not heard the term AMS. Nearly all of the participants (99%) have agreed with the statement that appropriate knowledge of antimicrobials is important for the future career of pharmacists. A significant percentage of respondents (87%) reported that more training on AMS is essential. In conclusion, the study found that the knowledge and perception regarding AMS concepts were much lower (<30%) among the participants. Furthermore, participants reported that they prefer more academic training on AMR and AMS. Therefore, this study suggests that new interventional strategies are essential to improve teaching on the principles of AMS to enhance the knowledge and awareness among B. Pharm students in Sri Lanka.

Keywords: Antimicrobial stewardship, Perception, Knowledge, Antimicrobial resistance, Pharmacy students, Sri Lanka

Effectiveness of Low-Level Laser Therapy for Nonspecific Chronic Low Back Pain

M.K.I.D. Senarath*, D.A.R.K. Dasanayaka, S. Mayooran, V.V. Senadheera,
V.M.B.K.T. Malwanage and A.L.I. Prasanna

*Department of Physiotherapy, Faculty of Allied Health Sciences,
University of Peradeniya, Peradeniya 20400, Sri Lanka
dilharisenarath@pdn.ac.lk

Pain in the lumbo-sacral area, commonly known as the low back pain, has lately reached the epidemic proportions in its incidence. This common musculoskeletal disorder affects 70% - 85% of world population at some point in their lifetime. Low level laser therapy (LLLT) is suggested as an effective method to relieve pain in patients with non-specific chronic low back pain (NSCLBP) and widely utilized, therapeutic outcomes of LLLT in NSCLBP are varied and conflicting. However, there is still lack of evidence regarding its effectiveness on functional outcomes. Therefore, this single blinded randomized controlled study was aimed to identify the effectiveness and therapeutic efficiency of LLLT in treating NSCLBP. In this current study, 58 participants (patients from nearby hospitals) were included as 32 in experimental (mean age = 47.75, SD = 12.81 years) and 26 in control (mean age = 48.15, SD =11.03 years) groups where they received LASER + Exercises (Arm 1) and Heat Therapy + Exercises (Arm 2) respectively for consecutive three weeks, two sessions per week. Assessments were conducted for pain and AROM (forward flexion, extension, right and left side-flexion of lower back) at the baseline and at the end of the intervention. The data were analyzed with the time; baseline, and end of intervention and between two groups using two-way repeated measure MANOVA with significance at 5% significant level with 95% CI. According to the analysis, it was found that there is no statistical significance between the groups except for back extension at baseline. There is a significant improvement ($P \leq .005$) in all the variables in both the groups separately and experimental group have higher improvement than the control group. Therefore, it can conclude that the LLLT is an effective treatment modality for treating NSCLBP.

Keywords: Low level LASER therapy, Exercises, Low back pain, Non-specific, Chronic

Investigating Perceptions Regarding Pharmaceutical Care Services among Registered Pharmacists in Central Province, Sri Lanka

W.G.M. Rathnasiri, K. Dilakshana and M.H.F. Sakeena*

*Department of Pharmacy, Faculty of Allied Health Sciences,
University of Peradeniya, Peradeniya 20400, Sri Lanka
sakeena@ahs.pdn.ac.lk

Pharmacy profession has witnessed a significant transition from preparation and dispensing of medications towards patient-centered care. Enhancing pharmaceutical care services is vital for achieving positive health benefits in patients. Hence the aim of this study was to assess the perceptions and perceived barriers of pharmaceutical care services among registered pharmacists in Central province, Sri Lanka. This was a cross-sectional study and the ethical approval was obtained prior to the data collection. Community and hospital pharmacists working in government or private sectors in the Central province, Sri Lanka were invited to participate in this study using a validated self-administered questionnaire. Out of the 217 registered pharmacists selected in the study, 136 pharmacists have completed the questionnaire with a response rate of 62.67%. Majority of the pharmacists (52%) were 30-39 years of age and most of them were female (60%). More than half of the participants (68%) had above 5 years' experience and 56% had higher educational qualifications. Majority of them (94%) had an overall, correct understanding of pharmaceutical care service concepts. Half of the participants had positive attitudes regarding pharmaceutical care services (50%) and majority (97.1%) responded job satisfaction while offering pharmaceutical care services. However, only a few respondents perceived that they carefully assess and obtain patient information (37.5%), formulate a patient-specific action plan (30.9%) and take a general approach to patient care (32.4%). Furthermore, participants reported four important perceived barriers for the implementation of pharmaceutical care practices, lack of time and skills, lack of external conditions, lack of full support from other health professionals and absence of information and economic incentive. In conclusion, findings of this study indicate that pharmacists in Sri Lanka barely practice pharmaceutical care as part of their routine work, although they have good understanding and positive attitudes towards providing pharmaceutical care services.

Keywords: Perception, Barriers, Pharmaceutical care, Pharmacists, Sri Lanka

Effect of Different Types of Commercially Available Dinner Food on Fasting Blood Glucose (FBS) Level and Triacylglycerol (TAG) Level

K.M.N.S. Bandara[1]*, M.R.P.U. Bandara[1], P.T.S. Bandara[1], R.M.M.A. Bandara[1], S.B.Y.M.C.C.Y. Bandara[1], W.M.Y.H.K.W. Bandara[1] and S.P.A.S. Senadheera[2]

[1]Faculty of Medicine and Allied Sciences
[2]Department of Biochemistry, Faculty of Medicine and Allied Sciences
Rajarata University of Sri Lanka, Mihinthale 50300, Sri Lanka
*nirodhasamadi@gmail.com

Fasting blood sugar (FBS) is the main parameter used for screening, diagnosis, management and monitoring of diabetes mellitus. Therefore, any factor that significantly affects the FBS will interfere with the diagnosis and management of diabetes. The aim of the study was to determine the effects of various types of commonly consumed Sri Lankan dinner food on FBS and TAG in healthy individuals. Cross-sectional experimental study was conducted with 10 healthy individuals, (age 22-26 years, BMI 18 – 23 kg/m^2, FBS < 110 mg/dl, TAG < 150 mg/dl), selected by simple random sampling. Ten participants for each food item were recruited according to standard GI study protocol. Four dinner food (portion size= 300 g) 1) rice and curry (838 kcal), 2) fried rice (932 kcal), 3) *kottu* (937 kcal) and 4) soup with bread (422 kcal) were provided for the dinner and after 8-10 hours fasting, FBS and TAG levels were measured on the next day morning using Glucose oxidase assay kit, and TAG colorimetric assay kit respectively. Presence of any significant difference in mean FBS and mean TAG relevant to the food types, at 95% CI were measured using ANOVA Tukey's posthoc test. Rice and curry meal showed significantly lower (p<0.05) mean FBS (65 mg/dL) compared to all other food. A significantly lower FBS value was obtained for rice and curry meal (p<0.005) compared to *kottu* and fried rice while there was no significant difference (p=0.666) between *kottu* and fried rice. TAG levels were not statistically significant among all meals. It can be concluded that rice and curry meal for dinner has the lowest effect on FBS while fried rice and *kottu* for dinner significantly increase the FBS level compared to soup meal and rice and curry meal. None of the tested meals for dinner significantly changed the fasting TAG.

Keywords: Diabetes mellitus, Dinner foods, Fasting blood sugar, Triacylglycerol, Light diet

Impact of Hamstring to Quadriceps Strength Ratio (HQR) on Agility and Sprint Speed of Under-17 Male School Cricket Players in Kandy

G.W.W. Malshani[1]*, W.N.S.D. Chandradasa[1], R.M.A. Dilrukshi[1],
D.M.U.I. Dissanayake[1], J.M. Karandawela[1], W.K.M. Lakmali[1],
A.S. Ariyasinghe[2] and A.P. Kariyawasam[2]

[1]*Department of Physiotherapy, Faculty of Allied Health Sciences*
[2]*Department of Physiology, Faculty of Medicine*
University of Peradeniya, Peradeniya 20400, Sri Lanka
**wishmila94@gmail.com*

Hamstring and quadriceps muscles which maintain the dynamic stability of knee joint are important for the enhancement of agility and sprint speed; two main physical fitness characteristics which are important for the cricket players' performance. The aim of the study was to assess the impact of hamstring to quadriceps strength ratio (HQR), hamstring and quadriceps muscle strength, player role and fielding position on agility and sprint speed of under 17 male school cricket players in Kandy. A cross sectional study comprising of 68 male school cricket players was selected through convenience sampling from 6 schools around Kandy city. Height, weight, BMI, muscle strengths of quadriceps and hamstring (handheld dynamometry), HQR, leg dominance (standard kick a ball test), agility (T drill agility test) and sprint speed (10-30 meter sprint test) were determined. Demographic data of medical history, playing role and position were obtained using a pre-tested questionnaire. Pearson correlation, two sample t-test and ANOVA test were used to assess the correlation between variables and significance. Data was analyzed using Minitab 17 statistical software. The mean age and BMI were 15.01 ± 1.07 years and 18.1 ± 1.84 respectively. Out of 68 cricketers, 52.9% were batsmen while 47.1% were bowlers. There was no significant impact of HQR of dominant leg on agility ($p = 0.903$) and sprint speed ($p = 0.206$) and HQR didn't vary with leg dominancy ($p = 0.353$). There was a weak negative correlation only between quadriceps strength and sprint speed ($p = 0.025$). Sprint speed varied with both playing role ($p = 0.005$) and fielding position ($p = 0.043$) while agility varied according to the playing role only ($p = 0.034$). This study showed that HQR did not have an impact on the agility and sprint speed of the cricketers. Sprint time varied according to playing role, fielding position and quadriceps strength while agility varied according to playing role.

Keywords: HQR, Agility, Sprint speed, Playing role, Fielding position

Effectiveness of Computed Tomography Scans for Management of Patients with Chronic Headache

D.M.J. Nuwan[1]*, J.J.K.H. Udupihille[2] and J.C. Marasinghe[3]

[1]*Department of Radiology, National Hospital Kandy, Kandy 20000, Sri Lanka*
[2]*Department of Radiology, Faculty of Medicine*
[3]*Depatment of Radiography/Radiotherapy, Faculty of Allied Health Sciences*
University of Peradeniya, Peradeniya 20400, Sri Lanka
*janakanu@gmail.com

Chronic headache is one of the most common disorders experienced by patients and it is the most common symptom among the patients who are referred by the physicians for Computed Tomography (CT) scan of brain. This study was performed using CT head scan data and scan reports. Those data were related to the patients who had undergone CT brain scans during the period of January- 2015 to May- 2017. Socio demographic data, medical history and the final comments of CT scan given by radiologists were collected, recorded and analyzed. Dose Length product (DLP) values of the CT scans were also collected to calculate the effective dose to the patients.850 patients were selected out of 1577 and there were 8 patients (0.94%) who were positive for major malignant findings. 50 patients were positive (5.8%) for significant neurosurgical findings. 321 (37.76%) patients were positive for clinically non-significant findings and among those patients 296 (34.82%) patients were positive for sinusitis. There were 471 patients (55.41%) with no abnormality found in their CT scans. All positive scans except the sinusitis were considered as effective scans and there were only 83 (10%) effective scans and 767 (90%) non-effective scans. The average DLP of those CT scans was recorded as 1580.34 mGy cm and calculated average effective dose was 3.6 mSv. CT head scan imaging performed for the management of chronic headache patients was found to be clinically less significant for positive findings. The effectiveness of CT scans to manage chronic headache patients is very low and cost effectiveness of those scans is also lacking. Patients being exposed to high radiation doses can be limited by judicious requests for CT scans by establishing a local clinical practice guideline for decision making regarding the CT scan imaging.

Keywords: Chronic headache, Computed tomography, Dose length product (DLP), Effective dose

Effect of Gender and Physical Activity on Flexibility of the Trunk and Lower Body among Students of Faculty of Allied Health Sciences, University of Peradeniya

A.M.M. Rikas[1]*, H. Ajmala[1], M.H.F. Hana[1], H.M.G.S. Herath[1], N.G.Y.W. Karunaratne[1], M.K.I.D. Senarath[1] and B.M.H.S.K. Banneheka[2]

[1]*Department of Physiotherapy, Faculty of Allied Health Sciences*
[2]*Department of Basic Sciences, Faculty of Dental Sciences*
University of Peradeniya, Peradeniya 20400, Sri Lanka
**mailtorikaz.abde@gmail.com*

Physical inactivity is a leading risk factor for global mortality while the flexibility is a key factor for determining an individual's status of health. This study intended to discover the impact of gender and physical activity level on the flexibility of lumbar spine and lower extremities in set of students from the Faculty of Allied Health Sciences of University of Peradeniya. It further explored the correlation of flexibility of two different regions of body in individuals categorized in the same level of physical activity as well. In this cross-sectional study, the sample was chosen using stratified random sampling method. 35 students from each gender (n=70) were divided into three categories (low, moderate and high) based on their physical activity level evaluated using International Physical Activity Questionnaire-short form (IPAQ). Modified Schober test was used to measure the flexibility of lumbar spine while Sit-and-Reach and Groin Flexibility tests were used to measure the flexibility of lower limbs. The study revealed that the males were more flexible in both lumbar spine (22.26) and lower limb (7.46) than that of females (21.4), (6.66) respectively. With regard to physical activity, it showed a weak positive correlation (r=0.236, p<0.05) with the flexibility of lower limbs but showed no correlation with the flexibility of lumbar spine (r = -0.179, p>0.05). It further revealed that the flexibility of lumbar spine and lower limbs had no correlation in between them in people who were either moderately or highly active, but in people categorized under low physical activity level, they had a strong positive correlation in between them. This study showed that, physical inactivity may reduce the flexibility irrespective of its specificity to each joint or area of the body. Thus, importance should be given clinically to alleviate physical inactivity in order to improve the general status of health.

Keywords: Physical activity, Flexibility, Gender, Lower limb, Lumbar spine

Relationship between Quadriceps Muscle Strength and Postural Balance in Institutionalized Elderly People in Two Selected Elders' Homes in Colombo District

G.A.D. Perera*, I.M. Kandege and L.G.O. Pramodhya

Department of physiotherapy, Faculty of Allied Sciences,
General Sir John Kotelawala Defense University, Colombo 10390, Sri Lanka
*amaradamayanthi@gmail.com

The quadriceps muscle strength and the postural balance are two main clinical characteristics that deteriorate with the process of aging. The apparent evidence depicted the alters in the postural balance in the elders is rooted due to the changes in the quadriceps muscle strength. However, there is less knowledge about the role of the quadriceps muscle strength in the changes of postural balance among the elderly. In Sri Lanka, there were not enough studies carried out to determine the relationship between the quadriceps muscle strength and postural balance in elderly people. Our study was carried out to determine the relationship between quadriceps muscle strength and postural balance in older people in Salina Alwis elders' home and Sahana Udaya elders' home. A cross-sectional study was conducted under a non-probability convenient sampling method to collect the data. Sixty elders (34 females & 26 males) who dwelt in the two elders' homes participated in the study. Bilateral quadriceps muscle strength was measured using a modified sphygmomanometer test (MST) and postural balance was assessed by mini-Balance Evaluation Systems Test (Mini-BEST).The mean age of the participants was 76.67 (SD ± 6.23) years old. The mean and standard deviations of right quadriceps muscle strength, left quadriceps muscle strength, and average quadriceps muscle strength were 149.90 (SD ± 28.53) mmHg, 137.63 (SD ± 24.35) mmHg, 143.83 (SD ± 25.68) mmHg respectively. The mean postural balance was 20.88 (SD ± 2.70). According to the Pearson correlation coefficient, there was positive linear relationship between quadriceps muscle strength and postural balance ($p = 0.000$, $r = 0.815$) among elderly people. The study revealed a strong positive correlation between quadriceps muscle strength and postural balance in the elderly people who participated in this study.

Keywords: Quadriceps muscle strength, Postural balance, Institutionalized elderly, Modified Sphygmomanometer Test, Mini-balance Evaluation System Test

Health and Society

Effect of Prior Participation in an Event on Triathlon Performance of Elite Male Triathletes in Sri Lanka

M.K.K. Perera* and L.R.N.D. Weerarathne

Department of Sports Sciences and Physical Education, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya 70140, Sri Lanka
*mkkperera.kd@gmail.com

Triathlon is a late specialized endurance/transfer sport which consists of three individual events that are completed in a sequential order such as swimming (1.5km), cycling (40 km) and running (10 km). Based on the current practices and evidence in Sri Lanka, most of the elite triathletes may be a former marathoner, swimmer or cyclist. Therefore, there is a scarcity of young triathletes who begin triathlon at the grass root level due to its' less popularity. The prime aim of this study was to identify how physiological parameters and triathlon performance differ due to the effects of prior participation in an event. Twenty elite male triathletes (7 former swimmers, 7 former cyclists, 3 former marathoners & 3 pure triathletes) (age (25.6 ± 2.68 years), weight (58.95 ± 7.27 kg) and height (172.65 ± 4.26 cm)) were randomly selected for this study. The Cooper 12 minutes test, running based anaerobic sprint test & BIA test were performed to identify the mean values of maximum oxygen consumption (VO2 max), peak power output (PPO) and body composition respectively. ANOVA analysis of data demonstrated that there was a significant impact of prior participation event on triathlon performance (p value – 0.002) & triathletes' VO2 max capacity (p value - 0.024) & except PPO, Fat Mass, Fat Free Mass & Muscle Mass (p value>0.05). According to Tukey's Pairwise comparison, it was shown that triathletes whose prior participation event was cycling, or swimming had a significant positive impact on triathlon performance. Furthermore, the triathletes whose prior involvement event was swimming & cycling had significantly higher VO2 max capacity than marathoners & pure triathletes of the sample. Within the confines of the study, it was revealed that, there was a significant positive impact of swimming and cycling as prior participation events on triathletes' maximum oxygen consumption and their performance.

Keywords: Triathletes, Cycling, Swimming, Sri Lanka

A Study of Body Composition and Selected Physical Fitness Components among Female Kabaddi and Kho-Kho Players in Sabaragamuwa University of Sri Lanka

K.U.P. Abesinghe, D.S.L. Perera* and H.A.C.S. Hapuarachchi

Department of Sports Sciences and Physical Education, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya 70140, Sri Lanka
*sameeraperera@appsc.sab.ac.lk

Kabaddi and Kho- Kho are contact team sports played between two teams of 7 players and 9 players respectively. The present study aimed to study the body composition and selected physical fitness components of female Kabaddi players and Kho-Kho players of the Sabaragamuwa University of Sri Lanka. Under cross-sectional research design, a total of 50 (Kabaddi 35, Kho Kho 15) subjects were selected using the purposive population sampling technique. The sample's body composition was recorded by operating Multifrequency Tanita Body Composition Analyzer® (MC-780). Body compositions of total fat, muscle mass, fat-free mass, body mass index were recorded. EUROFIT® fitness test battery and standardised speed test were used for data gathering of selected physical fitness components of flexibility, agility, and speed. Sit and Reach, Shuttle Run 10m*5, and 35m sprint tests were performed. Minitab version 17 and Microsoft Excel 2013 were used for statistical analysis. According to the One-way ANOVA test the mean differences of selected body composition parameters and selected physical fitness components of the sample were significantly different (P=0.000). However, according to the two-sample t-test, there was no mean difference between the body composition among Kabaddi and Kho-Kho players (P=0.006). Moreover, the agility of both groups was significantly different (P=0.023) and, flexibility and speed were not significantly different among both groups. In a conclusion, it is evident that body compositions of fat, muscle mass, fat-free mass and body mass index were associated with selected physical fitness components of flexibility, agility, and speed of Kabaddi players and Kho-Kho players. However, only the agility physical fitness component was different in the sample groups. It is suggested to consider the body composition levels in order to gain a higher level of physical fitness among players of both sports.

Keywords: Body composition, Kabaddi, Kho-Kho, Physical fitness components

Clinically Important Variants in Intra Cranial Arterial Circulation as Demonstrated in MR Angiogram Studies in a Tertiary Care Center in Sri Lanka

D.A. Herath* and A.S. Pallewattte

Department of Radiology, National Hospital of Sri Lanka, Colombo 00700, Sri Lanka
*dini.ashwi@gmail.com

The cerebral arterial circulation demonstrates a range of clinically important variants which are frequently found in the general population. The aim of the study was to describe the frequency of cerebral arterial variants encountered in a tertiary care setting in Sri Lanka. A retrospective cross sectional descriptive study was conducted at the Department of Neuroradiology at National Hospital of Sri Lanka (NHSL), on images of patients who underwent non contrast 3D Time of Flight (TOF) MRA studies from 1st of January 2017 to 31st of January 2021, in a 3T Philips MR systems Ingenia machine. (TE/TR (ms) 23/3.5; Acquisition matrix M×P 320 x 246;) Systematic sampling was done to obtain a sample size of 392. Images were reviewed for anatomical configuration using maximum intensity projection (MIP) and 3D volume rendering. Anatomical variations were grouped as variations in Circle of Willis (COW) and variations in Carotid-basilar anastomosis and other variants. Ethical clearance was obtained by the Ethics Review Committee of NHSL. Sample consisted of 392 studies out of which 156 (39.79%) were of females and 256 (65.30%) were of males. Age ranged from 14 – 85 years. A variant in the intracranial arterial circulation were detected in 11.22% of patients (44/392). Most common variant was a hypoplastic or absent A1 segment of the Right Anterior cerebral artery (ACA) with an incidence of 3.57% (14/392). Variants were most common in the COW (8.92%) with variants in the anterior part of the COW (5.61%) being more common than in the posterior part (3.31%). Persistent Carotid-Basilar anastomosis were seen in 1.02% out of which 100% were persistent trigeminal arteries. Other variants in the anterior and posterior circulation accounted for 1.27% of cases. The intracranial arterial circulation demonstrates a range of variants which are important to be recognized due to its clinical implications, which would in turn aid in endovascular interventions.

Keywords: Variants, Intra cranial arterial circulation, Magnetic Resonance Imaging (MRA)

Health and Society

Discrimination of Benign and Malignant Brain Tumors Using Texture Properties of Magnetic Resonance Apparent Diffusion Coefficient

M.S. Jayaweera*, B.P. Wijemuni, I.P.B.M. Idirisinghe, S. Kulatunga and M.L. Jayatilake

Department of Radiography/Radiotherapy, Faculty of Allied Health Sciences, University of Peradeniya, Peradeniya 20400, Sri Lanka
*msjaweeraj@gmail.com

Nowadays the incident rate of brain tumors is increasing in the world and therefore, the diagnosis of brain tumors is very important. Diagnosis and identification of brain tumor type using surgical methods is painful, costly and takes a long time. But noninvasive imaging modality like Magnetic Resonance Imaging (MRI) is very useful in these cases because MRI provides detailed information about brain tumors. Apparent Diffusion Coefficient (ADC) images which indicate the magnitude of diffusion of water molecules within the brain obtained using MR Diffusion Weighted Imaging (DWI) sequence play a huge role in diagnosing brain tumors. Aim of this study was to discriminate benign brain tumors and malignant brain tumors using texture properties of magnetic resonance apparent diffusion coefficient. A sample of 30 patients including 10 malignant, 10 benign and 10 normal brain tissues was used for this study. MR ADC images of these patients were acquired from an open-source database (www.cancerimagingarchive.net). The Grey Level Co-occurrence Matrix (GLCM) which indicates the distribution of co-occurring pixel values at a given offset of the ADC images were created using a MATLAB algorithm and five texture properties (contrast, correlation, energy, homogeneity and entropy) of the GLCM were extracted. Then the correlation and the T tests were done. The results showed that there were significant statistical differences between the texture properties of benign, malignant and normal brain tissues. According to the study, entropy texture property can be used to discriminate malignant and benign brain tissues. The contrast and entropy texture properties can be used to discriminate benign and normal brain tissues. Malignant and benign brain tissues had a strong correlation for contrast texture property. For correlation texture property, normal and malignant brain tissues had a strong correlation, benign and normal brain tissues had a strong correlation for entropy texture property. Therefore, it can be concluded that the GLCM texture properties, contrast and entropy are potential biomarkers to discriminate benign and malignant brain tumors.

Keywords: Benign brain tumors, Malignant brain tumors, Texture properties, Magnetic Resonance Imaging, Apparent diffusion coefficient

Factors Related to Subjective Health of Older People over Age 75 Who Only Live with Other Older People in Japan

R.A.M.S.D.L. Jayathilake[1]*, T. Saito[2] and T. Narita[2]

[1]*Department of Nursing, Faculty of Allied Health Sciences, University of Peradeniya, Peradeniya 20400, Peradeniya, Sri Lanka*
[2]*School of health Sciences, Niigata University, Niigata, 950-3198, Japan*
*savithrilakshika28@gmail.com

The number of Japanese older people over age 75 years has been increasing. Subjective health is the self-reported evaluation of one's overall health status. In Japan trends towards nuclear families are increasing and the age of caregivers is also increasing. Therefore, finding new ways to promote older citizens' health is vital. This was a retrospective study. This study aimed to identify the factors related to subjective health of older people over age 75 years living only with other older people and to remedy that gap in previous research and to promote the health of older people in Japan. Data of 1500 older people were collected from the Niigata City Resident Basic Ledger. Data from them was collected using a self-administered questionnaire. Ten subscales were in the questionnaire. Participants who responded "very healthy" or "fairly healthy" were included in the good subjective health group, and those who responded "not very healthy" or "not healthy" were included in the poor subjective health group. Five questions were asked related to Instrumental Activity of Daily Living (IADL). The chi-squared test and logistic regression analysis were used to analyze the differences in subjective health. The number of valid responses was 1,102 (73.5%). Among them 778 (71.3%) of the respondents were fully healthy. Logistic regression analysis revealed the factors related to subjective health, as having a full IADL (Instrumental Activities of Daily Living) score (p = 0.003, OR = 1.81), full social role score (p = 0.003, OR = 1.65), not being socially isolated (p = 0.020, OR = 1.65), going out often (p = 0.009, OR = 1.75), and not being lonely (p < 0.001, OR = 2.65). The results suggest that age, IADL, how often respondents' left the house, social isolation, and loneliness as related factors to older peoples' subjective health. Maintaining IADL and social participation will allow them the opportunity to develop more interpersonal relationships, thereby improving their subjective health.

Keywords: Subjective health, Older people over age 75, Live with other older people, Related factors

Effectiveness of *Karanjadi Dhuma Varti* (Medicinal Smoking Stick) in the Management of *Peenasa* (Allergic Rhinitis) – A Review

M.D.S.S. Subasinghe[1]*, N.D. Kodituwakku[2] and L.D.R. De Silva[3]

[1]Institute of Indigenous Medicine
[2]Unit of Dravyaguna Vignana, Institute of Indigenous Medicine
[3]Unit of Shalya Shalakya, Institute of Indigenous Medicine
University of Colombo, Rajagiriya 10107, Sri Lanka
*shanakasathsara@gmail.com

Peenasa which can be compared with allergic rhinitis, is a disease mentioned in both Ayurveda and Sri Lankan Traditional Medicine with the clinical features of excessive sneezing, especially in the morning or on exposure to cold weather or dust. The prevalence of allergic rhinitis is approximately 10 to 30% of adults and 40% of children globally. The aim of the study is to logically find the effectiveness of *Karanjadi dhuma varti* (KDV): modified herbal smoking stick considering the Ayurveda pharmacodynamic properties, pharmacological activities and modern pharmacological attributes of the formula. The ingredients of KDV are *Pongamia pinnnata, Caesalpinia bonduc, Madhuca longifolia, Coscinium fenestratum, Curcuma longa, Acorus calamus, Nigella sativa, Ferula asafetida, Apium graveolens, Cedrus deodara, Santalum album, Aquilaria agallocha, Ricinus communis* and *Cinnamomum camphora*. The review was conducted by utilizing Ayurveda and modern texts, index journals and data bases as Pub med, Google scholar. The observations were recorded accordingly, and the results were analyzed by percentage. KDV consist of *Katu rasa* (pungent) and *Tikta rasa* (bitter) in equal percentage as 33.33%. *Peenasa* is a *Kapha Vata* predominant disease and majority *Rasa* and *Laghu guna* (lightness) (35.29%) in the ingredients counteracts with the *Kapha dosha* which in turn help to manage *Peenasa*. *Sukshma guna* (fineness) is 2.94% which enhances the efficacy of the formula. *Ushna virya* (hot potency) is prominent (73.33%) which pacifies both *Kapha* and *Vata dosha* while *Katu vipaka* (pungent) (80.00%) pacifies *Kapha dosha*. The modern pharmacological actions such as antioxidant, anti-inflammatory, antimicrobial, immuno-modulatory, anti-allergy, anti-histaminic, analgesic, and anti-spasmodic properties are fruitful in the treatment of *Peenasa*. Considering Ayurveda pharmacodynamics and modern pharmacological actions of ingredients of KDV, it is concluded that conceptually *Karanjadi dhuma varti* is a potent remedy for all types of *Peenasa*.

Keywords: *Peenasa*, Allergic rhinitis, *Dhuma varti,* Sneezing

Review of *Madhuyashtikadi Anjana* (Herbal Eye Liner) Used in the Management of *Timira* (Ametropia)

M.A.P.H. Silva[1]*, J.N. Dahanayake[2] and L.D.R. De Silva[3]

[1]Institute of Indigenous Medicine
[2]Unit of Dravyaguna Vignana, Institute of Indigenous Medicine
[3] Unit of Shalya Shalakya, Institute of Indigenous Medicine
University of Colombo, Rajagiriya 10107, Sri Lanka
*hashanisilvasp@gmail.com

Visual impairment is a major health problem globally according to the WHO. The abnormal optical system causes visual impairment which is compared with *Timira* (Ametropia / refractive errors). *Madhuyashtikadi anjana* (MA) is a modified herbal *Anjana* (herbal eye liner) used in Sri Lankan Traditional Ophthalmology for a long period without reported toxic effects. The present study was focused to logically analyze the effectiveness of MA considering the Ayurveda pharmacodynamics and the modern pharmacological attributes. The literature was searched in authentic Ayurveda, modern, traditional texts, index journals and databases such as Pub Med, Medline and Google scholar with specific key words. The data were tabulated and analyzed by percentage. MA consists of nine ingredients viz. *Glycyrrhiza glabra*, *Piper nigrum*, *Piper longum, Symplocos racemosa*, *Coscinium fenestratum*, *Curcuma longa*, *Terminalia chebula*, *Terminalia bellirica* and *Phyllanthus emblica*. The prominent *Dosha karma* was *Kapha Vata shamaka* (44.4%) which clears the channels of the eye thus, enhance normal vision. The ingredients possess *Katu rasa* (pungent) (30%), *Kashaya rasa* (astringent) (25%), *Tikta rasa* (bitter) (20%), *Madhura rasa* (sweet) (15%) which collectively mitigate the abnormal eye function. The *Shita virya* (cold potency) was prominent (55.5%) which pacify the provoked *Pitta dosha* due to the cooling effect and maintains normal visual acuity. The most prominent *Guna karma* are *Chakshushya* (promote healthy vision) and *Balya* (strength) which consecutively improves the vision and strengthen the eye muscles, nerves and vessels. The herbal ingredients are possessed with the antioxidant property where the eye gain normal color, movements and vision. Considering the Ayurveda pharmacodynamic properties, Ayurveda and modern pharmacological attributes of the ingredients of MA, it is capable of managing *Timira* (Ametropia) effectively which will be beneficial for the patients. Further it is a need to conduct clinical trials to prove the effectiveness of *Madhuyashtikadi anjana* in managing Ametropia.

Keywords: Ametropia*, Timira, Chakshushya,* Herbal eye liner

A Review of *Erandadi Nasa Sheka* (Herbal Nasal Spray) in the Management of Nasal Polyps

K.A.T.K. Gayashani[1]*, J.N. Dahanayake[2] and L.D.R. De Silva[3]

[1]Institute of Indigenous Medicine
[2]Unit of Dravyagunavignana, Institute of Indigenous Medicine
[3]Unit of Shalya Shalakya, Institute of Indigenous Medicine
University of Colombo, Rajagiriya 10107, Sri Lanka
*thilakshikavinduka1108@gmail.com

Nasal polyps are mucosal lesions of the nasal or paranasal sinuses with a prevalence of 1% - 4% globally. *Erandadi nasa sheka* (herbal nasal spray) (ENS) is a traditional Sri Lankan modified herbal nasal spray used to manage nasal polyps without any reported adverse effects. The aim of the present study was to review the Ayurveda pharmacodynamics, Ayurveda and Modern pharmacological attributes of the ingredients of the ENS to find the effectiveness of the formula. Data were collected from Ayurveda, modern and traditional classics, databases as PubMed, Google scholar and index journals up to 2020 with specific key words. The retrieved data were tabulated and analyzed accordingly. The herbal ingredients of ENS are *Ricinus communis*, *Asparagus racemosus*,*Madhuca longifolia*, *Embelia ribes*, *Cassia tora*, *Glycyrrhiza glabra*, *Zingiber officinale*, *Alpinia calcarata*, *Elephantopus scaber*, *Sahindhava lavana* (rock salt). According to the results *Madhura rasa* (sweet taste) (33.33%), *Katu rasa* (pungent taste) (22.22%) and *Kashaya rasa* (astringent taste) (22.22%) were prominent which pacify the vitiated *Vata* and *Kapha dosha* of the nasal mucosa, relieving redness, oedema and congestion. The most prominent qualities were *Laghu guna* (lightness) and *Snigdha guna* (unctuousness) which reduce the size of nasal polyp which in turn cure dyspnoea. Anti-inflammatory property (16.98%) was prominent among the ingredients, relieving the inflammatory features of nasal polyposis, while analgesics (11.32%), antioxidant (13.21%) properties of the ingredients accelerate the healing process. The antitumor action was 5.66% which is a key factor in decreasing the size of the nasal polyp with curing the difficulty in breathing. Thus Ayurveda pharmacodynamics, Ayurveda and modern pharmacological attributes of the ingredients of the *Erandadi nasa sheka* (herbal nasal spray) hypothetically proved the efficacy in managing nasal polyps successfully.

Keywords: Nasal polyps, Nasal spray, Nasal mucosa, Anti- inflammatory

Perceived Sleep Quality and Predictiveness of Sleep Quality among Shift Working Nursing Officers in Two Government Hospitals, Sri Lanka

L.C. Nawarathne[1]* and A.A.T.D. Amarasekara[2]

[1]Higher Education Institute Society-Linkage Cell, Kaatsu International University, Battaramulla 10120, Sri Lanka
[2]Department of Nursing and Midwifery, Faculty of Allied Health Science, University of Sri Jayewardenepura, Nugegoda 10250, Sri Lanka
*lahiruchannaka@yahoo.com

Current research studies have revealed and defined various key determinants of sleep quality, that measure sleep quality of an individual instead considering the quantity, an individual actually slept. Major sleep/ wake imbalance and, ultimately, poorly dealt sleep deprivation occurs due to compulsory shiftwork that is being carried out in the healthcare sector. This descriptive cross-sectional study was conducted through self-administered questionnaires, profiling demographic data and assessing Global Pittsburgh Sleep Quality Index (PSQI) scores; cumulative scores of PSQI components indicating perceived sleep quality, among shift working nursing officers in two selected government hospitals. Correlation analysis, hierarchical multiple regression analysis and descriptive statistics were run using SPSS version 25.0. Ethical approval and permission to conduct the study was gained from Faculty of Medical Sciences, University of Sri Jayewardenpura (Nur/13/19), Colombo South Teaching Hospital (Application number 792), and Homagama Base hospital. Participants reported a mean age of 33±7, majority (95%) being females, worked maximum 12 shifts with a mean 8 (SD ±2) shifts per average week. Mean values reported in two of seven PSQI components; sleep duration (1.07±0.85) and sleep disturbances (1.00±0.63), were comparatively high, where 60.9% gained a Global PSQI score ≥ 5, indicating poor sleep quality. Predictiveness of each PSQI component towards Global PSQI score was not significant for all the models analyzed. However, a significant correlation was evident (r = 0.14, p = 0.01) between total shifts reported per average week and the Global PSQI score. Studies are recommended in evaluating staffing strategies and policies related to shift work as well as exploring the aspects of employee turnover related to nurses' sleep quality, due to the majority reporting poor sleep quality. A more definite picture of sleep quality by actigraphy is warranted among nurses, as the current study was limited to PSQI, a self-evaluation.

Keywords: Sleep quality, PSQI, Shift working, Nursing officers

Herbal Products, COVID-19 Pandemic and Consumption Trends in Sri Lanka

M.L.D. Nipunika* and D.A.M. De Silva

Department of Agribusiness Management, Faculty of Agricultural Sciences,
Sabaragamuwa University of Sri Lanka, Belihuloya 70140, Sri Lanka
*mldnipunika@gmail.com

COVID-19, deadly virus claimed thousands of lives around the world including hundreds in Sri Lanka threatening to the mankind. The first era of the pandemic spread without treatment and the second stage or new normal moving with waiting for the vaccines, rumors on side effects of the vaccine. Ayurveda products are recognized and considered as remedy based on traditional practices of many Asian nations including Sri Lankans. Present study attempts to identify the consumption trends of herbal products during the COVID-19 pandemic and explore the consumer behavior. Special concerns were to find out the consumer knowledge and beliefs on consumption of herbal products for the prevention of COVID-19 infection. Study sample comprised of 134 participants aged above 18 years. Primary data were collected through self- administered structured questionnaire. Descriptive analysis used mainly to describe the dimensions. Study shows that 89% participants used herbal products during the pandemic period. Among them 41% reported that they prepared herbal products at their home. 50% who tried herbal products during this period are mainly motivated by the recommendations received from the family, friends or relatives. Before pandemic, herbal porridge (72%) was the most used herbal product. During the pandemic paspanguwa (83%) and steam inhalation (81%) was the most used herbal remedies. In addition, 2% of participants used herbal drinks introduced by Ministry of Indigenous Medicine. Of the sample, 72% participants had a general knowledge about herbal products while 90% participants were willing to know further. Majority, (67%) was concerned on the product manufacturer. Control and regulation mechanism on production of herbal products were key concern of 90% of the consumers while 88% highlighted the need of government intervention in public awareness of the benefits of the products. There was a significant increase in the consumption of herbal products among Sri Lankans, due to the COVID-19 pandemic and the main factor influencing was immunity boosting capability of herbal products. Consumers highlighted the need of safety and quality control mechanism for herbal products available in local market.

Keywords: COVID-19, Herbal product, Consumer behavior

Health-Related Quality of Life among Individuals Receiving Treatment at a Selected Drug Rehabilitation Center, Sri Lanka: A Preliminary Study

A.R. Jayamaha[1], N.D.K. Ranadeva[1], H.N.N.D. Dharmarathna[1]*,
L.C. Nawarathne[1], H.M.N.D.M. Herath[1], D.G.H. Buddhini[1],
D.N.A.W. Samarakoon[1], A.M.P.S. Arachchi[1], S.N. Senerath[1],
K.L. Samarasinghe[1], S.S.N. Fernando[2], S.S.S. Perera[1] and U.G.N. Priyadarshani[1]

*[1]Faculty of Health Sciences, Kaatsu International University,
Battaramulla, 10120 Sri Lanka
[2]Department of Microbiology, Faculty of Medical Sciences,
University of Sri Jayewardenepura, Nugegoda 10250, Sri Lanka
nishadi@kiu.ac.lk

It has been revealed that the quality of life (QOL) of the individuals with substance use disorders decreases as substance use progresses in the absence of appropriate treatment or rehabilitation. The current study aimed to fill the paucity of evidence in Sri Lanka and to further assess the health related QOL among individuals receiving therapeutic Community treatment at a drug rehabilitation center. A descriptive cross-sectional study was carried out as a preliminary study among 50 individuals who are enrolled in residential treatment. Health-related quality of life was measured using pre-tested EQ-5D-5L questionnaire. Descriptive statistics and paired sample t test were carried out using IBM SPSS version 26. All participants were male poly drug users. The age of the participants ranged from 19-40 years. The mean treatment duration was 8±5 months. All the QOL dimensions: Mobility (t=2.07, p=0.043), Self-care (t=3.28, p=0.002), Usual activities (t=3.85, p=<0.001), Pain/discomfort (t=4.29, p=<0.001) and Anxiety/ depression (t=4.31, p=<0.001) were significantly improved with the residential rehabilitation treatment when comparing baseline data before enrollment to the treatment. The self-reported mean EQ visual analogue scale score during rehabilitation was 83.56±14.20. As the QOL of the rehabilitees improved, "Therapeutic Community" residential rehabilitation can be recommended as a treatment intervention for individuals in Sri Lanka suffering from drug abuse disorders.

Keywords: EQ-5D-5L, Health-related quality of life, Rehabilitation, Substance use disorder, Therapeutic community

Knowledge about and Attitude towards Breast Cancer and Screening Practices among Female School Teachers in Selected Schools in Batticaloa Educational Zone

K.G.D. De Silva*, S.K. Dahanayake, N. Karshath, M.B. Fayas,
J. Joseph and A.M.S.S. Alahakoon

*Department of Supplementary Health Sciences, Faculty of Health Care Sciences,
Eastern University, Batticaloa 30000, Sri Lanka
gimhanidevindi@gmail.com

Breast cancer is the most frequent cancer of women worldwide as well as in Sri Lanka. According to the World Health Organization (WHO), the occurrence of breast cancer is increasing. Breast cancer is often curable, if detected early. However, Sri Lankan females are not aware of the state or tend to suffer from this. Therefore, the purpose of this study was to assess the knowledge, attitude of breast cancer and screening practices among female schoolteachers in selected schools in Batticaloa educational zone. A cross sectional descriptive study was conducted among 174 female teachers in selected schools in Batticaloa educational zone, including 3 divisions: Manmunai North, Eravur Pattu-1 and Manmunai Pattu. Simple random sampling method was used and self – administered questionnaires were used to collect the data. Frequencies and percentages were obtained through data analysis using SPSS version 19.A total of 174 participants were recruited for this study. Only 1.7% of participants had high knowledge on risk factors, signs and symptoms and treatment of breast cancer. Regarding knowledge on breast cancer screening, respectively breast self-examination 39%, clinical breast examination 25% and mammography 9% could identify correctly. The attitude of breast cancer occurrence was positive in the study population while attitudes about barriers for participation of breast cancer screening practices were poor. The knowledge on breast cancer and its screening were poor among the female teachers and it is recommended a greater focus on related education programs to improve the knowledge and to change misconceptions about breast cancer and to avoid barriers related screening practice of breast cancer as attitude regarding breast cancer screening is a major lacking part and should be attended and intervened.

Keywords: Breast cancer, Breast cancer screening, Breast self-examination, knowledge, Attitude and barriers

Awareness regarding Sports First Aid among Newly Appointed Sports Coaches in Schools in Sabaragamuwa Province in Sri Lanka

U.G.L.G. Ranasinghe, D.S.L. Perera* and L.R.N.D. Weerarathna

Department of Sports Sciences and Physical Education, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya 70140, Sri Lanka
*sameeraperera@appsc.sab.ac.lk

The present study is directed to identify the awareness of sports first aid among newly appointed sports coaches in schools in Sabaragamuwa province. The association of chronological age, educational level, district and sex were investigated to measure the awareness of sports first aid. Under the survey research design, a questionnaire consisting of two parts was distributed to collect demographic information and awareness of sports first aid. Sample of 207 was selected using a stratified random sampling method. Minitab version 17 and Microsoft Excel 2013 were used for statistical analysis. One-way ANOVA test used to investigate the mean differences of chronological age with awareness of first aid. Two sample t-test used to investigate mean differences of sex and districts with respect to the awareness of first aid. The mean score of overall awareness of sports first aid was 48.4%. Male coaches mean score was 49.2% and female coaches mean score was 46.7% for awareness of sports first aid and it was not statistically significant (P=0.058). Coaches in Kegalle scored a mean of 49% and coaches in Ratnapura scored a mean of 47.8% respectively for the awareness with respect to the districts and the differences were not statistically significant (P=0.303). Regards to awareness of chronological age groups, coaches who were age 23 or below, 24 to 33 and over 33 scored 46%, 49.1% and 49% respectively and it was not significantly different (P=0.111). Coaches qualified in O/L were scored 47.5% and coaches qualified in A/L scored 48.6% respectively and it was not significantly different (P=0.056). In a conclusion, it was evident the awareness of coaches of sports first aid was not sufficient (<50%). The researcher recommends respective authorities to conduct programs to improve awareness of sports first aid of newly appointed coaches in Sabaragamuwa Province which is crucial in coaching athletes.

Keywords: Awareness, Sports coaches, Sports first aid

Effects of Risk Factors on Prognostic Determinants of Female Breast Cancer Patients at National Cancer Institute, Maharagama: A Retrospective Study

T.W. Uyanahewa[1]*, D.D.D. Chathuranga[1], R.D.D.S. Ranaweera[1],
S.R. Kamburapolage[2] and J.K.M.B. Jayasekara[1]

*[1]Department of Medical Laboratory Science, Faculty of Allied Health Sciences,
Sir John Kotelawala Defence University, Ratmalana 10390, Sri Lanka
[2]National Cancer Institute, Maharagama 10280, Sri Lanka
uhthara@gmail.com

A gradual increase of breast cancer incidences among female population was observed in Sri Lanka and several features have been identified as risk factors for breast cancer. Prognostic determinants as Estragon Receptors (ER), Progesterone Receptors (PR), Human Epidermal growth factor Receptor2 (HER2), Ki67, lymphovascular invasion, sites of metastasis and Nottingham grading are exploited to estimate the growth fraction of the breast cancer mass. The aim of our study is to determine the effects of breast cancer risk factors on predetermined prognostic characteristics of female breast cancer patients. We conducted a retrospective analysis of 406 female breast cancer patients, registered from year 2016 to 2018, at National Cancer Institute, Maharagama. The correlations and association among risk factors as age, Body Mass Index (BMI), Body Surface Area (BSA), clinical history, family history and menopausal status and prognostic determinants of patients were evaluated. Age was positively correlated with ER expression (r=0.186, P<0.01) and PR (P<0.01), while over-expression of HER2 was associated with the menopausal status (P<0.05) of patients. BMI and BSA did not show any correlation with prognostic determinants. Compared with the year 2016, the distribution of Diabetic Mellitus (21.8% to 33.3%) and hypertension (30.4% to 38.3%) was increased. Post-menopausal category among breast cancer patients have been increased to 66.9% in the year 2018. Research based on Sri Lankan population in 2017 and 2018 have revealed that majority of breast cancer patients were found among 40–50 ages and post-menopausal category. The results of the current study indicated that female breast cancer patients at higher ages tended to express more ER and PR than young, aged patients and pre-menopausal breast cancer patients could be more aggressive in prognosis due to high expression of HER2 and low expression of ER and PR as they are in younger ages.

Keywords: Breast cancer, Risk factors, Prognostic determinants

Prevalence and Perceived Factors for Lower Back Pain among Nursing Officers at Colombo South Teaching Hospital, Sri Lanka

H.H.N.D. Dharamarathna*, A.C.H. Perera, S.H.S. Ranjani, M.D.N. Sanjeewani, V.K.G. Vithana, W.S.V.M.C.N.K. Wijerathna and M.A.C. Wijesinghe

Department of Nursing, Faculty of Health Sciences, Kaatsu International University, Battaramulla 10120, Sri Lanka
*nishadi@kiu.ac.lk

Lower back pain (LBP) is one of the most serious work-related health problems among healthcare professionals around the world. This problem is associated with major consequences, including disability, activity limitation and frequent sick leave. Nurses are at a higher risk for developing LBP compared to other health professionals. The study aimed to assess the prevalence and perceived factors for LBP among nursing officers at Colombo South Teaching Hospital, Sri Lanka. A descriptive cross-sectional study was conducted among 218 nursing officers at Colombo South Teaching Hospital, Sri Lanka. A pretested self-administered questionnaire which was developed by the researchers was used for data collection. The questionnaire consisted of three parts profiling demographic data, assessing LBP and perceived factors for LBP. The severity of LBP was assessed by using a numeric pain scale (0-10). A systematic random sampling method was applied to select the study sample. Data were analyzed for descriptive statistics and SPSS version 25.0 was used as an analytical tool. Of 218 nurses, the majority of nurses (95%) were females and belonged to the age range of 24-55 years. Only 40% of nurses were within the range of normal BMI (18.5-24.9 kg/m$^{2)}$. It was reported as a rare practice among nurses (14%), to use a sliding board to transfer patients. The prevalence of LBP over the last twelve months was 59% and 54% of the nurses have reported this pain with moderate severity. The majority of the nurses (86%) who suffered from LBP used pain medications. The most-reported perceived factors for LBP were long-standing hours (44%), not having enough rest (42%), and heavy lifting (37%). Prevalence of LBP among nurses is high. Therefore, an effective management strategy for LBP should be implemented.

Keywords: Lower back pain, Nursing officers, Perceived factors

Knowledge, Practice and Attitudes of Pharmacists towards Dispensing Antibiotics in Sri Lanka

C.S.T. Waththuhewa[1], E. Galpin-Lebreau[2] and R.S. Rajakaruna[1]*

[1]Department of Zoology, Faculty of Science, University of Peradeniya, Peradeniya 20400, Sri Lanka
[2]National Veterinary School of Toulouse, 23 Chemin des Capelles, Toulouse 31300, France
*rupikar@pdn.ac.lk

Antibiotic resistance is one of the biggest threats to global health today. Although antibiotic resistance occurs naturally, misuse is accelerating the process. Community pharmacists, owing to their role in dispensing antibiotics must be knowledgeable about the issue and actively involved in the solution. This study was designed to determine the knowledge, practices and attitudes (KPAs) of pharmacists towards dispensing antibiotics. A cross-sectional survey was conducted in eight districts (Anuradhapura, Gampaha, Kandy, Kurunegala, Kegalle, Matara, Matale and Puttalam) covering 80 drug outlets/pharmacies. A pretested semi-structured questionnaire gathered information from the pharmacists through interviews after obtaining verbal consent. There were 37 males and 43 females, among which only 36% were qualified pharmacists while the others who were involved in dispensing drugs were the owner of the outlet (17%), manager (5%), and sales associate (38%). Few (4%) claimed that they did not have proper status. Dispensing antibiotics without proper prescription was reported in all the outlets visited in the Anuradapura and Kurunagala districts while about half of those in the rest of the districts. However, in Matara district, only 10% of the respondents claimed that customers request antibiotics without a prescription. The majority of the respondents (60%) had scored 50% or more for the questions assessing KPAs. Level of education and years of experience did not have a relationship with the KPA score. However, the employment status of the respondent significantly contributed to the KPA scores (Fisher's Exact test, p=0.0025), designated pharmacists scoring higher. The observation checklist had noted that at some outlets, the guidelines for storage of drugs were not practiced. Survey results show that employing proper pharmacists in dispensing drugs is important in preventing misuse of antibiotics and maximizing the utility of available drugs. The importance of conducting pharmacist-directed antibiotic stewardship programs is therefore highlighted.

Keywords: Antibiotic resistance, Drug dispensing, Pharmacists, Sri Lanka

Measuring the Diameter of Abdominal Aorta Using Contrast Enhanced Computed Tomography in Relation to Age and Sex

J.J.K.H. Udupihille*, M.M. Amarathunga, L.K.S. Arunodi, A.E.S. Athukorala,
B.A.R.A.A. Bamunuarachchi, H.M.K.V.P. Bandara, H.M.T.N. Bandaranayaka,
N.M.T. Buddhika, G.K.D. Chalangana, K.K.G.K. Chandika and N.L.N.P. Charukeshi

*Department of Radiology, Faculty of Medicine, University of Peradeniya,
Peradeniya 20400, Sri Lanka
jeevani_u@yahoo.co.uk

This study is a descriptive type cross sectional study. This is aimed at evaluating physiological variation of the abdominal aortic diameter. Objectives of this study are to measure the abdominal aortic diameter of the study group in relation to age and sex and to find out the influence of the age and sex on the diameter of the abdominal aorta. This is a retrospective study which was conducted on 55 patients (25 women, 30 men) who underwent abdominal contrast enhanced Computed Tomography (CT) scans for various abdominal pathologies. Computer based entries of the patients' records were used to obtain data for the study. The internal anteroposterior and transverse diameters of the abdominal aorta were measured at the suprarenal and infrarenal levels. Mean age of the study group was 54.58 ± 16.75 years. Mean anteroposterior aortic diameter was 16.1 ± 2.3 mm while mean transverse aortic diameter was 16.6 ± 2.2 mm at the suprarenal level. Mean anteroposterior aortic diameter is 14.8 ± 1.9 mm and mean transverse aortic diameter is 14.8 ± 1.8 mm at the infrarenal level. Independent t test was used to compare the mean value of the abdominal aortic diameter at the suprarenal and infrarenal levels between males and females. Mean anteroposterior suprarenal aortic diameter in males was 17.1 ± 2.1 mm while it was 15 ± 2.2 mm in females ($p < 0.001$). Mean transverse suprarenal aortic diameter in males was 17.7 ± 2 mm while it was 15.4 ± 2 mm in females ($p < 0.001$). According to the Pearson correlation coefficient, abdominal aortic diameter and the age was found to have significant correlation at 0.01 level (2-tailed). Abdominal aortic diameter has a significant correlation with age. Females have lesser abdominal aortic diameter than males. This pilot study can be improved by expanding into a multicenter study involving larger number of subjects.

Keywords: Abdominal aortic diameter, Abdominal CT, Age, Sex

Camp Test Versus Dc-PCR in Diagnosis of Group B Streptococcus Infection in Pregnant Women

W.M.D.H. Suranimala[1], H.M.T.K. Karunarathna[2], K.S.A. Kottawatta[2],
S.P. Kodithuwakku[3], W.G.N.D. Weerasekara[4], S. Premaratne[5] and R.M.C.J. Ratnayake[1]*

*[1]Department of Obstetrics and Gynaecology, Faculty of Medicine
[2]Department of Veterinary Public Health and Pharmacology, Faculty of Veterinary
Medicine and Animal Science
[3]Department of Animal Science, Faculty of Agriculture
University of Peradeniya, Peradeniya 20400, Sri Lanka
[4]Teaching Hospital Peradeniya, Peradeniya, 20400, Sri Lanka
[5]National Livestock Development Board, Nawala Road, Narahenpita,
Colombo 00500, Sri Lanka
chathura67@hotmail.com

Group B *Streptococcus* (GBS) colonizes in the gastrointestinal and genitourinary tract of pregnant women and infect babies during labor. Thus, prenatal GBS screening of pregnant women at term is recommended. Culture based Christie, Atkins, Munch-Petersen (CAMP) test has been using as gold standard in detection of GBS. However, it has drawbacks like longer turn over time and false negative results. Therefore, we aimed to develop a duplex colony polymerase chain reaction (DC-PCR) to detect GBS specific genes: *atr* (encodes protein amino acid transporter gbs0538) and *cfb* (encodes CAMP factor) for rapid diagnosis of GBS while comparing the outcomes with CAMP test. First using *Streptococcus agalactiae* ATCC 12386, the DC- PCR was established to detect the *atr* and *cfb* genes using gene specific primers. Thereafter recto-vaginal swabs were taken from women over 35 weeks (n=150) at term pregnancy who were admitted to Teaching Hospital, Peradeniya. Swabs were transferred to laboratory in Todd-Hewitt broth and cultured on blood agar plates supplemented with gentamycin. Suspected colonies were tested with established DC-PCR and CAMP test. Antimicrobial resistant profiles of GBS isolates were detected. CAMP test, DC-PCR:*cfb*, DC-PCR:*atr* identified GBS colonization as 21.33% (32/150), 28% (42/150) and 30.67 (46/150) respectively. Presence of *atr* gene and CAMP test results and presence of *cfb* gene and CAMP test results were used for calculation of sensitivity, specificity, positive predictive value and negative predictive values separately; those values were 100%, 88.14%, 69.57%, 100% and 100%, 91.53%, 76.19%, 100% respectively. The GBS isolates demonstrated resistant to chloramphenicol (17.40%), ampillicin (41.30%), cefotaxime (43.48%), erythromycin (56.52%), and clindamycin (56.52%). Overall, results suggest that the use of *atr* gene detection is better than use of *cfb* gene in PCR and both targets can perform well over CAMP test. Further AMR data highlight the necessity of practicing prudent use of antimicrobials in the clinical settings.

Keywords: Group B Streptococcus, *atr* gene CAMP Test, *cfb* gene, AMR Profile

Assessment of the Burden of Uncollected Test Reports at the Laboratory of Teaching Hospital Peradeniya, Sri Lanka

T.V.I. Nimanthika[1]* and S. Wijetunge[2]

*[1]Department of Medical Laboratory Science, Faculty of Allied Health Sciences,
University of Peradeniya, Peradeniya 20400, Sri Lanka
[2]Department of Pathology, Faculty of Medicine, University of Peradeniya,
Peradeniya 20400, Sri Lanka
isharivithanage.ahs@gmail.com

Uncollected laboratory test reports are a major problem in clinical laboratories in Sri Lanka. Apart from the negative effects on patient management, this is a waste of financial and human resources. Although this is a well-known problem in Sri Lankan government hospitals, there are no published studies to assess the scale of the problem. Hence, a cross-sectional descriptive study was conducted intending to assess the number of uncollected laboratory reports and the reasons for non-collection in the Teaching Hospital, Peradeniya (THP). All uncollected test reports in all laboratory sections at THP during the year 2019 were included in the study. The total number of uncollected test reports at THP during 2019 was 25,716 (2.43%). The number of uncollected reports from biochemistry, haematology, immunology, microbiology, urine analysis, histology/cytology and serology sections were 15,591 (60.6%), 6,952 (27.0%), 1,066 (4.1%), 880 (3.4%), 832 (3.2%), 275 (1.1%) and 120 (0.5%), respectively. The highest number of uncollected test reports were observed for Full Blood Count (FBC) test (5,434, 2.78%) and the highest percentage was identified for Ferritin reports (161, 26.52%). The other tests with higher rates of non-collection were Serum Electrophoresis (19.76%), Free T3 (19.04%), HbA1c (11.48%) TSH (10.20%) and PSA (10.11%). Improper filling of the sample request form *i.e.* illegible hand writing, not writing the name of the patient properly, not including the sampling unit, and poor patient awareness on the importance of the clinical laboratory tests were some of the identified reasons for non-collection. In conclusion, 2.4% of the reports have not been collected and the highest percentages were observed for routine tests such as FBC test. Significant percentages of the non-collection were observed for more costly immunological tests. The establishment of an appropriate Laboratory Information Management Systems possibly will improve this problem.

Keywords: Laboratory reports, Uncollected reports, Teaching Hospital Peradeniya

Importance of Radiographic Measurements in Diagnosis of Megaesophagus in Dogs and Their Association with Hypothyroidism

G.K. Dharmaratne[1]*, G.A.D.K.K. Gunathilaka[1], R.A.V.S. J. Ranasinghe[2],
C. Abeykoon[1] and D.D.N. de Silva[1]

[1]Department of Veterinary Clinical Sciences, Faculty of Veterinary Medicine and Animal Science
[2]Department of Statistics and Computer Science, Faculty of Science
University of Peradeniya, Peradeniya 20400, Sri Lanka
*kanishkadh.rad@gmail.com

Megaoesophagus is a disorder of the oesophagus in human and other mammals, in which the oesophagus is enlarged abnormally. Lack of normal peristaltic movements, paralysis of oesophageal musculature or obstructions are the causes of this condition. Megaoesophagus could arise secondary to underline conditions such as hypothyroidism, immune mediated diseases, and congenital conditions etc. Plain thoracic radiography is useful in the diagnosis of megaoesophagus in dogs as the delineation of the oesophageal wall is well visualized. The objective of the current study is to find the association between the Relative Oesophageal Diameters (ROD) with proven cases of hypothyroidism. ROD is the ratio between Thoracic Inlet Diameter and average oesophageal diameter (OD). Medical records of twenty dogs with megaoesophagus admitted to the Veterinary Teaching Hospital, University of Peradeniya from 2020 to 2021 February, were reviewed. The OD was measured in each left lateral radiograph using the image processing software (FCR PRIMA V Console). The measurements were taken in parallel with a line drawn perpendicular to the midpoint of the body of each thoracic vertebra (T1-T10). Also, four radiographic findings, the triangular air column in cervical oesophagus, trachea-oesophageal stripe sign, diffuse oesophageal dilatation and aspiration pneumonia were assessed. In comparison, 6 cases of proven hypothyroidism (T4 levels < 1.0 µg/dL) showed severe oesophageal dilatation as evident in the radiographs. Two sample t test ($\alpha = 5\%$), showed there is a significant difference between the mean ROD values of hypothyroidism cases and non-hypothyroidism cases (P=0.0452). In addition, the radiographic findings, the triangular air column in cervical oesophagus and trachea-oesophageal stripe sign were also prominent. It is concluded that ROD could be used to confirm that megaoesophagus is caused by hypothyroidism.

Keywords: Dog, Megaoesophagus, Hypothyroidism, ROD

Health and Society

Effect of Cycling on Albuminuria

K.I.U. Kodagoda[1]*, W.K.D.S.A. Wickramarachchi[1],
L.R.N.D. Weerarathne[1] and U.D. Senarathne[2]

*[1]Department of Sports Sciences and Physical Education, Faculty of Applied Sciences,
Sabaragamuwa University of Sri Lanka, Belihuloya 70140, Sri Lanka
[2]North Colombo Teaching Hospital, Ragama 11010, Sri Lanka
ushedya.kodagoda@gmail.com

Albuminuria is a presence of abnormal amounts of albumin in urine that is considered as a sign of defective glomerular membrane. It can also be benign when present due to physical exercise; called 'exercise induced albuminuria' which is reversible. Prime aim of this study was to identify the effect of cycling on urine albumin excretion. A quasi experimental research design was used for the study with an interventional approach. 12 –professional cyclists from Naval-base, Welisara were selected using total population sampling. Urine Albumin to Creatinine Ratio (ACR) was used to assess albuminuria before and after training sessions. Workout intensity was measured by calculations done using post training pulse rate. Hydration level was measured using the body weight loss, water intake and the urine volume passed. Paired t-test was used to analyze data from pre and post-test ACR levels. Pearson correlation test was used to identify the relationship between hydration level measured by sweating rate, and ACR increase, between intensity and ACR increase and between pre-test ACR level and post-test ACR level. There was a significant difference between pre session urine ACR and post session ACR (P=0.026). There was a positive correlation between the ACR difference and the intensity (p=0.002, r=0.793). There was no significant relationship between hydration level measured by sweating rate and the ACR difference (p=0.353, r=0.295)). There was a positive relationship between pre-session ACR and post-session ACR levels (p=0.000, r=0.987). The post exercise urine ACR was calculated to be 1.305 mg/mmol which was within the normal range according to the NICE Guidelines (2008) – UK though the amount had been increased. It was increased up to micro-albuminuria level. Testing urine albumin excretion 24-48 hours after training would be better to confirm recovery of athletes to ensure whether there is no negative effect of training on renal function.

Keywords: ACR, Intensity, Hydration, Cycling

Relationship between Gym Training and Albuminuria among Female Gym Trainees

K.I.U. Kodagoda[1]*, W.K.D.S.A. Wickramarachchi[1],
L.R.N.D. Weerarathne[1] and U.D. Senarathne[2]

[1]*Department of Sports Sciences and Physical Education, Faculty of Applied Sciences,
Sabaragamuwa University of Sri Lanka, Belihuloya 70140, Sri Lanka*
[2]*North Colombo Teaching Hospital, Ragama 11010, Sri Lanka*
*ushedya.kodagoda@gmail.com

Albuminuria is presence of abnormal amounts of albumin in urine that is considered as a sign of defective glomerular membrane. It can also be benign when present due to physical exercise; called 'exercise induced albuminuria' which is reversible. Prime aim of this study was to identify the effect of gym training on urine-albumin excretion. A quasi-experimental research design was used for the study with an interventional approach. 30 female gym trainees in Gampaha divisional secretariat division were selected using proportionate stratified random sampling. Urine Albumin to Creatinine Ratio (ACR) was used to assess albuminuria before and after training sessions. Workout intensity was measured by calculations done using post-training pulse rate. Hydration level was measured using body weight loss, water intake and urine volume passed. Pearson correlation was used to identify the relationship between hydration level measured by sweating rate, and ACR increase, between intensity and ACR increase and between pre-session ACR level and post-session ACR level. There was a significant difference between pre-session urine ACR and post-session ACR (P=0.002). There was a positive correlation between ACR difference and intensity (p=0.003, r=0.521). There was no significant relationship between sweating rate and ACR difference (p=0.379, r=-0.182)). There was a positive relationship between pre-session ACR and post-session ACR levels (p=0.010, r=0.473). According to the statistical analysis, the mean value of pre-exercise albumin level of the gym trainees was 1.147 mg/mmol indicating that their average urinary albumin excretion is within the accepted normal range. The post-exercise urine ACR was found as 3.293 mg/mmol indicating that urinary albumin excretion has increased to the range of micro-albuminuria following exercise according to the NICE Guidelines (2008) – UK. Testing urine albumin excretion 24-48 hours after training would be better to confirm recovery of athletes to ensure whether there is no negative effect of training on renal function.

Keywords: ACR, Intensity, Hydration, Gym training

Effectiveness of Yoga Exercises to Improve Attention and Concentration of Athletes in Holy Angels Girls College, Kuliyapitiya, Sri Lanka

T. Piyumika[1], K.C. Gunasekara[2]* and S. Weerasinghe[1]

[1]Department of Sports Science and Management, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda 10250, Sri Lanka
[2]Health and Physical Education Unit, National Institute of Education, Maharagama 10280, Sri Lanka
*gunasekara.kalpani@gmail.com

This study was conducted to explore the effect of yoga exercises to maintain attention and concentration of the school athletes during sports training. A sample of 60 athletes (netball/athletics/cricket) aged 13-15 years were selected using stratified random sampling and randomly assigned to control and treatment groups (n=30 per group). Participants of both the groups engaged in their respective sports training as usual. The treatment group underwent three yoga sessions per week for 03 months. All participants completed the Test of Attention and Concentration (TACL) before and after a training programme. TACL focuses on broad external attention (BET), broad internal attention (BIT), narrow effective focus (NAR), external overload attention (OET), internal overload attention (OIT), and errors of under-inclusion (RED). Paired t-test was used to compare between attention and concentration of athletes before and after training. According to results, pre- and post-test scores of the treatment group were significantly different (P<0.05) with respect to OIT (P=0.000), NAR (P=0.000), BIT (P=0.008) and RED (P=0.001) whereas no differences existed between scores for BET and OET. In contrast, pre- and post-scores of all tested traits did not differ (P>0.05) in control group. Thus, the proposed yoga session improved athletes' ability to concentrate on more than one task and effectively narrowed the attention/concentration focus, while reducing the difficulty of broadening attention focus and diminishing the tendency for internal overloading. In conclusion, the yoga training programme had a positive effect on concentration and attention of the sample.

Keywords: Concentration, Attention, Yoga

Knowledge, Attitude, Motivational Factors and Barriers for Donating Blood Voluntarily among People Aged between 18-55 Years Living in Manmunaipattu, Batticaloa

K. Kajenthini*, L.D.M Madhuwanthi, J.P.M Chandrika and A.P.G.S.M Jayarathna

Department of Supplementary Health Sciences, Faculty of Health Care Sciences, Eastern University, Batticaloa 30000, Sri Lanka
*kajufhcs12@gmail.com

According to global data, there is a gradual decline in voluntary blood donations throughout the past decade. Increase in the life expectancy, rates of accidents and specialized surgeries have increased the rate of blood usage. It has become a global need to study on blood donation to obtain safe blood from the donors. The statistics available in the blood bank, Batticaloa number of voluntary blood donors are very less in all divisions. A cross sectional descriptive study was conducted by using an interviewed administered questionnaire, anonymous questionnaire to determine the knowledge, attitude, motivational factors and barriers among people in selected Grama Niladhari Divisions in Manmunaipattu. Simple random sampling method was used to select the sample. Validity of the study instrument was done by primary supervisor of our study, medical officer and nursing-in-charge attached to the blood bank. The ethical clearance was obtained from Ethical Review Committee, Faculty of Health care sciences, Eastern University. Data was entered, analyzed and interpreted using SPSS version 19. This study included 405 randomly selected participants with age range from 18-55 years with the mean age of 30(SD 7.8). Majority of them were females (52.1%), married (48.9%), Tamils Hindu (89.4%) and had secondary education (92.9%).33.1% of them had previous experience on voluntary blood donation. 51.36% had adequate knowledge on eligible criteria for blood donors.92.3% of them answered positively as blood donation is a healthy habit. Altruism, peer pressure was significant motivational factors, in which the majority accepted donating blood as social responsibility. 55% of them responded that fear of seeing blood, fear of needle pain and fear of gaining weight were major barriers for not to donate blood voluntarily. Motivating the individuals from the society for voluntary blood donation through conducting series of well-planned awareness programme is a novel finding of this study.

Keywords: Voluntary blood donation, Motivational factors, Validity, Altruism, Awareness

Patterns and Practices of Food Consumption according to Ayurveda and Sri Lankan Traditional Medicine among School Children

N.V.Y. Diloopa* and E.R.H.S.S. Ediriweera

Institute of Indigenous Medicine, University of Colombo, Rajagiriya 10107, Sri Lanka
*nanayakkara.yd@gmail.com

Nonhealthy patterns and practices of food consumption are proven as a major health determinant in increasing of noncommunicable diseases. Modern scientific findings provide evidence for benefits of some food consumption methods mentioned in Ayurveda and Sri Lankan traditional medicine. Hence, implementing healthy food consumption practices per Ayurveda and Sri Lankan traditional medicine are important. This was a cross-sectional study conducted to determine the prevalence of these practices among the school children. Consented 147 volunteer students from a selected school in Bandaragama, Kaluthara district within the age of 14-15 years were given an interviewer administered questionnaire based on the recommended and non recommended patterns and practices of food consumption mentioned in Ayurveda and Sri Lankan traditional medical texts. Prevalence of certain food consumption patterns and practices were calculated as a percentage. Prevalence of non-healthy food patterns of skipping meals (48.29%), suppressing hunger (54.2%) and thirst (4.89%), natural milk consumption substituted by formulated milk and artificial drinks (88.43%), consumption of tea (6.85%) and coffee (10.28%) within short gaps from main meals, inadequate liquid consumption (74.56%), disregarding the relationship between seasonal changes and food consumption (94.56%), ignoring post-consumptive etiquettes based on different facts (4.09%- 98.76%) and paying less attention to food while consuming meals (36.05%) were major contradictory patterns and practices that came in to light. Almost all the participants were unaware about the *Guru* (hardly digestible) and *Laghu* (easily digestible) properties of the food. The survey concluded that there exist a considerable range of non healthy food consumption patterns and practices in relation to Ayurveda medicine among the sample. Further, studies with a wider scale of population within different socio demographic status are important to find reasons behind these unhealthy practices. It will help to improve the health status by applying appropriate lifestyle modifications and healthy practices for the prevention of higher incidences of noncommunicable diseases.

Keywords: Ayurveda, Dietary practices, Food, Patterns, Sri Lanka

Impact of Organizational Culture on Employee Motivation: A Study on Managerial Nurses in Children's Hospitals of Sri Lanka

S.Y. Bandara[1]*, W. Athukorala[2], A. Gannoruwa[3], S. Kulathunga[4] and N. Hewageegana[5]

[1]*Lady Ridgeway Hospital for Children, Colombo 00800, Sri Lanka*
[2]*Department of Economics and Statistics, Faculty of Arts, University of Peradeniya, Peradeniya 20400, Sri Lanka*
[3]*Department of Materials and Mechanical Technology, Faculty of Technology, University of Sri Jayewardenepura, Homagama 10206, Sri Lanka*
[4]*Department of Human Resource Management, Faculty of Commerce and Management Studies, University of Keleniya, Kelaniya 11300, Sri Lanka*
[5]*Ministry of Health, Colombo 00010, Sri Lanka*
*samanyapabandara@gmail.com

Organizational culture is a common set of values and norms followed by individuals or groups within an organization. A hospital-based cross-sectional study was carried out to identify the impact of organizational culture on employee motivation in two children's hospitals of Sri Lanka. The level of perception of managerial nurses (matrons, sisters, and in-charge nurses) on how organizational culture (values, norms, and leadership styles) influence in motivating employees was investigated. 71 nurses working at the managerial level from the two Hospitals participated in the study. There was a positive correlation between employee motivation and organizational culture. The results of the linear regression model implied that a meaningful impact of organizational culture exists on employee motivation. Further, the responses from the two respective hospitals showed no difference in two means. These findings were consistent with existing literature and a positive correlation between organizational culture and employee motivation was observed in this study. The results will be useful to measure and adjust organizational culture to motivate employees in order to achieve successful pediatric patient care in Sri Lanka.

Keywords: Organizational culture, Motivation, Health care workers, Leadership styles, Values and norms

Who Pays for Healthcare in Sri Lanka?:
A Progressivity Analysis in Healthcare Financing

A.N. Fernando

Department of Economics, Faculty of Arts, University of Colombo,
Colombo 00300, Sri Lanka
ashani@econ.cmb.ac.lk

Often, government healthcare policies are aimed at safeguarding the most vulnerable groups by ensuring pro-poor financing of human development services. Furthermore, ensuring affordable and equitable healthcare and financial protection is an important policy objective accepted universally. The healthcare financing mix of Sri Lanka consists mainly of public spending, out of pocket expenditure (OOP) and private health insurance. However, the key research problem is to identify the extent to which the financing mix is able to address the equity goals of Sri Lanka. The main objective of the study was to investigate who among the rich and poor contribute to healthcare financing by reviewing the behaviour of the sources of healthcare financing. The Household Income and Expenditure Survey (HIES) of 2016 was used in the study. The methodology was sharpened to assess progressivity of healthcare payments by deriving the Concentration Curve and computing the Concentration Index (CI) and Kakwani Index for each health financing source. The results indicate that the total health expenditure of Sri Lanka was mainly financed by direct payments done by households, sources of government revenue and private insurance premiums. The analysis revealed a positive CI and Kakwani index for direct and indirect taxes, OOP, and private insurance premiums. This implies that in all health financing sources of Sri Lanka, the rich not only pay more in absolute terms but also in relation to ability to pay. The negative Kakwani index recorded for taxes for tobacco and liquor consumption implies that the poor pay more taxes in this regard than the rich. The paradox of the progressive healthcare financing mix is reflected through the strong contribution of OOP spending and the growth of the private sector where households are compelled to finance health through their own funds. This would cause households to incur catastrophic expenditures, especially among the lower income spectrum of the society.

Keywords: Concentration index, Healthcare financing, Kakwani Index, Progressivity analysis

Relationship between Childhood Maltreatment and Alcohol Addiction in Middle Adulthood

H.C. Abhayarathna* and A. Bulathwatta

*Department of Psychology, Faculty of Arts, University of Peradeniya,
Peradeniya 20400, Sri Lanka
chathurikaabhayarathna@gmail.com

Childhood trauma and maltreatment have been frequently identified in the life histories of patients in treatment for substance use disorders. This paper examines the relationships between the childhood profiles who reported to have undergone childhood maltreatment and alcohol addiction characteristics. In this regard, the methodology adopted was the following: twenty- five alcohol addicted male patients between the age of forty to sixty years from Mampitiya rehabilitation hospital were recruited. Childhood maltreatment/trauma was assessed using Childhood Trauma Questionnaire (CTQ),(*Bernstein & Fink*, *1998*) and by a semi structured interview questionnaire consisting of questions relevant to childhood and alcohol consumption. Content and narrative analysis methods were used with predetermined themes (The socio-economic background and the educational level of the participants were also considered). It was found that the mean age of subjects was 45.2 yrs. The majority were raised in low socio-economic backgrounds (88%) and were poly drug users. On the CTQ 56% reported physical neglect, 60% emotional neglect, 72% emotional abuse and 84% for physical abuse. Overall, 74% of participants reported experiencing at least one type of abuse. Subjects who scored high on CTQ are heavy users of alcohol with an early age onset (< 15 yrs) compared with the subjects with low to moderate scores. The findings of the study portray that a majority of alcohol addicted patients has undergone at least one form of childhood maltreatment in their childhood. The results suggest childhood maltreatment and trauma occur due to many factors, with socio-economic problems, poverty, inadequate love, and care serving as risk factors for alcohol addiction in later life.

Keywords: Childhood, Maltreatment, Trauma, Alcohol, Addiction

Enduring Death and Bereavement: An Analysis of Sinhala Buddhist Funerary Practices and Worden's 'Four Tasks of Mourning'

G.M.V.P.S. Gunawardana

Navy Headquarters, Colombo, Sri Lanka
gunawardanavishanka@gmail.com

Cultures around the world practice different funerary rites to cope with death and bereavement. Similarly, Sri Lankan Sinhala Buddhist funerary practices have their inherent way of managing the negative emotions and feelings of people who suffer at their loved ones' death. It is an aid to the immediate family members of the deceased to move on with life. Western psychologists also have developed treatment models to manage negative consequences concerning human behaviour in utmost needy situations. This study comparatively analyzed Sinhala Buddhist funerary practices and the psychologist J. W. Worden's model of 'four tasks of mourning' to endure death and bereavement. His model is flexible for healthy grieving as well as adjusting to life without any enforcement. Participatory observation was used to collect primary data on Sinhala Buddhist funerary practices while psychological treatments were used as secondary data. The study analyzed the two modes under accepting death, working through the pain, adjusting life, and moving on with life. Worden's model is scientific and a gradual process while Sinhala Buddhist funerary practices incorporate the same but as a ritualistic process. Sinhala funerary practices are mostly influenced by the Buddhist philosophical concepts '*kamma*' and impermanence. For example, funeral banners carry the Buddhist principle 'All compounded things are impermanent' (*anicca vata sankhara*). The social support system also helps the enduement process of the family. These support systems aid in adjusting to the new reality of living in the absence of loved ones. Worden's framework of four tasks manipulates the inner spiritual peace and the support of society. Hence, features of Worden's flexible model can be identified in the Sinhala Buddhist funerary practices of Sri Lanka. Methodical processes aid a person to cope with death and bereavement through psychological support while Sinhala-Buddhist funerary practices provide the same aid as a cultural practice.

Keywords: Death and Bereavement, Enduement, Four tasks of mourning, Funerary practices, Sinhala Buddhist Culture

Factors Related to Substance Abuse among Students in Rajarata University of Sri Lanka

J.A. Milroy

Research Centre for Drama Therapy, Colombo 00500, Sri Lanka
asamilroy@gmail.com

The gradual increase of substance abuse among educated youth has become a critical issue in Sri Lanka. Due to absence of systematic efforts, reasons as to why educated youth tend to use such illicit drugs remain unexplored**.** The present study explores the factors underlying the substance abuse of educated youth by taking a risk sample of young undergraduates from a Sri Lankan State University. This qualitative study employed in-depth interviews to gather data. Sample selection was conducted utilizing the snowball method, to include the undergraduate students who engage in substance abuse. Data was gathered from 10 key informants and the analysis began with coding. Coding was done in two rounds; first to identify the broad categories and then to identify the themes in each category. Accordingly, the first round of coding divided the responses into five categories as usage stage, usage pattern of drug varieties and the consequences experienced, in addition to the factors affecting the usage of drugs**.** The responses reveal that many of the young students use varieties of drugs, namely, cigarettes, alcohol, cannabis, hash, heroin, crystal meth, tablets, pills, stamps and LSD. Factors that lead to substance abuse appear in three main themes: personal factors, social factors, and economic factors. It is curiosity, relaxation and happiness-expectations, biological factors, and psychological factors that appear as personal reasons. Peer influence, freedom of the environment, and undisturbed access to the drug network were found at the social level. Having a personal source of income and adequate external financial support appeared to be the economic factors for students' engagement in drug usage. Accordingly, the findings of this study offer a basis to take necessary measures to avoid the potential threats and negative consequences created by this hidden problem, while establishing the vital importance of engaging in serious discussion on the matter.

Keywords: University students, Substance abuse, Variety of drugs, Living environment

Development of a Screening Tool to Identify Psychological Morbidity of New Entrants of University of Peradeniya

H.M.C.L. Herath[1]*, T. Rajapakse[2], D. Edussuriya[2],
D.D.K.S. Karunannayake[3] and W.D. Chandrasena[5]

[1]Health Centre
[2] Department of Psychiatry, Faculty of Medicine
[3]Department of Forensic Medicine, Faculty of Medicine
[4]Department of Psychology, Faculty of Arts
[5]Science Education Unit, Faculty of Science
University of Peradeniya, Peradeniya 20400, Sri Lanka
*drchalakmini@gmail.com

Mental well-being is very important to become an effective and efficient member of the society. The mental health and behavior of a person is influenced by individual and environmental factors experienced during childhood, adolescence and early adulthood. Although many studies have been conducted with the general public, there are only a very few studies conducted to identify risk factors for development of psychological morbidities among university students. Thus, the aim of this study was to develop a screening tool to identify those at risk of developing psychological morbidity among new entrants to the University of Peradeniya. This study adopted a mixed methods approach. In phase I, the preparation of a preliminary questionnaire was accomplished with developing a Semi-Structured Interview Guide (SSIG) through literature review. To identify risk factors for development of psychological morbidity among new entrants, in-depth interviews were conducted using the SSIG among key informants and a list of risk factors was identified through thematic analysis. In the phase II, refining the preliminary questionnaire and the reduction of items were carried out through discussion with an expert group and after conducting two Delphi rounds among experts consisting of administrative staff and service staff of the university and teaching hospitals in Peradeniya and Kandy. The data was collected in the above two phases from the Deputy Vice-Chancellor, Registrar, Wardens, Sub-Wardens, Heath Center staff, Staff of the Career Guidance Unit, Senior Student Counsellors, Consultant Psychiatrists, and Psychologists. The pilot test of the prepared tool was conducted with 50 first year students. The final tool was constructed with 28 items and the reliability of the factors was greater than .6 in the Cronbach alpha scale. The prepared tool is ready to use with the new entrants of University of Peradeniya to screen and extend support to vulnerable students to help them overcome their psychological issues.

Keywords: Psychological morbidity, University new entrants, Risk factors, Screening tool, SSIG

Developing a Culturally Sensitive Parenting Style Measure

E.H.M.R.K. Ekanayake[1]*, R.M. Mudiyanse[1] and V.P. Wickramasinghe[2]

[1]Department of Paediatrics, Faculty of Medicine, University of Peradeniya, Peradeniya 20400, Sri Lanka
[2]Department of Paediatrics, Faculty of Medicine, University of Colombo, Colombo 00700, Sri Lanka
*rkekanayaka1992@gmail.com

The significance of parenting on child development has been recognized as early as the 17th century. Baumrind recognized authoritative, authoritarian, and permissive parenting styles in 1971. After the recognition of responsiveness and demanding dimensions of parenting, a 4th entity called neglectful parenting also emerged. The implications of parenting style on child development have been well documented. Developing tools to assess parenting style is a challenge due to the socio-economic and cultural influences on it. The instruments developed taking these facts into consideration would help educators and researchers to assess parenting style. The objective of this study was to explore items available in the literature to determine parenting style and to evaluate their suitability to be used among Sinhala speaking parents of preschool-aged children in Sri Lanka considering expert opinion. Out of 54 instruments published from 1941 to 2017, 19 were parent-reported questionnaires and 35 were child-reported questionnaires. Out of them, Parenting practices questionnaire, Parent as Social Context Questionnaire, Preschool Parenting Measure and Parenting Style Four Factor Questionnaire were selected because of their reported validity as parent-report questionnaires. These instruments consisted of 134 items and they have been recognized either as parenting styles or as core features of parenting. After the elimination of duplicates, there were 74 items that could possibly be adopted to develop a parenting style survey tool. These items were submitted to a 4-member panel of experts in the field of pediatrics and education with the request to comment on the suitability of those items to assess parenting style in Sri Lanka. However, the panel stressed the need to develop authentic and culturally sensitive items suitable for Sri Lanka. In conclusion, in spite of the availability of internationally recognized tools for the assessment of parenting style, the consensus was to develop a culturally sensitive locally validated tool. Available literature could be used in developing a guide for Focus Group Discussions and In-depth interviews.

Factors Affecting Overall Quality of Life of the Elderly Living in Informal Caregiving Settings in Colombo District, Sri Lanka

H.S.M.S.K. Wijesiri[1]*, S.H. De Silva Weliange[2],
S. Wasalathanthri[3] and C.N. Wijeyaratne[4]

[1]*Department of Nursing and Midwifery, Faculty of Allied Health Sciences, General Sir John Kotelawala Defence University, Boralesgamuwa 10290, Sri Lanka*
[2]*Department of Community Medicine* [3]*Department of Physiology*
[4]*Department of Obstetrics and Gynecology*
Faculty of Medicine, University of Colombo, Colombo 00800, Sri Lanka
*maligaskumari@kdu.ac.lk

Quality of life (QOL) explains the aspects of health, functional status and well-being of the people. This community-based cross-sectional study examined the factors affecting the overall QOL of the elderly living in informal caregiving settings in Colombo district, Sri Lanka. A representative sample (n=723) of elderly people aged >65 years was obtained by multi-stage cluster sampling. Sociodemographic variables were recorded and overall QOL was assessed using a validated Sinhala version of WHOQOL BREF Questionnaire. Activities of daily living (ADL) and instrumental activities of daily living (IADL) were assessed using validated Sinhala versions of 10-item Barthel Index and Lawton IADL scales respectively. Data analysis was done using SPSS 20. Simple and multiple linear regression analyses were conducted to find the associations between overall QOL and the sociodemographic data, activity limitations and morbidity data. Mean ± SD age of the elderly was 72.23±6.3 years and mean ± SD score of the overall QOL was 56.73±12.57 out of 100. Overall QOL was negatively associated with ADL (beta coefficient [β]=-6.44, p<0.001) and IADL limitations (β=-4.82, p<0.001), and having arthritis (β=-3.01, p<0.01) and heart disease (β=-2.84, p<0.05) in adjusted models. Significant positive associations were observed between the overall QOL and the educational status (secondary education β=3.29, p<0.01; tertiary education β=8.91, p<0.001), living conditions (living with spouse β=6.43, p<0.01; living with spouse and children β=5.05, p<0.01), participation in religious activities (β=7.01, p<0.001), frequently visited by relatives or friends (β=3.13, p<0.001) and financial independence (β=3.52, p<0.001) in adjusted models. Presence of activity limitations and chronic diseases, especially arthritis and heart disease tend to reduce the QOL while having higher educational status, living with family members, participating in religious activities, having regular social interactions with friends and relatives and financial independence tend to improve the QOL of elderly living in informal caregiving settings.

Keywords: Overall QOL, ADL, IADL, Elderly, Informal caregiving settings

Impact of Stuttering Related Emotions on Participation in Educational Activities among Adolescents with Stuttering in Western Province

K.A.W.M. Kudaarachchi*, T. Wijesinghe and B.M.R.K. Perera

Department of Disability Studies, Faculty of Medicine, University of Kelaniya, Ragama 11010, Sri Lanka
*warunikudaarachchi@gmail.com

The nature of stuttering has the potential to elicit embarrassment, frustration, and/or pity from the listener; therefore, it is inevitable that it is associated with some degree of fear, anxiety, and/or frustration in the person who stutters. The main aim of the study was to determine the influence of stuttering-related emotions on participation in educational activities and to specifically identify the types of emotions (negative/positive) of adolescents with stuttering, to determine thoughts associated with activities related to education of adolescents with stuttering and to identify the impact of stuttering related emotions and thoughts on the participation in the activities related to education. The study included 20 adolescents in the age range 11 – 17 with stuttering who are attending mainstream schools and have accessed speech and language therapy clinics in general hospitals in the Western Province but still received only the assessments. 75% were male and 25% were female. A descriptive cross-sectional mixed study (with quantitative and qualitative components) was used for this study and two different tasks were used for collecting data: self-administered questionnaire (Likert scale) and Semi-structured interview. The content validity was done with 5 SLTs with 5 years' clinical experience. The continuous variable was used in obtaining the mean, standard deviation, minimum, and maximum values, while the descriptive analysis of the discrete variables was used to calculate the absolute and relative frequency. Phenomenological qualitative data was analysed through thematic analysis. The present study indicates that adolescents with stuttering have more negative feelings and thoughts toward their stuttering; the majority of the participants had to experience negativity in school, classroom and private class situations. These negative emotions and thoughts related to stuttering mainly negatively affected their participation in educational activities. Therefore, the current study concludes that most adolescents with stuttering impact their participation in educational activities due to negative emotions and thoughts related to stuttering. However, supportiveness from friends, teachers and other educational professions can encourage positive feelings and thoughts which may then transform this to a positive output.

Keywords: Adolescents, Emotions related to stuttering, Thoughts related to stuttering, Participation of educational activities

Factors Affecting Perceived Stress:
A Study of First-Year Undergraduates of Eastern University, Sri Lanka

A.M.S.S. Alahakoon[1]*, K. Arulanandem[2], K.W.N. Savinthani[1], S.P.E.G. Smarasinghe[1], A.H.R. Ahamed[1] and R.M.N. Jayaweera[1]

[1]Department of Supplementary Health Sciences
[2]Department of Primary Health Care
Faculty of Health Care Sciences, Eastern University, Batticaloa 30000, Sri Lanka
*shashishardhapgck@gmail.com

Stress is associated with limitations in higher education and negatively affects academic performance, physical health, and psychological wellbeing of students. This cross-sectional study addressed factors that are associated with perceived stress (PS), their prevalence, and the correlation to PS. From the first-years, 333 were selected representing all 7 faculties of the Eastern University, Sri Lanka using a simple random sampling technique. A Self-administered questionnaire was used to gather data. Frequencies and correlations with PS with regard to academic, physiological, social, psychological, and environmental factors were analyzed using Pearson correlation coefficient. Among the participants difficulty to deal with academic problems (13.1%), and studying for long hours (23.5%), too much academic work load (24.1%), poor performance at lectures (5.2%), and boredom felt when attending regular lectures (8.8%) were identified as academic factors significantly correlating with PS. Frequent headaches (12.2%), problems related to gastrointestinal system (5.5%), sleep related issues (14.3%), respiration (2.1%), cardiac (1.5%) and urinary (3.4%) systems related issues, poor appetite (13.4%), and fatigue and tiredness (12.2%) were the physiological factors ($p<0.05$) that significantly correlated with PS. Lacking good relationship with family (10.4%) and friends (3%), inability to enjoy meeting people (9.1%), conflicts with others (4%) and lecturers (8.5%), desire to be alone (13.7%), insisting others on self-opinion (4.9%), poor conflict resolution skills (2.1%), financial problems (19.5%) were the social factors that significantly correlated with PS ($p<0.05$). Suicidal thoughts (2.1%), feeling inferior (5.5%), lack of clear vision on future (7.9%), low self-esteem (5.5%), problems with love affairs (5.2%), feeling lonely (4.3%) were the psychological factors that significantly correlated with PS ($p<0.05$). Lack of extracurricular activities (3.7%), changes in food and food patterns (14%), low quality health services (26.8%), and lack of well-equipped hostels (25.6%), were the environmental factors which significantly correlated with PS ($p<0.05$). There were many factors prevalent among first-year students which positively correlated with PS and were statistically significant. The university system should address these issues and take appropriate interventions to minimize them.

Keywords: Affecting factors, Perceived stress, Undergraduates

Social Factors Affecting Health Seeking Behaviour (HSB) of Elders with Physical Disabilities (EWPD)

W.A.S. Thilanka* and K.A.K.I.C. Gunasena

Department of Sociology, Faculty of Arts, University of Peradeniya, Peradeniya 20400, Sri Lanka
*sumuduwijesuriya@gmail.com

Since ageing has become an alarming issue in the Sri Lankan population, elders' wellbeing is being challenged in many domains. Among them, physical disability increases the degree of elders' vulnerability. In this milieu, this study identified HSB of EWPD as a significant research area. Study attempted to identify the availability of supportive services and individual determinants that impact the HSB of EWPD. Primary qualitative data was collected through in-depth interviews from purposively selected 20 EWPDs. Study was conducted in 205-A GN division of Ja-ela DS division located in the industrial zone. Data was analysed using thematic analysis method. The elected area had the necessary public and private infrastructural facilities. It was found that EWPD prefer private facilities over public ones due to unspecific reasons. Considering individual determinants, it was revealed that financial capacity has a great impact on individual's HSB. Those who have savings, receive pensions, or possess other financial capacity are independent in making decisions with regards to their health expenses. When caregiving is performed by family, it becomes an influencing factor of HSB. Intimate relationships are a push factor to be self-conscious about the wellbeing of EWPD. Conflictual primary relationships discourage the HSB further increasing health vulnerability. In addition, cultural beliefs and practices play a significant role in governing HSB. Specially, disability is interpreted in terms of religious beliefs. Instead of professional medical support, they mostly seek complementary or alternative medical support. Based on these findings, it can be concluded that the financial self-sufficiency leading to affordability of health and other supportive facilities empowers EWPD to make decisions on HSB Despite physical impairments. The nature of their primary relationships plays a decisive role in HSB of EWPD. Finally, socio-cultural constructions on ageing and disability too determine HSB although other factors contribute positively. Overall, HSB of EWPD is primarily influenced by individual factors, not socio-economic factors such as the availability and accessibility of health services.

Keywords: Health seeking behaviour, Elderly, Physical disability, Complementary medicine, Alternative medicine

A Preliminary Study on Factors Affecting Betel Quid Chewing, Smoking and Alcohol Use, Following Diagnosis of Potentially Malignant Oral Disorders and Oral Cancer

S.R. Sumithrarachchi[1]*, W.A.U.C. Pemasiri[2], D. Pathiranage[2] and P.R. Jayasooriya[1]

[1]*Department of Oral Pathology, Faculty of Dental Sciences*
[2]*Department of Nursing, Faculty of Allied Health Sciences*
University of Peradeniya, Peradeniya 20400, Sri Lanka
*sumalis94@gmail.com

Betel quid (BQ) chewing, smoking and alcohol use are known risk factors of oral potentially malignant disorders (OPMDs) and oral cancer. This study aimed to determine key factors for quitting or continuing these habits after diagnosis of such oral lesions. A cross sectional study was conducted among 50 participants who had risk habits diagnosed with OPMDs or oral cancer. A questionnaire validated in Sinhalese was used to gather information on dependence to risk habits. The sample consisted of a majority (82%) of males and >90% were from a low socio-economic background. A nearly equal age distribution of ≤60 years (44%) and >60 years (56%) were observed. 34% of them had all risk habits and when analyzed separately 82%, 58% and 56% had BQ, smoking and alcohol use respectively. Majority of BQ (93%) and alcohol users (79%) were dependent while only 14% of smokers were dependent on the habit. 34% of the sample had developed OPMDs while 66% were diagnosed with oral cancer. It revealed that after diagnosis of oral lesions, a significant ($p<0.05$) majority quit their habits; BQ (75%), smoking (79%), alcohol (68%) mainly due to factors like fear of death (BQ-35%; smoking-10%; alcohol-21%), pain and discomfort (BQ-29%; smoking-24%; alcohol-26%), medical interventions (BQ-10%; smoking-22%; alcohol-11%) and presence of other co-morbidities (BQ-13%; smoking-14%; alcohol-16%). However, out of 10, 6 and 9 persons who continued BQ, smoking and alcohol use, 20% (2), 34% (2) and 78% (7) of BQ, smoking and alcohol users respectively were occasional users while the rest were extremely addicted daily users. Key factors for habit cessation after diagnosis of OPMDs or oral cancer include fear of death and pain/discomfort which can be emphasized through prevention programs, even prior to development of such oral lesions in those with risk habits.

Keywords: Habit cessation, Betel quid chewing, Tobacco smoking, Alcohol use, Oral cancer

A Survey on Orthodontic Retention Practices among Consultant Orthodontists in Sri Lanka

W.B.M.C.R.D. Weerasekera*, A.A.A.K. Wimalarathna and E.M.U.C.K. Herath

Department of Community Dental Health, Faculty of Dental Sciences,
University of Peradeniya, Peradeniya 20400, Sri Lanka
*chandimaw@pdn.ac.lk

Orthodontic retention phase is mandatory following active treatment. New developments in the orthodontic retention strategies have created a wide variation and hence a personal preference exits. This study aimed to survey the retention practices of the consultant orthodontists in Sri Lanka. Consultant orthodontists (n=34) who fulfilled inclusion criteria were enrolled in this study. A survey questionnaire was modified according to Sri Lankan perspective, pre tested and self-administered via online Google forms. Questionnaire comprised 04 parts; 1. socio-demographic information of the orthodontist 2. clinician's preference on different retainer types, wearing duration, number of retention check-ups 3. type and size of wires used for permanent bonded retainers and 4. information on unintentionally active fixed retainers. Data was analysed using SPSS version 21 and descriptive statistics were obtained. A total of 29 (85.29%) orthodontists responded (27% of males and 73% of females). Most of the orthodontists (44.7%) belonged to 46-55-year age range and 69% were attached to government hospitals. The most preferred maxillary appliance was the Hawley retainer (62%) and bonded retainer (41.3%) for the mandible. 96% of Hawley retainers were fabricated by technicians and 96% of bonded retainers by orthodontists. Functional appliance (51.7%) was the most common adjunctive retention appliance used. An initial full time wearing of removable retainers was prescribed by all orthodontists for maxilla and 86.2% for mandible with check-ups performed every 2-4 months by 83% of orthodontists. Stainless steel triple strand round wire (41%) was the most commonly used wire type for bonded retainer. Hawley retainers for the maxilla and bonded retainers for the mandible were the most commonly prescribed retainers by Consultant Orthodontists in Sri Lanka.

Keywords: Orthodontic retention, Retainers, Consultant orthodontists

Validation and Cross Cultural Adaptation of Sinhala Version of Psychosocial Impact of Dental Aesthetic Questionnaire (PIDAQ) among Adolescents Seeking Orthodontic Treatment

W.B.M.C.R.D. Weerasekera[1]*, S.L. Pathirage[2] and M.M.S.L. Mellawa[1]

[1]Department of Community Dental Health, Faculty of Dental Sciences, University of Peradeniya, Peradeniya 20400, Sri Lanka
[2]Teaching Hospital Karapitiya, Galle 80000, Sri Lanka
*chandimaw@pdn.ac.lk

Use of a psychosocial index is essential for the assessment of the impact of malocclusion on the quality of life of the orthodontic patients. Psychosocial Impact of Dental Aesthetic Questionnaire (PIDAQ) developed for young adults seeking orthodontic treatment is a multi item psychometric instrument which investigates on four domains:dental self confidence, social impact, psychological impact and aesthetic concern. PIDAQ comprises of 23 items. The objective of the present study was to determine the construct validity and reliability of Sinhala version of PIDAQ.This was a cross sectional descriptive validation study and translation of the original English version of PIDAQ into Sinhala was done by a team of professionals adhering to translation and cross cultural adaptation and validation guidelines. Inclusion and exclusion criteria were checked and in a convenient sampling method 11-17 year old adolescents were recruited from University Dental hospital, Peradeniya and Teaching Hospital Karapitiya. Data was analyzed using SPSS version 21 and evaluated for reliability and validity. A total of 479 adolescents (51% of males and 49% of females) participated and mean age was 13.1 years. Kaiser-Meyer-Olkin measure of sampling adequacy was 0.870. A principal component analysis was conducted on the 23 items with varimax rotation and revealed 05 components with 57.88% variance. The internal consistency measured with Crohnbach alpha value was 0.8 (p<0.001). The internal consistency for subdomains were 0.8, 0.8, 0.6 and 0.8.The mean PIDAQ total score and the score of the Dental Esthetic Component of the Index of the Orthodontic Treatment Need (IOTN) showed significant correlation. PIDAQ Sinhala version has good internal consistency and construct validity.The Sinhala version of the PIDAQ is a reliable and valid tool to assess the psychological impact of the dental esthetics of the Sinhala speaking adolescent orthodontic patients.

Keywords: Quality of life, Adolescents, Orthodontics, Dental esthetics, Sinhala

CBCT Aided Pre-Assessment of Mandibular and Maxillary Bone Quality for Dental Implants

S. Subaviththiran[1], H.A. Sudam[1], S.P.C. Wathsala[1]*,
P. Gunathilake[2] and P.V.K.S. Hettiarachchi[3]

[1]Department of Radiography/Radiotherapy, Faculty of Allied Health Sciences
[2]Department of Statistics and Computer Science, Faculty of Science
[3]Department of Oral Medicine and Periodontology, Faculty of Dental Sciences
University of Peradeniya, Peradeniya 20400, Sri Lanka
*pathirana0806@gmail.com

Dental implants play a major role in permanent tooth replacement. Cone Beam Computed Tomography (CBCT) can be used to acquire detailed volumetric image data of the maxillofacial region for diagnostic and pre-surgical planning of dental implants. The purpose of this study was to design and evaluate a decision-making algorithm to quantitatively assess the alveolar bone density of the maxilla and mandible as a pre-implant assessment. CBCT images with edentulous maxillary and mandibular bone areas of 50 patients who have undergone CBCT scans in the University Dental Hospital, Peradeniya were selected. Those CBCT images were imported to the developed algorithm to calculate the Hounsfield values (HU) derived from Grey Values (GV) and categorized into types of alveolar bone density as stated in the Misch bone density classification. Moreover, same set of images were independently analyzed by two experts, and a manual assessment was performed on alveolar bone density according to Misch classification. The algorithm was more effective at locating the edentulous bone areas selected by the examiner and analyzing the bone density. Both experts were biased only on 40 cases with each other (80%) out of 50 cases. The correlation between CBCT, GV and CT numbers should be calculated when converting GV into HU. Even in our study, it was assumed that there is a linear relationship regardless of the kV due to the shortfall of proper calibration in the CBCT machine. Besides the two-expert biased optical assessment and lack of proper calibration of CBCT machine, the algorithm was competent to achieve overall reliability of 77.5% following the comparison of manual and algorithm assessed results.

Keywords: Cone beam computed tomography, Dental implants, Hounsfield units, Grey value, Bone density

Health and Society

Inhibitory Effects of Three Sri Lankan Herbal Formulas on Acid Production and Biofilm Formation by Major Cariogenic Bacterium – *Streptococcus mutans*

K.S.N.D. Gunawardhana, B.G.T.L. Nandasena, B.M.H.S.K. Banneheka,
N. Ranasinghe and M.P. Paranagama*

*Department of Basic Sciences, Faculty of Dental Sciences,
University of Peradeniya, Peradeniya 20400, Sri Lanka
madhaviparanagama@gmail.com

Dental caries is the most common oral disease of mankind. *Streptococcus mutans* is the primary etiological agent of dental caries. It metabolizes dietary carbohydrates to produce acids leading to tooth demineralization. This acidogenicity and the formation of a resilient biofilm are main factors contributing to their cariogenic potential. High incidence of caries in the community shows the need of alternative strategies to prevent this disease. Traditional herbal remedies (mouth fresheners, rinses, tooth brushing powders) are considered as effective alternative anticariogenic compounds. However, their scientific validation and characterization are scarce. This study aimed to analyze anticariogenic potential of three Sri Lankan herbal formulas. Formula I consisted of *Jasminum grandiflorum, Punica granatum, Elettaria cardamomum, Cinnamomum zeylanicum,* formula II consisted of *Cinnamomum Zeylanicum*, *Elettaria cardamomum*, *Pogostemonheyneanus* and formula III consisted of *Syzygiumaromaticum*, *Myristica fragrans*, *Elettaria cardamomum*, *Piper betle*, *Kaempferia galanga*, *Coriandrum sativum.* Their ability to inhibit the biofilm formation and acid production was evaluated by culturing *S. mutans* (ATCC 700610) in Tryptic soy broth containing 1% glucose with different concentrations (0.125 to 1 mg/ml) of methanolic extracts of herbal formulas in 12 well plates. Dimethyl sulfoxide and Chlorhexidine were used as negative and positive controls respectively. After 24 hours, pH of the cultures was measured and biofilm was stained with 0.1% safranin, photographed and analyzed. All three herbal formulas showed concentration dependent inhibition of *S. mutans* acid production and biofilm formation. Formulae I and II showed complete inhibition of *S. mutans* biofilm formation and acid production at a concentration of 0.5 mg/ml while for formula III it was 0.25 mg/ml. These results show that these 3 polyherbal formulas can inhibit the biofilm formation and acid production of *S. mutans*. Effect of these formulas on expression of genes responsible for *S. mutans* acid production and biofilm formation are in progress.

Keywords: Herbal formulas, *Streptococcus mutans*, Inhibitory effects, Acid production, Biofilm formation

Socio-Demographic Factors Associated with Postgraduate Training in the Specialty of Community Dentistry

B.K.G. Thilakarathne[1]*, D. de Silva[2] and L. Ekanayake[1]

*[1]Department of Community Dental Health, Faculty of Dental Sciences,
University of Peradeniya, Peradeniya 20400, Sri Lanka
[2]Health Human Resource Division, Ministry of Health, Colombo 01000, Sri Lanka
krishnat@dental.pdn.ac.lk.

The Postgraduate Institute of Medicine is the main training institute that is responsible for postgraduate training of medical officers and dental surgeons in Sri Lanka. It offers various programmes leading to diploma, Master's and doctoral degrees. In order to function as a specialist in a given speciality it is mandatory that a medical officer or a dental surgeon obtains the doctoral degree in that specialty. With respect to the specialty of Community Dentistry, the PGIM offers two degrees; MSc and MD and the MSc is a prerequisite to follow the MD programme. The aim of this study was to determine the association between socio-demographic factors and the decision to follow the MD programme among MSc degree holders in Community Dentistry. A descriptive cross-sectional study was conducted among 68 dentists who had passed the MSc in Community Dentistry within 2000-2019. A self-administered questionnaire was developed on Google Form. Socio-demographic data collected included age, sex, ethnicity, marital status, occupation of the spouse, permanent residence, number of kids and employment sector. Chi square test with Fishers exact test was used to assess the associations between socio demographic variables and the decision to pursue further studies. Subsequently a binary logistic regression analysis was performed to determine the independent associations between explanatory variables and the dependent variable; decision to pursue further studies. Having obtained the MSc, around 65% of the respondents had proceeded to follow the MD programme in Community Dentistry. Of those who did not pursue further their studies, nearly 25% had returned to clinical practice. Number of kids and working sector were significant variables associated with the decision to follow further studies. The findings indicate that apart from the desire to pursue further studies, number of kids and working sector were significantly associated with the decision to continue further studies in Community Dentistry.

Keywords: MSc (Com Dent), Socio-demographic factors, Career progression

Essential Oil from Ceylon Cinnamon (*Cinnamomum ceylanicum.* Blume) Inhibits Oral Bacterial Biofilms

W.A.M.U.L. Abeyasinghe[1]*, D.J. Epasinghe[4],
J.A.M.S. Jayatilake[2] and S.P. Kodithuwakku[3]

[1]*Department of Oral Pathology, Faculty of Dental Sciences*
[2]*Department of Oral Medicine and Periodontology, Faculty of Dental Sciences*
[3]*Deaparment of Animal Science, Faculty of Agriculture*
University of Peradeniya, Peradeniya 20400, Sri Lanka
[4]*Faculty of Dentistry, University of Hong Kong, Hong Kong*
*udari2005@gmail.com

Ceylon cinnamon (CC) is native to Sri Lanka and commonly available. Although CC essential oils have shown antibacterial effects they have not been tested against biofilms of clinically important oral bacteria such as *Streptococcus mutans, Actinomyces naeslundii* and *Lactobacillus acidophilus.* Our objective was to observe the effects of CC essential oils on biofilms of *S. mutans, A. naeslundii* and *L. acidophilus*. Biofilms were formed *in vitro* using a reactor combined flow system simulating the oral cavity. *S. mutans* and *A. naeslundii* were cultured in Brain Heart Infusion (BHI) broth supplemented with 50 mM sucrose. *L. acidophilus* was cultured in Rogosa and Sharpe agar supplemented with 50 mM glucose. Single-species biofilms of the bacteria mentioned above were formed on Hydroxyapatite Discs placed in the oral biofilm reactor. After 48 hour growth period, the discs were aseptically removed, and treated with following agents for 10 minutes: CC essential oil dissolved in 20% Dimethyl Sulfoxide (DMSO) in 0.2% and 0.4%; Chlorhexidine 0.2%; 20% DMSO as the solvent; respective culture medium as the negative control. Afterwards discs were assessed for viability by XTT assay, CFU units, and imaged using confocal laser scanning microscopy. XTT assay depicted significant reduction of viable bacteria in biofilms treated with 0.4% CC ($p<0.05$) for *L. acidophilus* (0.73 ± 0.023), *A. naeslundii* (0.81 ± 0.006) and *S. mutans* (0.21 ± 0.015) compared to the negative control. The CFU counts followed the same pattern with a significant reduction in colony forming ability by 0.4% CC ($p<0.05$). Confocal laser scanning microscopy with live/dead staining revealed the highest proportion of dead bacteria in biofilms treated with 0.4% CC. 20% DMSO only did not depicted significant inhibitory effect. In conclusion, 0.4% of CC essential oil in DMSO exerted generalized antimicrobial effects on tested biofilms.

Keywords: *Streptococcus mutans, Actinomyces naeslundii*, *Lactobacillus acidophilus*, Ceylon cinnamon

Evaluation of Epithelial and Fibroblast Senescence in Oral Submucous Fibrosis Using a Novel Senescent Marker DEP-1

W.A.M.U.L. Abeyasinghe*, T.M.P.B. Tennakoon,
W.M. Tilakaratne and P.R. Jayasooriya

*Department of Oral Pathology, Faculty of Dental Sciences,
University of Peradeniya, Peradeniya 20400, Sri Lanka
udari2005@gmail.com

Cellular senescence is a mechanism which has the potential to promote or suppress malignant transformation. Grade of oral epithelial dysplasia (OED) is being used to assess the probability of malignant transformation with variable success. The aim of this study was to evaluate the relationship between expression of senescence in the epithelium and fibroblasts at different grades of OED in oral submucous fibrosis (OSF) using the senescent marker-Density Enhanced Phosphatase-1 (DEP-1). Five micrometer sections of 106 formalin fixed- paraffin embedded OSF tissues were stained with anti-DEP-1 antibody according to the manufacturers' instructions. Quantification was done by counting fibroblasts with cytoplasmic and membranous positivity for DEP-1 and negative fibroblasts in 5 high power fields to obtain a mean value and by recording presence or absence of DEP-1 positivity of the epithelium. Statistical analysis (Chi square, ANOVA) was performed considering $p<0.05$ as significant. The results revealed that there is a statistically significant reduction ($x^2=7.019^a$, $p=0.043$) in DEP-1 expression in the epithelium in OSF cases with moderate and severe epithelial dysplasia (n=12/22) when compared to OSF cases without dysplasia and mild epithelial dysplasia (n=55/84). However, the number of senescent fibroblasts in the lamina propria did not show a significant relationship with OED ($p>0.05$). During early stages of OED and in cases of OSF without dysplasia, occurrence of senescence in the epithelium could be a mechanism which suppresses malignant transformation. In later stages of OED, epithelial cells which escapes the state of senescence may promote or/ undergo malignant transformation. Thus it could be worthwhile to explore further if DEP-1 expression in the epithelium is a more reliable predictor to identify OSF that may not undergo malignant transformation than the grade of OED.

Keywords: Senescence, Oral submucous fibrosis, Oral epithelial dysplasia, Density enhanced phosphatase-1

Knowledge about First Aid for Dental Avulsion among Nurses

S.D. Maithreepala*, D.R.T.S. Dassanayake, H.R.B.K. Rahinduwa,
N.T. Wijesinghe and H.D.W.T. Damayanti

*Department of Nursing, Faculty of Allied Health Sciences,
University of Peradeniya, Peradeniya 20400, Sri Lanka
sujeemaithreepala@ahs.pdn.ac.lk

An avulsion of a tooth is one of the most severe forms of dental injuries. Prompt and appropriate first aid for dental avulsion improves the prognosis of the tooth. Although nurses provide first aid for various trauma patients, evidence of providing first aid for dental avulsion is lacking. There is limited literature regarding nurses' knowledge of first aid for dental avulsion. Therefore, this study aimed to evaluate the knowledge of first aid for avulsed teeth among nurses using a narrative review approach. Abstracts, full texts, books, and documents that have been written in English language on nurses' knowledge on first aid for dental avulsion were searched. The keywords used for the search were knowledge, first-aid, dental avulsion, and nurse. Articles published from 2011 to 2021 were searched through Google Scholar, PubMed, and Science Direct databases. A total of 14 articles were selected and reviewed utilizing the thematic analysis method. From 50% (n=7) of selected articles, it was found that the knowledge among nurses on first aid management of dental avulsion was poor. Areas of inadequate knowledge on first aid management were identified under three themes: the ability of reimplantation, transport media, and cleaning media. There was no formal training for nurses to update knowledge on first aid for the avulsed tooth. They identified self-learning as a strategy to get the related knowledge. More than half (64%) of the articles indicated the willingness of nurses to participate in a formal training program on first aid for a dental avulsion. Initial management of the avulsed tooth, including first aid, is lacking in nursing education. Therefore, well-structured training on first aid management of dental avulsion needs to be arranged to improve the oral health-related quality of life.

Keywords: Knowledge, First aid, Dental avulsion, Nurse

Evaluation of Interpretational Skills of Dental Panoramic Radiographs among Dental Specialists, Postgraduate Trainees, Undergraduates and General Dental Practitioners in Sri Lanka

C. Gunasena*, P.V.K.S. Hettiarachchi, R.M.S.H.B. Medawela and R.D. Jayasinghe

*Department of Oral Medicine and Periodontology, Faculty of Dental Sciences,
University of Peradeniya, Peradeniya 20400, Sri Lanka
cgunasena039@gmail.com

Dental panoramic tomography (DPT), a commonly performed extra oral radiographic examination is an essential armamentarium that aids in the diagnosis, treatment planning, and assessment of prognosis of disorders of teeth and supporting structures. As this imaging modality results in the superimposition of the anatomical structures in the head and neck region, a thorough knowledge of the complex anatomy in this region is essential. Hence the present study aims to evaluate the knowledge level in different aspects of interpretation in DPT's among dental undergraduates and graduates in Sri Lanka. A cross-sectional descriptive study was performed, administering a questionnaire via the World Wide Web. Aspects of interpretational skills tested were anatomical landmarks, operator errors and pathologies. A total of 216 responses were obtained with female preponderance (females 132; males 84). 31.8% of respondents were general dental practitioners, 30.8% were undergraduates, 26.2 % were post-graduate trainees and 11.2% were consultants/ academics. Females scored more than males in all three aspects of the questionnaire (60.2 %, 57.9% and 59.7%). General dental practitioners had the highest average score among the four categories in all aspects of interpretation (anatomic landmarks: 30.7%, operator errors: 33.4% and pathologies: 31.3%). Comparison of scores among the different age groups revealed that the recently passed out graduates with 0-5 years' experience had the highest. Out of the sections in the questionnaire, 17% lacked knowledge in interpreting anatomical landmarks, 21.6% on operator errors and 26% on pathologies. These findings reveal that there is inadequate knowledge in the interpretation of anatomical landmarks and pathological lesions among the personnel in the Dental field in Sri Lanka. A reasonable number of participants showed a lack of knowledge in the interpretation of operator /positional errors in DPT's. Continuous dental educations sessions in DPT's should be done with more weight on the interpretation of operator /positional errors in DPT's.

Keywords: Dental panoramic tomography, Dentistry, Oral radiology, Radiological interpretation

Health and Society

Gender Classification and Prediction Using Eruption Status of Permanent Teeth in Sri Lankan Children

B.D.H.H. De Silva[1], L.S. Nawarathna[1]* and V.S.N. Vithanaarachchi[2]

[1]Department of Statistics and Computer Science, Faculty of Science
[2]Department of Community Dental Health, Faculty of Dental Sciences
University of Peradeniya, Peradeniya 20400, Sri Lanka
*lakshikas@pdn.ac.lk

Gender prediction is a dominant component in forensic identification procedures. Teeth are better preserved than other parts of the human body, resistant to high temperature and any mass disaster, thereby providing the best records for forensic investigations. Moreover, tooth eruption is a process that teeth enter the mouth and become visible and eruption status is a measure that can be taken at low cost and efficiency. Hence, this study was undertaken to predict the gender using the eruption status of permanent teeth. Although many studies have been done based on different measures of teeth, this is a novel study for Sri Lankan children using eruption status of permanent teeth. This cross-sectional study was carried out on 3321 children with 1681 males and 1640 females from 7 provinces and 20 schools. A tooth was considered erupted, if more than $1/3^{rd}$ of the crown is visible and recorded as status 1. Gender is a binary variable and all 28 predictor variables (permanent teeth) are also binary variables with status 1 or 0.Therefore a classification based approach was used to predict the gender of a child using machine learning classifiers, namely Classification and Regression Tree (CART), Random Forest and Extreme Gradient Boosting (XG Boost) which are non-parametric and based on decision trees. The fitted models were validated using 10-fold cross-validation technique and the model performance was measured using accuracy, F1 score, sensitivity and specificity. The Extreme Gradient Boosting classifier was selected as the best performance model compared to the other fitted models which are performed with the highest accuracy 62.80% and 0.6340 F1 score. Hence, the gender of a child can be predicted using the best-fitted model in situations as forensic investigations. Furthermore, gathering data covering all the districts in Sri Lanka would enhance the performance of the proposed classifier for gender prediction.

Keywords: Gender classification, Classification tree, Eruption status, Extreme gradient boosting, Random forest

Evaluation of Demographic and Clinical Characteristics of Oral Submucous Fibrosis in a Group of Sri Lankan Patients – A Retrospective Cohort Study

S. Anupama, P.V.K.S. Hettiarachchi* and R.D. Jayasinghe

*Department of Oral Medicine and Periodontology, Faculty of Dental Sciences,
University of Peradeniya, Peradeniya 20400, Sri Lanka
kalaniz2004@yahoo.com

Oral submucous fibrosis (OSF) is a well-established oral potentially malignant disorder (OPMD) that affects the South Asian countries including Sri Lanka where the traditional habit of areca nut chewing prevails. The aim of this study was to evaluate the demographic and clinical characteristics of OSF among patients presented to the Faculty of Dental Sciences, University of Peradeniya. A retrospective cohort of 503 patients, diagnosed with OSF, followed up in the Oral Medicine clinic, for the past 22 years were included in the study. Patients' age ranging from 3 - 81 years (394 males (78.3%) and 109 females (21.6%); mean age, 43.38 years) with the diagnosis of OSF presented to Oral Medicine clinic. The main complaint of the patients presented was burning sensation (45.1). Fifty six patients complained either of an ulcer or a white/red patch. Majority, 69.8% had the habit of betel chewing only, while 14 had chewing areca nut alone as their risk factor and 18.1% had the synergistic habit of betel chewing and smoking. 65.4 % had the involvement of the buccal mucosa with the presence of fibrous bands on the initial visit with 28.4% demonstrating restricted tongue movements. The commonest abnormality observed on the tongue was depapillation (55.7%) and de-pigmentation, an early feature noted in 27.2%. A total of 463 patients had undergone a histopathological investigation and almost 50% of those were devoid of any dysplastic lesions. According to the grading system by Kerr et al. (2011), 39% of cases were at Grade 4B, that is OSF with any grade of dysplasia in the biopsy at the initial presentation and only 16% presented with mild disease (Grade 1). The clinical characteristics of OSF patients may differ due to variations in risk habits practiced.

Keywords: Oral submucous fibrosis, Oral potentially malignant disorders, OSF, OPMD, Clinical features

Oral-Health-Related Knowledge, Attitudes and Oral-Care Practices of Nursing Undergraduates of Faculty of Allied Health Sciences, University of Peradeniya, Sri Lanka

D. Leuke Bandara[1]*, G.K. Weerasinghe[2] and P.H.G.J. Pushpakumara[3]

*[1]Department of Oral Medicine and Periodontology, Faculty of Dental Sciences,
University of Peradeniya, Peradeniya 20400, Sri Lanka
[2]Covid 19 Special Treatment Centre, Welikanda, Polonnaruwa 51070, Sri Lanka
[3]Department of Family Medicine, Faculty of Medicine and Allied Sciences,
Rajarata University of Sri Lanka, Mihintale 50300, Sri Lanka
dhanulb@dental.pdn.ac.lk

As primary caregivers, it is important to establish adequate knowledge and a better attitude towards oral care in nursing officers. This study aimed to assess the oral health knowledge, attitude and oral-care practices among nursing undergraduates of the Faculty of Allied Health Sciences, University of Peradeniya, Sri Lanka. A cross-sectional analytical study was carried out in March 2019.Self-reported knowledge, attitude and oral-care practices of all students were assessed using a pre-tested self-administered questionnaire. Oral-health-related knowledge was evaluated under six sub scales. The majority of the participants were females, 109/148(73.65%). The highest mean score for knowledge was on dental plaque 7.16 (SD 4.5) while the lowest was on oral cancers, 3.89 (SD 3.13). However, nearly one-third of the undergraduates (37.84%) were not aware of the main purpose of tooth brushing. A positive attitude towards oral health was reported by 45 (30.41%, 95% CI 22.3-38.5%) undergraduates. Nevertheless, the distribution of the scores for the knowledge and attitude was not statistically different between gender and among different academic year of study.80% (n=118) of undergraduates brushed twice a day and 72% (n=107) used fluoridated toothpastes. Slightly more than half of the undergraduates (53.4%, 95% CI 44.6-62.2%) had snacks in between main meals while 41.9% (95% CI 33.3-50.6%) had maintained regular dental visits. Although a majority showed good oral practices, a significant percentage was not aware of the main purpose of tooth brushing. Similarly, the knowledge on oral cancer, which is a highly prevalent condition in Sri Lanka, was not satisfactory. No difference was found in scores of knowledge and attitude on oral health between genders or among academic year of study. Thus, suggest further studies and incorporation of properly designed oral health education programmes for the nursing undergraduates.

Keywords: Oral health, Knowledge, Attitude, Oral care practice

A Clinico-Pathological Analysis of Malignant Odontogenic Tumours:
A Group of Rare Diagnostically Challenging Entities

W.A.M.U.L. Abeyasinghe*, I.K. Rambukewela and P.R. Jayasooriya

Department of Oral Pathology, Faculty of Dental Sciences,
University of Peradeniya, Peradeniya 20400, Sri Lanka
*udari2005@gmail.com

Malignant odontogenic tumours (MOTs) are diagnostically challenging tumours that may occur *de novo* or in an existing lesion of odontogenic origin. WHO classification with reference to the MOT entities keep on evolving and due to the rarity of MOTs, difficulties have been encountered in establishing well defined diagnostic criteria for some entities. The objective of the study was to present a clinico-pathological analysis of MOTs, highlighting demographic characteristics and the pathological findings that resulted in the definitive diagnoses. Twenty six MOTs diagnosed in the Department of Oral Pathology between the years 2000-2019 were reclassified according to diagnostic criteria of 2017 WHO. Age, gender and site of occurrence of MOTs were recorded. Out of all odontogenic tumours, 1.9% (26/1346) were MOTs. The commonest MOT was primary intra osseous carcinoma (PIOC)-NOS accounting to 53.9% of cases out of which 13.8% were carcinomas arising in cysts, followed by 19.2 % of ameloblastic carcinomas, 15.4% of clear cell odontogenic carcinomas, 3.8% of ghost cell odontogenic carcinomas and 7.7% of ameloblastic fibrosarcomas (odontogenic sarcoma). MOTs showed a slight female predilection (14/26) with majority (17/26) occurring in the mandible. Infiltrative nature and nuclear & cellular atypia resulted in the diagnosis of ameloblastic carcinoma and PIOC-NOS while exclusion of extra-osseous squamous cell carcinoma was essential to achieve a diagnosis of the latter tumour. PIOC-NOS which included carcinomas arising in cysts were diagnosed by the presence of infiltrating solid tumour islands in a predominantly cystic lesion. Majority of MOTs except odontogenic sarcomas occur in adults and show a predilection to the mandible. Both clinical and histopathological characteristics are useful when diagnosing MOTs. It is also suggested that in the next revision of the WHO classification, carcinoma arising in cysts which were included under PIOC-NOS category should be revised to be considered as a separate entity.

Keywords: Malignant odontogenic tumours, Primary intra-osseous carcinoma-not otherwise specified, Clear cell odontogenic carcinoma, Odontogenic sarcoma

Malnutrition Inflammation Score in Assessing Nutritional Status of Haemodialysis Patients at National Hospital, Kandy, Sri Lanka

S.D.B.P.P. Samarasekara[1,3]*, H.M.R.K.G. Nandasena[1], B.M.D.B. Basnayake[3], D.R.T.S. Dasanayake[1,3], E.G.N. Erangika[3], M.A.A. Nayanamali[2,3] and N. Nanayakkara[3]

[1]*Department of Nursing, Faculty of Allied Health Sciences, University of Peradeniya, Peradeniya 20400, Sri Lanka*
[2]*Department of Fundamental Nursing, Faculty of Nursing, University of Colombo, Colombo 00300, Sri Lanka*
[3]*Centre for Research, National Hospital Kandy, Kandy 20000, Sri Lanka*
*sdbppsamarasekara@ahs.pdn.ac.lk

Many haemodialysis (HD) patients at End Stage Renal Disease (ESRD) experience protein energy wasting (PEW). They are more prone to develop PEW due to undernourishment, under dialysis, hypercatabolic state, and other comorbid conditions. *The International Society of Renal Nutrition and Metabolism* (ISRNM) has recently suggested the use of Malnutrition Inflammation Score (MIS) as a chronic kidney disease specific nutritional scoring system. This study was aimed to use the MIS in assessing the nutritional status among HD patients attending the Nephrology Unit, National Hospital, Kandy. This study was a descriptive cross-sectional study that was conducted among 300 randomly selected HD patients at the Nephrology Unit, National hospital, Kandy. An interviewer-administered questionnaire and patient's health records were used to collect data. Nutritional status was evaluated by using MIS. It consisted of 10 components under 4 principal categories: patient's medical history, body mass index (BMI), physical testing, and laboratory parameters. The overall score was given on 30. MIS score <5 was considered as normal while ≥5 considered as malnourished. Multiple logistic regression analysis was done to identify the associations; Pearson's correlation coefficient (r) was used to analyze the linear associations. Data were analyzed with statistical software SPSS version 25. A total of 270 participants (90%) were malnourished and 68.9% (n=186) were males. Mild (5<MIS<10) and moderate (10<MIS<20) stages were reported as 30% (n=90) and 54.3% (n=163) respectively. Only 5.7% (n=17) were severely (20<MIS<30) malnourished. Age (OR: 0.948, CI: 0.90-0.99, p=0.012), unemployment (OR: 0.159, CI: 0.059-0.429, p=0.0001) and haemoglobin (Hb) concentration (OR: 0.705, CI: 0.563-0.883, p=0.002) were significant predictors of nutritional status. Hb concentration (r= -.146, p=0.011) showed a significant negative correlation with the malnutrition inflammation score. Malnutrition is extremely common among HD patients. Therefore, frequent nutritional assessment has paramount importance in the early detection of malnutrition and to prevent malnutrition associated complications.

Keywords: Nutritional assessment, Malnutrition inflammation score, Haemodialysis

Malnutrition, Aging and Quality of Life of Patients with Type 2 Diabetes Mellitus

D.K. Gunawardana[1], B.D. Kariyawasam[1], S.S. Salgado[1],
I.E. Gunarathna[2] and D.C. Kottahachchi[3]*

[1]*Department of Biomedical Science, Faculty of Health Science,
Kaatsu International University, Battaramulla 10120, Sri Lanka*
[2]*Office of Regional Director of Health Services, Galle 80000, Sri Lanka*
[3]*Department of Physiology, Faculty of Medicine, University of Kelaniya,
Ragama, 11010, Sri Lanka*
dulanikottahachchi@gmail.com

Malnutrition which refers to deficiencies, excesses, or imbalances in energy and/or nutrients intake is a powerful and modifiable risk factor for diabetes mellitus (DM). The increase in life expectancy would result in a higher incidence of chronic diseases including diabetes. DM has a significant physical and emotional impact, culminating in the reduction of the autonomy and self-confidence of affected individuals, altering their self-perception and quality of life (QoL). Objectives were to determine the association between malnutrition status, age, and QoL of the patients with type 2 DM. A cross-sectional descriptive study was carried out among 136 DM patients above 45 years of age in three specialized diabetes centers in Sri Lanka. Patients were systematically selected from clinic registers. Data were collected through a pre-tested interviewer-administered questionnaire and the brief version of the World Health Organization Quality of Life (WHOQOL-BREF) questionnaire which has four domains: physical, psychological, social, and environmental. Out of 136, the majority were females (74.3%). The mean age of the sample was 62 (±10) years. Malnutrition: underweight, overweight, and obesity among the study sample were 2.2%, 40.4%, and 27.2% respectively. Malnourished DM patients had a significant association with physical QoL nevertheless malnutrition did not interfere with environmental and psychological QoL. The age of diabetes patients was negatively correlated with all four dimensions of QoL ($p<0.05$). In conclusion, aging is a major contributory factor for diabetes. Maintaining a healthy weight would improve diabetes status and thereby improves physical QoL. The current overweight and obesity epidemic among the diabetes population must be tackled to improve QoL among affected patients. It is important to use multidimensional assessments of QoL than overall QoL assessment to get a better understanding to plan out focused interventions to prevent DM along with aging.

Keywords: Malnutrition, Quality of life, Type 2 diabetes mellitus, Aging

Dietary Knowledge and Practice in Patients Undergoing Continuous Ambulatory Peritoneal Dialysis

D.R.T.S. Dasanayake[1,2]*, A.M.S.D. Pathiranage[1], H.G.N. Erandika[2],
M.A.A. Nayanamali[2,3], S.D.B.P.P. Samarasekara[1,2] and N. Nanayakkara[2]

[1]Department of Nursing, Faculty of Allied Health Sciences, University of Peradeniya, Peradeniya 20400, Sri Lanka
[2]Center for Research, National Hospital Kandy, Kandy, 20000, Sri Lanka
[3]Department of Fundamental Nursing, Faculty of Nursing, University of Colombo, Colombo 00300, Sri Lanka
*thakshila760@gmail.com

Adhering to multiple dietary recommendations may be difficult to follow but crucial in maintaining optimal nutritional status in patients on Continuous Ambulatory Peritoneal Dialysis (CAPD). Adherence to these recommendations require patients to have a clear knowledge on type, quality, and quantity of food they consume. Objectives were to assess the participants' dietary practices and dietary knowledge on foods they consume. This cross-sectional study was conducted on randomly selected 102 CAPD patients at National Hospital, Kandy. An interviewer-administered questionnaire and a food frequency questionnaire were used to collect dietary data. Daily dietary intake was compared with European Society for Parenteral and Enteral Nutrition guideline recommendations. Knowledge on food sources were assessed in relation to protein, calories, potassium, phosphorus, and sodium. The mean age of the participants was 54.91 ± 12.57 years and 35.3% (n=36) were females. Percentage of participants who had a poor knowledge on nutrients were; protein (44.11%), phosphorus (95.09%), calorie (98.03%), sodium (67.64%), potassium-fruits (51.9%) and potassium-vegetables (60.78%). Dietary practice was described in relation to adherence to guideline recommendations. A minority who had a good knowledge on nutrient components in consuming foods also did not always follow good practices. Dietary practice was significantly associated with monthly income (p=0.007), age (p=0.01) and treatment duration (p=0.046). Majority of the participants had a poor awareness of deciding daily amount of food allowances predominantly for protein (96.1%), phosphorus (85.3%) and potassium (81.4%) resulting in unsatisfactory dietary practices. Majority [80.4% (n=82)] had a poor knowledge on nutrient composition in foods they consume. The participants whose knowledge was good also had unsatisfactory dietary practices proving that good knowledge does not always translate to better practice. Therefore, dissemination of proper knowledge is important. An effective education model on nutrition could be easily implemented through nursing officers, with the support of multidisciplinary team involving nutritionists, medical doctors, and counselors.

Keywords: Dietary knowledge, Dietary practice, Recommendations, Nutrients

Knowledge about Stroke and Its Management among Hypertensive Patients Attending Medical Clinic at Teaching Hospital Batticaloa, Sri Lanka

S. Krishana*, S. Sujendran and A.S. Vathanraj

Department of Supplementary Health Sciences, Faculty of Health Care Sciences, Eastern University, Batticaloa 30000, Sri Lanka
*suthatharankrishana@gmail.com

Stroke is a worldwide health problem and a major contributor to mortality and disability in both developing and developed countries. It is the third commonest cause of death worldwide and the single largest cause of adult disability. Awareness of stroke is a major part of preventing the prevalence and complications of stroke. The recognition of stroke symptoms by the public and activation of the Emergency Medical Services are the most important factors in initiating pre-hospital stroke care. This study was conducted to assess the knowledge regarding stroke among hypertensive patients who were attending the medical clinic at Teaching Hospital Batticaloa. A cross sectional descriptive study was conducted for one year among 269 hypertensive patients who were attending medical clinic. After obtaining written consent, data were collected according to systematic sampling through a pre-designed and pre-tested interviewer administered questionnaire. Statistical Package of Social Science 19 was used for analyzing the data. The descriptive analysis was employed and the association of knowledge with demographical factors was assessed through Chi square test. Only 5.6 % hypertensive patients (n=15) had good knowledge, while many of them (n=151) 56.1% had adequate knowledge regarding stroke. The most common risk factors identified were hypertension (79.2%) and hyperlipidemia (40.1%). Sudden numbness (85.1%) and weakness or paralysis of face, arms, and limbs (67.3%) were the commonly identified signs and symptoms. There was a significant association ($p<0.05$) between the knowledge of stroke and the following background characteristics; place of living, education, occupation, income, duration of hypertensive clinic follow ups and family history of stroke. In conclusion, knowledge on stroke among the patients was satisfactory in many aspects.

Keywords: Hypertension, Stroke, Knowledge

Associated Parental Risk Factors among Epileptic Patients Attending Teaching Hospital Anuradhapura, Sri Lanka: A Case Control Study

L.N.S. Randika[1]*, W.V. Ruwanthi[1], D.G.H. Ruwanthika[1], M.S.M. Safnas[1], A.S.M.U.D.B. Samarakoon[1], S.M.I.S. Samarakoon[1] and M.V. Kumari[2]

*[1]Faculty of Medicine and Allied Sciences, Rajarata University of Sri Lanka,
[2]Department of Physiology, Faculty of Medicine and Allied Sciences,
Rajarata University of Sri Lanka, Anuradhapura 50000, Sri Lanka
supun.liyanwila@gmail.com*

Epilepsy is a common neurological disorder of the brain, affecting around 65 million of people worldwide. Reported risk factors associated with epilepsy are family history, head trauma, brain infection, prenatal injuries, and newborn distress. However, paucity of data is found regarding associated parental risk factors of epilepsy especially in developing countries like Sri Lanka. Objective was to determine the association between epilepsy and parental risk factors among the epileptic patients attending to Teaching Hospital Anuradhapura, Sri Lanka. This was an unmatched case control study. Two hundred diagnosed epileptic patients [male (52%), age 12-45 years] were recruited from neurology clinic at Teaching Hospital Anuradhapura, Sri Lanka as the case group. Patients with cerebral palsy, mental retardation and psychiatric disorders were excluded. Only the first identified cases in each sibling were included while affected siblings were excluded. Two hundred controls [male (30%), age 12-45 years] were recruited from the Out Patient Department (OPD), excluding those having any neurological disorders. An interviewer administered questionnaire was used to identify associated parental risk factors among epileptic patients. Parental risk factors associated with epilepsy were consanguinity [18.8% in epileptics vs 8% in controls, odds ratio (OR) 2.6, 95% confidence interval (CI) 1.4-4.9, p=0.002] and family history (18.3% vs 5.5%, OR 3.8, 95% CI 1.9-7.7, p=0.0001). However, maternal age at child birth, parental age gap and mode of delivery were not associated with epilepsy. Parental factors such as consanguinity and family history increase the risk of epilepsy among offspring. Hence, it is advisable to increase awareness in the community, about the possible medical problems associated with consanguineous marriage in Sri Lanka.

Keywords: Epilepsy, Parental risk factors, Consanguineous marriages, Family history, Parental age gap

Assessment of Knowledge about and Attitude towards Sexual and Reproductive Health among Advanced Level School Students in Kurunegala Municipal Council Area

W.M.A.U.K. Wijesinghe[1]* and S. Tennakoon[2]

[1]*Postgraduate Institute of Science*
[2]*Department of Community Medicine, Faculty of Medicine*
University of Peradeniya, Peradeniya 20400, Sri Lanka
achiwijesinghe@gmail.com

Adolescence is a transitional period in life in which an individual attains sexual maturity. Adolescent's knowledge and attitude on sexual and reproductive health (SRH) can have many implications. If wrongly informed, they can suffer adverse consequences. The objective was to assess SRH knowledge and attitudes among Advanced Level school students in municipal council area in Kurunegala. This was a descriptive cross-sectional study. Data were collected using a pretested self-administered questionnaire. Students who answered ≥50% questions in the knowledge assessing section of the questionnaire were considered as having sufficient knowledge. The schools were chosen by selecting sixth of each boys', girls', and mixed schools. The sample included 377 students. Sixty eight percent had sufficient knowledge (70% of girls and 66% boys). The percentages of sufficient knowledge among girls', boys' and mixed schools were 77%, 69%, and 58% respectively. Also, 88% of biology, 63% of mathematics, 61% of commerce, and 59% of art students showed sufficient knowledge, and 99% of total students demonstrated good attitudes on sexual and reproductive health. There was a significant difference ($P<0.05$) between knowledge regarding SRH and school type as well as subject streams, respectively. The most common intimate person with whom students shared their personal issues, was the mother (50.8%). The other prevalent confiding people were friends (32%), father (9.3%), siblings (6.6%), and teachers (1.3%). Same age groups (55.1%) were the most common source of knowledge on SRH. This study concluded that knowledge regarding SRH was moderately satisfactory while it's relatively low among boys compared to girls. Students in girls' schools are more knowledgeable than boys' and mixed schools. Also, a substantial gap was seen in the knowledge of SRH between biology students and other students. This study suggests conducting special awareness projects, improvement of library facilities and educational materials on SRH in schools as necessary strategies.

Keywords: Adolescents, Knowledge, Attitude, Sexual and reproductive health

Physical Activity Level of the Patients with Type 2 Diabetes Mellitus Attending Diabetes Clinic at a General Hospital, Sri Lanka

W.E.I. Alwis* and A.A.T.D. Amarasekara

Department of Nursing and Midwifery, Faculty of Allied Health Sciences, University of Sri Jayewardenepura, Gangodawila, Nugegoda 10250, Sri Lanka
weidealwis@gmail.com

Physical activity, diet, and medication are the major treatment strategies in type 2 diabetes mellitus. Objectives of this study were to determine the level of physical activity among patients with type 2 diabetes mellitus attending the diabetes clinic in General hospital Kalutara, Sri Lanka and identifying the sociodemographic factors associated with the inactive lifestyle. A descriptive cross-sectional study was done using a systematic random sampling method from 1st October 2020 to 31st December 2020. The study instrument was a pretested (n=10) interviewer-administered questionnaire including sociodemographic characteristics and the International Physical Activity Questionnaire was used to collect data. Chi-square test, descriptive statistics and independence t-test using SPSS (version 26) were used to analyze the data. Ethical clearance was obtained from the Ethics Review Committee, Faculty of Medical Sciences, University of Sri Jayewardenepura. The total number of participants were 134. Among the participants, majority were females [76.1% (n=102)] and 36.6% (n=49) were between 51-61years. The mean total physical activity level was 5076 MET min/week. Seventy-nine participants (59%) had higher physical activity level. The means of total physical activity were nearly similar for both men (5277 MET minutes/week) and women (5013 MET minutes/week). Females gained their physical activity mostly from domestic activities while males engaged in job-related activities. There were associations between physical activity level and ethnicity (p=0.013), occupation (p=0.037) and duration of type 2 diabetes mellitus (p= 0.027). In all statistical analyses, p<0.05 were considered significant. According to study results, the patients attending to the diabetes clinic in General hospital Kalutara during the study period had a sufficient physical activity level. Regularly educating patients about the importance of physical activity and establishment of a continuous monitoring program would be of benefit in the control of diabetes. A longitudinal study on the physical activity level of the patients is recommended for future study.

Keywords: Physical activity, Type 2 diabetes mellitus, Glycemic control, Exercise

Analysis of Conversational Features between Individuals with Dementia and Their Communication Partners in Natural Conversation

K.T.G. Jinadasa* and A.D.S. Atapattu-Bakmeewewa

Department of Disability Studies, Faculty of Medicine, University of Kelaniya, Ragama 11010, Sri Lanka
thanujajinadasa1995@gmail.com

The study was conducted to identify the conversational features between the individuals with dementia (ID) and their communication partner (CP) during natural conversation (NC). Fifteen NC samples between IDs and CPs and 15 NC samples between age and gender matched healthy adults were audio recorded and transcribed verbatim. The data were analyzed based on two checklists of Discourse Impairing Conversational Features (DICF) and Discourse Building Conversational Features (DBCF). A self-administered questionnaire was used to identify perspectives of CPs on difficulties when communicating with IDs. Mixed method explanatory design, including descriptive and inferential statistics analysis using *statistical* package for the social sciences (SPSS version 22) software and qualitative thematic analysis was used. Absence of topic maintenance in IDs (n=6), inability to engage in extended discourse in IDs (n=6), and absence of repairing skills in IDs (n=6) were more frequently observed DICFs in IDs. The most frequently observed and helpful DBCF used by CPs was trying to figure out the meaning (n=12). A Mann-Whitney U test showed significant differences in the use of DICFs (Mann-Whitney U=30.500, Z=-3.449, p=0.001) and DBCFs (Mann-Whitney U=35.500, Z=-3.213, p=0.001) between the two groups. Perspectives of CPs on the communication difficulties faced with IDs were analyzed based on five primary themes; the knowledge of dementia, difficulties faced by CPs when communicating with IDs, strategies used by CPs to overcome communication difficulties, and successful communication strategies used by CPs and IDs. The findings provide an understanding of the communication difficulties faced by CPs due to the language and attention difficulties of IDs. Importantly it identifies the successful strategies used by IDs; asking for clarifications, short questions and attention and by CPs; recognition, validation, negotiation, facilitation, and asking short questions by providing useful information to the speech and language therapists to maintain their quality of life within resource limited clinical settings.

Keywords: Dementia, Discourse building conversational features, Discourse impairing conversational features, Communication, Speech and language therapists

Prevalence of Selected Cardiovascular Disease Risk Factors among Adults in Sabaragamuwa Province of Sri Lanka: A Community-Based Study

H.M.R.K.G. Nandasena[1,2]*, S.U.B. Tennakoon[2] and D.M.P.U.K. Ralapanawa[3]

[1]Department of Nursing, Faculty of Allied Health Sciences
[2]Department of Community Medicine, Faculty of Medicine
[3]Department of Medicine, Faculty of Medicine
University of Peradeniya, Peradeniya 20400, Sri Lanka
*renu88kalhari@gmail.com

Cardiovascular Disease (CVD) is the leading cause of death and disability worldwide. Therefore, the objective of this study was to assess the prevalence of selected risk factors of CVDs and their associations with socio-demographics and anthropometrics among adults in Sabaragamuwa Province of Sri Lanka. A descriptive cross-sectional study was conducted among adults aged between 30-60 years in Sabaragamuwa province, Sri Lanka. Participants were selected using three stage random sampling method. The WHO STEPS wise interviewer administered questionnaire was used to collect data. There were 366 participants with a male to female ratio of 1:2.1. Mean age was 45.2±8.8 years. Mean body mass index (BMI) was 23.9±4.1 kgm-2 and 27.6% and 10.1% were overweight and obese, respectively. Approximately two third were physically inactive (63.4%). Prevalence of high blood pressure, high blood glucose level, high total cholesterol, high low-density lipoprotein (LDL) cholesterol, low high- density lipoprotein (HDL) cholesterol and high triglycerides were 27%, 22.1%, 39.9%, 37.7%, 29% and 37.7% respectively. Women were significantly physically inactive than men ($p<0.001$). Mean systolic blood pressure (SBP) ($p=0.007$), diastolic blood pressure (DBP) ($p=0.01$) and triglyceride level ($p=0.001$) was significantly higher among men whereas mean HDL ($p=0.024$), LDL($p=0.007$), waist circumference ($p=0.025$) and BMI ($p=0.015$) was higher in women. Mean SBP ($p<0.001$), DBP ($p<0.001$) and prevalence of blood pressure ($p<0.001$) increased with age in both men and women. Mean waist circumference ($p=0.013$), total cholesterol ($p=0.008$), LDL ($p=0.031$) and fasting blood glucose level ($p=0.037$) increased by the years of education among women's' only. Accordingly, CVD risk factor prevalence is considerably high in this population. Therefore, public health interventions are required, considering the population characteristics which are associated with the CVD risk factors.

Keywords: Cardiovascular disease, Prevalence, Risk factors, Adults, Sri Lanka

Comparison of Mean Age of Diagnosing Osteoporosis between Patients on Long-Term Glucocorticoids and Patients Not on Glucocorticoids Treatment

D.K.K. Nanayakkara[1], A.R.M. Sanooz[2]*, S.I. Nawaz[1] and H.M.P.N. Herath[1]

[1]*Nuclear Medicine Unit, Faculty of Medicine, University of Peradeniya, Peradeniya 20400, Sri Lanka*
[2]*Department of Clinical Sciences, Faculty of Health-Care Sciences, Eastern University, Batticaloa 30000, Sri Lanka*
**sanoozarm@yahoo.com*

Glucocorticoid induced secondary osteoporosis is common in both genders and is one of the main causes of osteoporosis occurring before 50 years of age. This is mainly due to the bone loss and inhibition on bone formation by glucocorticoids. Aim of the study was to describe the difference in the mean age of diagnosing of osteoporosis between the patients on long-term glucocorticoids and those who were not on glucocorticoids. This retrospective study was carried out using the DXA scan data base at Nuclear Medicine Unit, University of Peradeniya. Treatment with systemic glucocorticoids for more than three months was considered as long-term glucocorticoid treatment. A total of 645 patients were included in the study. Of them 73 who received long-term glucocorticoids, 49.3% had osteoporosis (mean age $=50.66\pm16.81$ years) and 50.7% had no osteoporosis (mean age$=56.62\pm15.62$ years). Of the 572 patients who were not given glucocorticoids, 59.3% had osteoporosis (mean age$=60.02\pm12.85$years) and 40.7% had no osteoporosis (mean age$=57.22\pm12.32$ years). These results showed that patients who received long-term glucocorticoid had osteoporosis at a significantly lower mean age compared to patients not on glucocorticoids (p value<0.001). However, the mean age for the patients without osteoporosis in both groups did not have a significant difference (p value$=0.7$). This finding suggests the need for early assessment of bone mass for early detection of osteoporosis among patients who received long-term glucocorticoid treatment. High percentage of osteoporosis found among patients who did not receive glucocorticoid treatment could be due to the presence of other confounding risk factors that influence to have low bone mass and increases the prevalence of osteoporosis.

Keywords: Osteoporosis, Long term glucocorticoid, DXA scan

Correlation between Respiratory Function and Functional Exercise Capacity of Patients with COPD Presented to Two Selected Government Hospitals in Colombo District

G.A.D. Perera*, D.G.S. Malsri, L.A. Gordon and V.R. Wijesiriwardane

Department of Physiotherapy, Faculty of Allied Health Sciences, General Sir John Kotelawala Defence University, Ratmalana 10390, Sri Lanka
*amaradamayanthi@gmail.com

Six Minute Walk Distance (6MWD) is one of the popular methods used to assess functional exercise capacity of patients with Chronic Obstructive Pulmonary Disease (COPD) in clinical settings. A patient with COPD usually has reduced Forced Expiratory Volume 1 (FEV_1) in spirometry test results. To identify the correlation between functional exercise capacity and respiratory function, Six-minute walk test and spirometry tests results were used in this study. The objective of this study was to identify the correlation between the FEV_1 and 6MWD of patients with COPD presented to the National Hospital for Respiratory Diseases, Welisara and Chest Clinic at Medical Research Institute Sri Lanka. This descriptive cross-sectional study was conducted with 25 patients (19 males, 6 females) suffering from COPD aged between 40 to 60 years. The spirometry test results were collected by applying the method of American Thoracic Society (ATS) spirometric Criteria and the functional exercise capacity was tested through 6MWD. COPD patients with all stages were included in this study and coexisting restrictive patterns were excluded. The mean value and standard deviation of FEV1, 6MWD and age were $49.76\pm15.86\%$, 485 ± 113.80 metres, 56.06 ± 4.05 years, respectively. Pearson correlation coefficient test was used to measure the linear relationship between FEV1 and 6MWD according to the severity stage of COPD. The test results showed a positive correlation between moderate stage of COPD and 6MWD ($p=0.060$, $r=0.557$), severe stage of COPD and 6MWD ($p=0.013$, $r=0.717$) and very severe stage of COPD and 6MWD ($p=0.77$, $r=0.923$). The study results revealed that there is a moderate and significant positive correlation between functional exercise capacity and respiratory function of patients suffering from moderate, severe, and very severe stage of COPD, respectively.

Keywords: Six minute walk distance, Chronic obstructive pulmonary disease, Forced expiratory volume 1, Forced vital capacity

Psycho-Social and Health Related Problems Faced by Pre-Clinical Students during Online Learning at Faculty of Medicine, University of Peradeniya

N.J. Pahalawattage*, A.K. Jayaweera, E.W. Kosgallana, H.M.G.S. Hearath, S.B. Adikari and H.A. Amarathunga

Department of Anatomy, Faculty of Medicine, University of Peradeniya, Peradeniya 20400, Sri Lanka
*nadunjayasankita@gmail.com

Due to the covid-19 pandemic situation pre-clinical students had to adapt to learning online rather quickly. This sudden transition from onsite to online may have had an impact on the health and social aspects of students. The study was carried out to determine the psycho-social and health impact of this transition. A cross-sectional descriptive survey was conducted. A pre-tested questionnaire was designed and distributed via Google forms to 185 students who had undergone 2 semesters of online learning. A total of 115 Google-forms were received. The mean age of the sample was 21.9 ± 1.09 years and 50.9% of the sample were females. Of the participants 86%, 68.4% and 41.2% used smartphones, tablets, and laptop computers to access online content respectively. Of the participants, 49.1% complained about health issues and discomfort due to prolonged screen time. Prior to the pandemic, only 10.5% engaged in more than 4 hours per day of learning via online resources. During the pandemic it increased up to 70.2%. The reported common health problems were visual symptoms (83.9%) headache (78.6%), eye-fatigue (82.1%), focusing problems (35.7%) and burning sensation of the eyes (21.4%). Thirty-six-point two percent reported sleeping difficulties and 41.1% reported musculoskeletal pain: neck 70%, shoulders 40%, upper and lower back 37.5% and knees 12.5%. Social problems identified were expenses on internet (28.9%), missing university environment (85.1%), missing friends and teamwork (78.9%), and missing face to face communication with teachers (38.2%). The psychological problems identified were, stress (34.2%) and lack of self-motivation to learn (52.6%). In conclusion, online learning continues to play a vital role in continued education during the ongoing pandemic situation and this study highlights the health and psycho-social issues faced by students. Administrators and teachers should have these in mind when designing online teaching, learning sessions and remedial actions must be taken to minimize them.

Keywords: COVID-19, Online learning, Psycho-social impact, Health, Pre-clinical

Quantitative Characteristics of Peroneus Tertius and Extensor Digitorum Longus: A Cadaver-Based Study

E.W. Kosgallana[1]*, J.M. Eshwara[2], L.S. Nawarathna[3] and J.K. Dissanayake[1]

[1]Department of Anatomy, Faculty of Medicine, University of Peradeniya, Peradeniya 20400, Sri Lanka
[2]District General Hospital, Matale, 21000, Sri Lanka
[3]Department of Statistics and Computer Sciences, Faculty of Science, University of Peradeniya, Peradeniya 20400, Sri Lanka
*warukos@gmail.com

The extensor digitorum longus (EDL) and peroneus tertius (PT) muscles of the anterior compartment of the leg closely associated topographically, show much variation in morphology. The objective of our study was to analyze the quantitative characteristics of PT and EDL muscles and look for correlations between their characteristics. Cadavers used for routine dissections by medical students were utilized for this study. The anatomy of PT and EDL were clearly defined using blunt dissection. A standard measuring tape was used for measurements. The sample consisted of 54 lower limb specimens of which 32 were male. Minitab software was used for statistical analysis. A common origin of PT and EDL was noted in 26 of the specimens, while in 25, they were separate. According to the Mood Median test, inter-tendinous connections (ITC) between tendons of PT and EDL were present in 16, with no gender difference. The distal attachment of the PT tendon to the fifth metatarsal base was noted in 96% 50 specimens where the distal part of PT could be identified properly. PT had a mean muscle belly circumference of 3.52 cm, while EDL had a value of 4.18 cm. Further, Spearman rho revealed a moderately positive correlation between PT and EDL muscle belly circumferences. The PT had a muscle length ranged from 10.4 to 39.5 cm while the tendon length ranged from 10.5 to 17.7 cm. The study of morphometric characteristics of PT proves valuable as it is considered a non-essential muscle, used for tissue replacement surgeries. Insertion to the base of the fifth metatarsal bone is implicated in jones fracture. As the size of PT and EDL have a positive correlation, evolutionary replacement of EDL by PT becomes a controversial theory. Studying the variability of these muscles provides a better comprehension of their pathological implications and surgical considerations.

Keywords: Peroneus tertius, Extensor digitorum longus, Anterior compartment of leg, Soft tissue replacement surgery, Anatomical variations

A Comparative Study on COVID-19 and Dengue: A Sri Lankan Scenario

M.J. Mathushika* and C.M. Nanayakkara

*Department of Plant sciences, Faculty of Science, University of Colombo,
Colombo 00700, Sri Lanka
mathushikaj@gmail.com

The viral outbreak of SARS-CoV-2 has now resulted into a pandemic: COVID-19 with health impacts of catastrophic proportions. While this global catastrophe rightly demands the world's heed, Dengue which causes a high disease burden is neglected in Sri Lanka. This study aims to compare the disease rates of COVID-19 and Dengue in Sri Lanka during last two years and analyse the interdependence of those diseases. This comparative study was carried out utilizing the data sources from the World Health Organization, Epidemiology Unit of Sri Lanka, Centres for Disease Control and Prevention and Health promotion Bureau of Sri Lanka. Statistical analytical comparisons of the incidence, prevalence, and mortality of the diseases were analysed. In terms of narrative research, experts and professionals in the health sector were consulted and their perspectives were considered. Both COVID-19 and dengue have simultaneously negatively impacted the management, care, and control interventions specific to each of the two diseases. Ceasing of dengue control measures, reassigning of health workers due to COVID-19, refusing to go to hospitals because of fear of COVID-19 among patients diagnosed with dengue has contributed to the subsidence in the management and control of Dengue in Sri Lanka. However, lockdown and minimal daytime exposure to mosquitoes may have had a role to play in the slow growth rate of Dengue cases where a total of 31,031 cases were reported in 2020 in comparison to 105,049 in 2019. A total of 35 and 22 deaths were reported for Dengue and COVID-19 respectively as of November for the year 2020. Therefore, Sri Lanka needs to be vigilant in developing proactive policies and allocating adequate resources to prevent and manage dengue and other vector-borne diseases in the era where COVID-19 has taken precedent.

Keywords: COVID-19, Dengue, Incidence, Mortality, Prevalence, SARS-CoV-2

Knowledge regarding COVID-19 among Final Year Medical, Dental and Allied Health Sciences Students of University of Peradeniya

N.J. Pahalawattage*, A.K. Jayaweera, E.W. Kosgallana, H.M.G.S. Hearath,
M.D.W.A. Marapana, L.Y.V. Pathirana, S.B. Adikari and H.A. Amarathunga

*Department of Anatomy, Faculty of Medicine, University of Peradeniya,
Peradeniya 20400, Sri Lanka*
*nadunjayasankita@gmail.com

COVID-19 is a highly contagious viral disease which has spread across the world within a short duration of time. Due to the risk of rapid transmission of the virus, healthcare students must have sufficient knowledge regarding its spread for their protection as well as empowering the society with this knowledge. This study was conducted to assess the knowledge regarding COVID-19 among undergraduate final year students of the faculties of Medicine, Dental Sciences, and Allied health sciences. A questionnaire was developed using available information regarding clinical features, diagnostic protocols, and disease prevention. A descriptive web-based survey was conducted among 240 participants, via Google forms. The response rate was around 55.8%. Most of the participants were females (67.5%) and the mean age of the sample was 25.15 ± 1.5 years. Distribution among the faculties was: Medicine 62.5%, Allied Health Sciences 20.8%, and Dental sciences 16.7%. Of the participants, 72.1% were able to recognize the proper scientific name of the virus. Many of participants had incomplete knowledge (97.9%) regarding the transmission modes of the virus (droplet of saliva 57.5%, discharge from nose when infected person cough or sneezes 15.8%, contaminated surfaces or objects 0.4%) as well as testing procedures (95%). Knowledge regarding the COVID-19 prevention methods was high (85.1%) among the participants, but most of the respondents had incomplete knowledge regarding the correct hand hygiene practice methods (97.9%). Only 2% of the participants identified hand washing after exposure to body fluids as a correct answer. Most of the participants had good knowledge (57.9%) regarding the laws and guidelines about the COVID-19 prevention. There is no significant difference in knowledge between study programs. Students should be more aware of the virus transmission methods and hand hygiene practices, which could be improved through online sessions, to complete the knowledge regarding COVID-19 infection.

Keywords: COVID-19, Knowledge, Medical, Dental, Allied health sciences

Increasing Prevalence of *Rickettsia conorii* Infections in Central Province, Sri Lanka

E.G.C.N. Premathilaka[1], T.A.N. Mahakapuge[1], S.A.M. Kularatne[2], K.J.K. Karunathilake[1], D.M.A.E. Ranaraja[1] and R.P.V.J. Rajapakse[1]*

[1]Department of Veterinary Pathobiology, Faculty of Veterinary Medicine and Animal Science
[2]Department of Medicine, Faculty of Medicine
University of Peradeniya, Peradeniya 20400, Sri Lanka
*jayanthar@pdn.ac.lk

Rickettsiosis is a zoonotic disease caused by intracellular, obligate gram negative, rod-shaped bacteria belongs to genus *Rickettsia.* Zoonotic rickettsiosis is categorized in to three groups as spotted fever, typhus, and scrub typhus. These pathogens are commonly transmitted by ticks, fleas, chiggers, lice, and mites. According to clinical history of rickettsial infections in the country, most of the infections were recorded due to tick bites. A previous study on rickettsial infections among suspected patients from eight provinces (except Northern Province) confirmed the re-emergence of rickettsiosis from 2002. Hence, there is a great need of monitoring the prevalence of rickettsial infections. The objective of the current study is to determine the prevalence of rickettsial infections in the Central Province, Sri Lanka. Patients with clinical symptoms of fever more than five days, maculopapular skin rash, skin necrosis and headache with no definite diagnosis were included in the study (n=575). They were reported to the Teaching Hospital, Peradeniya from November 2018 to November 2020. Blood samples were collected, and serum was separated by centrifuging for 10 minutes at 1500 rpm. The samples were subjected to "Indirect fluorescent antibody test (IFAT)" using "vircell" *Rickettsia conorii* IgG antibody kit adhering to manufacturer's guidelines. Out of 575 samples, 395 (68.7%) were confirmed positive for *R. conorii* specific IgG. When comparing the districts of Central Province, 68.5 % positivity rate from Kandy, 70.5% positivity rate from Matale and 75% positivity rate from Nuwara-Eliya was observed. In conclusion, reporting of 395 positive patients within two years is extremely high compared to the previous reports. During the period of 2002-2007, only 6 *Rickettsia conorii* patients were reported in the research conducted in the Central Province. The current study shows an increasing prevalence of *Rickettsia conorii* in the Central Province of Sri Lanka.

Keywords: Rickettsiosis, *Rickettsia conorii*, IFAT, IgG, Central Province

Audit on Samples Tested for *Pneumocystis jirovecii* at Department of Parasitology, Faculty of Medicine, University of Peradeniya

T. Balendran, R. Morel* and L. Bandara

Department of Parasitology, Faculty of Medicine, University of Peradeniya, Peradeniya 20400, Sri Lanka
*rumala.morel@med.pdn.ac.lk

Pneumocystis jirovecii is an opportunistic fungus which causes severe pneumonia in immunocompromised patients, such as post kidney transplant (KT) recipients receiving immunosuppressive drugs. The objective was to carry out an audit to evaluate the demographic, clinical, and laboratory parameters of patients whose respiratory samples were sent to test for *P. jirovecii* to the molecular diagnostic unit of the Department of Parasitology, Faculty of Medicine, University of Peradeniya from January 2013 to December 2019. Referring physicians were contacted when necessary. Specimens included sputum, endotracheal secretions, and bronchoalveolar lavage fluid from 168 patients. Specimens were tested using Toluidine blue staining and polymerase chain reaction (PCR) with pAZ102E and pAZ102H primer pair. Of them, 22 tested positive for *P. jirovecii* by PCR. Stained smears were negative in all. Among the patients who tested positive by PCR, the ratio of females to males was 1:1.44, and the age range was from 10 months to 69 years (mean 40 years). Among them, 14 were post KT recipients and the rest were admitted to intensive care units (ICUs) with different co-morbidities. Among the positive samples, two were from infants and one was from a diabetic patient. Post KT recipients had been treated with immunosuppressive drugs for 2.5 to 12 years. Positive samples were received from the Nephrology and Transplant Unit Kandy, Respiratory wards of the National Hospital Kandy (NHK) and Intensive Care Units of NHK and Teaching Hospital, Peradeniya. We also had *P. jirovecii positive patients referred from District General Hospitals in Kegalle (n=1), Trincomalee (n=1), and Nuwara Eliya (n=1).* Majority of the positive patients were post KT recipients.

Keywords: *Pneumocystis jirovecii Pneumonia, Polymerase chain reaction,* Immunocompromised, Post kidney transplant, Sri Lanka

Detection of Pandemic *Escherichia coli* O25:H4-ST131 Clone in Humans and Companion Animals in Kandy, Sri Lanka: A Preliminary Study

W.A.P.M. Dewasmika[1], D.R.A. Dissanayake[1]*, B.N. Dissanayake[2] and V.R. Francis[3]

[1]*Department of Veterinary Clinical Sciences, Faculty of Veterinary Medicine and Animal Science* [2]*Department of Microbiology, Faculty of Medicine University of Peradeniya, Peradeniya 20400, Sri Lanka* [3]*Department of Pathophysiology, Faculty of Health Care Sciences, Eastern University of Sri Lanka, Batticaloa 30000, Sri Lanka* **anuruddhika@vet.pdn.ac.lk*

Escherichia coli (*E. coli*) sequence type O25:H4-ST131 is a worldwide disseminated multi-drug resistant pathogenic clone which has gained global attention as the reason for recent increase in resistance to broad-spectrum β-lactams and fluoroquinolones. Present study determined the occurrence and antibiogram of O25:H4-ST131 in humans and companion animals in and around Kandy, Sri Lanka. Clinical samples or organisms isolated from extra-intestinal infections of humans, cats and dogs were obtained from the diagnostic Microbiology laboratories at the Medical and Veterinary Teaching Hospitals in Peradeniya in January and February 2020 and confirmed as *E. coli* by biochemical and molecular testing. A total of 45 *E. coli* isolates (human = 26; dogs and cats = 19) were screened by quardruplex PCR for phylogroup, and by simplex PCR for *rfbO25b* gene of O25:H4-ST131 clone. Antimicrobial resistance of the isolates was determined by disk diffusion method. Of the 45 isolates screened, 33 (73.33%) belonged to the phylogroup B2 of which 21 (63.63%) were O25:H4-ST131 (humans = 14 dogs =7) and the remaining 12 belonged to phylogroups A (n=6), B1 (n=3), D (n=1) and F (n=2). All O25:H4-ST131 isolates were multidrug resistant (resistant ≥ 3 antimicrobial classes) with all 21 isolates resistant to ampicillin, 11 (52.38%) to amoxicillin/clavulanate and 17 (80.95%) to quinolones, third and fourth generation cephalosporins and to trimethoprime sulphanamides. Further, 3 (14.29%) isolates were resistant to carbapenems and 4 (19.05%) were resistant to gentamicin. Importantly, all O25:H4-ST131 isolates were sensitive to amikacin. The multidrug resistant pandemic *E. coli* clonal group, O25:H4-ST131 is present in humans and dogs in Kandy, Sri Lanka.

Keywords: *E. coli,* O25:H4-ST131, Antimicrobial resistant, Phylogroup

Modified Whitfield Ointment with Oral Griseofulvin as a Treatment for Difficult-to-Treat Dermatophytosis: A Randomized, Double-Blind, Placebo-Controlled Study

S. Fonseka[1]*, G.D.D.J. Bandara[1], A.G.C.N. Wijerathne[1] and P.V.R. Kumarasiri[2]

[1]Department of Pharmacology
[2]Department of Community Medicine
Faculty of Medicine, University of Peradeniya, Peradeniya 20400, Sri Lanka
*sanjeewani.fonseka@yahoo.com

Difficult-to-treat dermatophytosis is an emerging public health concern in Sri Lanka because the number of patients who do not respond to standard antifungal treatment is increasing. Safe and cost-effective treatment is needed for these patients. The objective of this study was to assess the effectiveness and safety of modified Whitfield ointment (MWO) applied twice daily with oral griseofulvin 500 mg daily for 8 weeks in patients with difficult-to-treat dermatophytosis. A randomized, double-blind, within-patient-placebo-controlled trial study was conducted on patients with clinically diagnosed difficult-to-treat dermatophytosis without contraindications for trial medications. Lesions in each patient (including lesions in the flexural areas) were randomized to receive either MWO (5% benzoic acid and 5% salicylic acid) or emulsifying ointment (EO) as a placebo. Oral griseofulvin 500 mg daily was given to all patients. The outcome measures were assessed every two weeks up to a maximum of 8 weeks. The calculated sample size was 65. An interim analysis was done after 30 patients had completed the study. At two weeks, there was a statistically significant improvement in the scores of clinical assessment of disease severity and the patient's perception in the MWO arm. There was a 7.59% reduction in the surface area of lesions in the MWO arm and a 5.83% increase in the surface area of lesions in the EO arm at two weeks and the difference was not statistically significant. There were no adverse events and application of the MWO to flexural areas did not cause any discomfort. A combination of MWO with griseofulvin is an effective, safe, and affordable option for treating difficult-to-treat dermatophytosis in Sri Lanka.

Keywords: Dermatophytosis, Modified Whitfield ointment, Griseofulvin, Difficult-to-treat dermatophytosis

iPURSE 2021 – 279   *Health and Society*

Improvement of Glucose Tolerance in Nondiabetic Rats Compared to Diabetes-Induced Rats by Feeding Virgin Coconut Oil or Soya Oil

M.C.N. Perera[1], P.H.P. Fernando[1]*, C.N.R.A. Alles[1] and C. Yalegama[2]

[1]Department of Biochemistry, Faculty of Medicine, University of Peradeniya, Peradeniya 20400, Sri Lanka
[2]Coconut Research Institute, Lunuwila 61150, Sri Lanka
*phpf@pdn.ac.lk

Diabetes mellitus is a chronic disease caused by either absolute insulin deficiency or impaired insulin action and characterized by hyperglycaemia that causes many derangements in the normal physiology. Its high prevalence worldwide and in Sri Lanka calls for novel measures to alleviate this condition. Earlier studies have shown an implication of coconut oil, in regulating blood sugar levels with varying results. This study aimed to elucidate the effect of virgin coconut oil (VCO) or soya oil (SO) on glucose tolerance in diabetic (D) and non-diabetic (ND) rats. Sprague Dawley male rats (n=48) of 6-8 weeks of age weighing 150-200 g were divided to six groups. Three groups were ND, and the other three groups were in the D state, induced using alloxan. The three groups in each category received, either water, VCO or SO as the test material, orally at 7.5 ml/1000 g for each rat. Water and food were given *ad libitum* to all the groups. Oral glucose tolerance test (OGTT) was performed on all animals, on Day 45 and 90 of being on test diets and the results were analyzed by one way ANOVA. In the diabetic groups, the three test treatments did not show significant difference in the results of OGTT. However, in the case of ND animals there was a statistically significant difference in the glucose tolerance, between the animals fed with water and the animals fed with VCO, and with the animals fed with SO, with a very high significance level ($p < 0.001$). These results clearly show that VCO and SO were capable of improving the glucose tolerance when insulin was available, but not in its absence as seen with the alloxan treated diabetic animals.

Keywords: Diabetes, Glucose tolerance, Virgin coconut oil, Soya oil

Is Aqueous Bark Extract of *Cinnamomum zeylanicum* Effective in Alleviating Doxorubicin-Induced Inflammation and Apoptosis in Myocardial Tissues?

J.A.N. Sandamali[1]*, R.P. Hewawasam[2], K.A.P.W. Jayatilaka[2] and L.K.B. Mudduwa[3]

[1]*Department of Medical Laboratory Science, Faculty of Allied Health Sciences*
[2]*Department of Biochemistry, Faculty of Medicine*
[3]*Department of Pathology, Faculty of Medicine*
University of Ruhuna, Galle 80000, Sri Lanka
*jansandamali@ahs.ruh.ac.lk

Although doxorubicin is a highly effective anti-cancer drug, its' chemotherapeutic efficacy is precluded by oxidative-stress, inflammation and intrinsic apoptotic pathways induced by doxorubicin. It is widely reported that medicinal plants with high antioxidant, anti-inflammatory and anti-apoptotic activities have significant effects on the myocardial tissues to protect against damage. Therefore, objective of this study was to investigate the anti-inflammatory and anti-apoptotic effects of *Cinnamomum zeylanicum* aqueous bark extract to alleviate doxorubicin induced cardiac damage in Wistar rats. Treatment groups of rats used in the study were as follows. Group 1: control; group 2: plant extract control (2.0 g/kg lyophilized plant extract, 14 days); group 3: Doxorubicin control (received dH2O 14 days, doxorubicin (18 mg/kg) on 11th day); group 4 was administered with lyophilized plant extract (2.0 g/kg) 14 days, doxorubicin (18 mg/kg) on 11th day; group 5: positive control (dH2O 14 days, dexrazoxane (180 mg/kg) 0.5 h before doxorubicin (18 mg/kg). All animals were sacrificed on day 15, serum myeloperoxidase (MPO) activity was measured and inflammatory (TNF-α) and apoptotic markers [caspase-3, Bcl2 and terminal deoxynucleotidyl transferase dUTP nick end labeling (TUNEL) assay] were analyzed in myocardial tissues using an immunohistochemical staining and area of expression was quantified. Results indicated that MPO activity (285.32 ± 1.64) and expression of TNF-α are significantly higher ($p < 0.001$) in doxorubicin control compared to the normal control. Pre-treatment with plant extract showed a significant reduction ($p < 0.001$) of above inflammatory markers compared to the doxorubicin control group. Expression of caspase-3 and TUNEL positive nuclei were significantly increased ($p < 0.05$) while Bcl-2 expression was weaker in doxorubicin control. Pre-treatment with aqueous bark extract has the potential to significantly reduce caspase-3 activity and TUNEL positive nuclei while Bcl-2 expression is significantly increased ($p < 0.05$). Therefore, *Cinnamomum zeylanicum* aqueous bark extract has the potential to alleviate doxorubicin induced inflammation and apoptosis in Wistar rats.

Keywords: Doxorubicin, Inflammation, Apoptosis, *Cinnamomum zeylanicum*, Wistar rats

iPURSE 2021 – 281   *Health and Society*

Effects of *Mimosa pudica* on Glycation Induced Protein Cross-Linking and Cell Viability

J.A.V.R. Jayasinghe[1], K.J.K. Karunarathilake[2], R.P.V.J. Rajapakse[2] and H.K.I. Perera[3]*

[1]Faculty of Science, Horizon Campus, Malabe 10115, Sri Lanka
[2]Department of Veterinary Pathobiology, Faculty of Veterinary Medicine and Animal Science
[3]Department of Biochemistry, Faculty of Medicine
University of Peradeniya, Peradeniya 20400, Sri Lanka
**kumudup@pdn.ac.lk*

Protein glycation is closely associated with hyperglycaemia and is a primary cause for many of the chronic diabetic complications. Advanced glycation end-products (AGEs) produced as a result of glycation, cause cross-linking in long-lived proteins such as collagen. Objectives of this study were to evaluate heat stability and effects of methanol extracts of *Mimosa pudica* whole plant (MP) on glycation-induced protein cross-linking and on viability of normal cells. Lysozyme was incubated with 500 mM fructose in the presence of heated or non-heated extracts (12.5 to 100 µg/mL) for 3 weeks at 37ºC. Aminoguanidine was used as the positive control. Reaction mixture without extracts was used as the negative control. Aliquots collected at 7 and 21 days of incubation were assessed for the extent of protein cross-linking using sodium dodecyl sulphate polyacrylamide gel electrophoresis. Cytotoxic effects of extracts (12.5 to 500 µg/mL) were assessed on L929 mouse fibroblasts using 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) assay. A dose-dependent inhibition was observed by the appearance of high molecular protein bands when tested at day 7 and 21 with MP. Almost complete inhibition of high molecular band formation was revealed with 50 µg/mL at 7 days and with 100 µg/mL at 21 days. Experiment was performed at a stronger glycating environment than what is expected in uncontrolled diabetes (500 mM fructose instead of ~10 mM glucose). Extent of the high molecular weight products formed in the presence of both heated and non-heated extracts were similar, demonstrating the heat stability of constituents. This is important as decoctions are often prepared with medicinal plants in traditional remedies. Cytotoxic effects were not detected up to 62.5 µg/mL. In conclusion, MP showed a dose-dependent inhibition on glycation-induced protein cross-linking under strong glycating conditions. Inhibitory effects were heat stable. Cell viability was not affected at lower concentrations of MP.

Keywords: *Mimosa pudica*, Glycation, Cross-linking, Cytotoxicity

Current Status of Quality Assurance in Relation to Ionizing Radiation in Diagnostic Imaging Departments in Sri Lankan Hospitals

R.D.C.I. Rajamuni* and B.S. Weerakoon

Department of Radiography/Radiotherapy, Faculty of Allied Health Sciences, University of Peradeniya, Peradeniya 20400, Sri Lanka
*isharachamudi@gmail.com

Ionizing radiation is used to diagnose diseases in modern medicine. Improper handling of ionizing radiation may contribute to a large amount of unnecessary radiation doses to patients and staff. Quality assurance in radiography helps to provide a successful service with proper radiation protection and good image quality. Sri Lanka Atomic Energy Regulatory Council is the main professional body responsible for quality assurance in radiography. Radiographers are responsible for performing needed quality assurance procedures according to the recommendations. This study aims to assess the level of knowledge and current state of quality assurance within selected radiology departments. A qualitative study was done with a distribution of a questionnaire among the participants. Survey data were analyzed using descriptive statistics and sample t-test. Twenty-five radiographers from three government hospitals participated in the study. Both demographic data and knowledge on quality assurance were assessed. The overall knowledge on quality assurance activities was insufficient ($p > 0.05$). The mean score of correct answers was 5.06 out of 11 questions. There was no correlation between quality assurance knowledge and work experience ($p > 0.05$). Participants did not obtain a proper training on quality assurance. The study identified a lack of quality assurance programs within the selected hospitals. Although the atomic Energy Regulatory Council has established quality assurance programs, manuals and exposure charts are not used in diagnostic imaging departments. The absence of quality assurance activities and functional supervisory structures for diagnostic imaging services in Sri Lanka could have adverse effects on quality service delivery. This survey should be done island-wide to determine the urgent need for robust actions to implement realistic quality assurance programs in diagnostic radiology.

Keywords: Diagnostic radiology, Quality assurance, Radiographers

Therapeutic Outcome of 10 mCi Radioactive Iodine for Graves' Disease: A Prospective Follow-up Study

A.R.M. Sanooz[1]* and D.K.K. Nanayakkara[2]

[1]Department of Clinical Sciences, Faculty of Health-Care Sciences, Eastern University, Batticaloa 30000, Sri Lanka
[2]Nuclear Medicine Unit, Faculty of Medicine, University of Peradeniya, Peradeniya 20400, Sri Lanka
*sanoozarm@yahoo.com

Radioactive Iodine (RAI) is one of the first-line treatments for Graves' disease (GD). The administered RAI activity influences the therapeutic outcome of the RAI. Induction of permanent hypothyroidism or euthyroidism is considered as therapeutic success after RAI therapy. This study aimed to determine the therapeutic outcome of the 10 mCi fixed-dose RAI treatment for GD. A prospective cross-sectional descriptive study was carried out among GD patients presented to the Nuclear Medicine Unit, University of Peradeniya, from August 2018 till February 2020. All patients were followed up at three monthly intervals for six months after RAI therapy. Thyroid status at 06 months after RAI therapy was considered as the therapeutic outcome. Ethical approval was obtained from the Ethics review committee, Faculty of Medicine, University of Peradeniya. There were 67 GD patients, including 56.7% females and 43.3% males with a mean age of 50.28±14.755 years. These patients had been given antithyroid drugs (ATD) for a mean duration of 35.31±37.428 months before RAI administration. Six months after RAI treatment, the overall therapeutic success was 77.6% (17.9% euthyroid and 59.7% hypothyroid) and 22.4% remained hyperthyroid, showing inadequate response. The total therapeutic success population (77.6%) included 75.9% of males and 78.9% of females from the total study population. The rate of therapeutic success achieved with 10 mCi of RAI in this study is similar to several other studies with a success ranging from 74%-88.5%. The present study found that a desirable outcome can be achieved with 10 mCi fixed dose of RAI for GD patients rather than treating them with ATD for a longer duration which is associated with a potential risk of severe adverse effects and morbidity.

Keywords: Graves' disease, Radioactive iodine, Thyrotoxicosis, Antithyroid drugs

iPURSE 2021 – 284   *Health and Society*

Finding Percentage Reduction Radiation Dose of Eye Lens during Brain Computed Tomography (CT) Scan with Anthropomorphic Phantom Using Gantry Tilt Technique

T. Kajenthiny*, H.M.L.M. Herath and D.T.D. Jayasinghe

Department of Radiography, Faculty of Allied Health Sciences,
University of Peradeniya, Peradeniya 20400, Sri Lanka
*kanythillainathan7@gmail.com

Brain CT scan is a valuable medical imaging tool performed to assess brain pathologies. Technically routine brain CT scans are performed parallel to the radiographic base line. As a result, the eye lens is always exposed to scattered radiation due to the direct beam. Lens is more sensitive to ionizing radiation and cataract is induced. Radiation to eye lens can be reduced by performing brain CT with gantry tilt excluding orbits without affecting image quality. This study was conducted to find out the percentage reduction of radiation dose to eye lens with gantry tilt during brain CT scan as studies related to this topic in both international and local literatures are sparse. The phantom was positioned for brain CT according to the standard patient positioning principles and two dosimeters were placed on two eyes to calculate the eye lens dose. Optimal tilt angle was found out as 15° and then the brain CT scans were done for the phantom without gantry tilt and with gantry tilt and dose reduction percentages were calculated. Fifteen radiation dose reduction percentage measurements with gantry tilt were obtained by using 15 different brain CT protocols from two different hospitals in Kandy district. Out of them, 9 were adult brain CT protocols and 6 were paediatric brain CT protocols. Our analysis showed that there was a linear proportional relationship between mAs (milliampere-seconds) and surface radiation dose and that surface radiation dose to eye lens can be reduced by gantry tilt technique during brain CT scan. It was concluded that the surface radiation dose to eye lens can be reduced between 25.23% and 32.71% by using gantry tilt technique during brain CT. Surface dose reduction percentage range for adult and paediatric protocols were 32.02% to 35.99% and 19.57% to 23.26% respectively.

Keywords: Brain CT, Eye lens, Gantry tilt, Dose reduction percentage, Radiographic baseline

A Study to Determine Patient Satisfaction and Quality of Services at Outpatient Urology Clinic of a Tertiary Care Hospital in Sri Lanka

K.P. Dharmasena[1]*, S. Nawaratne[2], S. Vidanapathirana[3], A.A.T.D. Amarasekara[1],
U. Wijemanna[4] and A.M. Abeygunasekara[3]

[1]*Department of Nursing and Midwifery, Faculty of Allied Health Sciences,*
University of Sri Jayawardenapura, Gangodawila 10250, Sri Lanka
[2]*Postgraduate Institute of Medicine, University of Colombo,*
Colombo 00700, Sri Lanka
[3]*Department of Urology, Colombo South Teaching Hospital,*
Dehiwala 10350, Sri Lanka
[4]*Colombo South Teaching Hospital, Dehiwala 10350, Sri Lanka*
*kpaba.dharmasena@sjp.ac.lk

Patient satisfaction where the service quality compares the patient's expectations with the services provided has become an important concern in the evaluation of health services in addition to medical outcome and cost. Even though patient's impression on health care services and necessity of patient satisfaction surveys in the clinical setting have been identified as major concerns in the developed world during the last few decades; studies to determine the patient satisfaction at specialized clinics of hospitals in Sri Lanka are scarce. The aim of this study was to assess the patients' satisfaction of services delivered at the urology out-patient clinic of a tertiary care hospital, Sri Lanka. A pre-tested, self-administered questionnaire based on the SERVQUAL questionnaire was used in this descriptive cross-sectional study on 220 patients. Seven questions were based on demography and eighteen were aimed at assessing responsiveness, tangibles, empathy, and reliability. Likert scale was used to determine the level of satisfaction. Nearly one third (32%) of them felt the waiting time to be registered at the clinic and to meet a doctor were too long. More than half (59%) said clinic was over-crowded. However, over 90% of the patients perceived that staff characteristics, laboratory services and waiting time from the date of referral to the clinic appointment were satisfactory. Nearly 93% of the participants would recommend the clinic to a friend or a relative for seeking treatment. The findings indicated that, although patient satisfaction was good on many domains, patient satisfaction and the quality of services provided at the urology clinic can be improved further by developing a better mechanism of giving appointments spread over the duration of the clinic.

Keywords: Service quality, Patient satisfaction, Outpatient clinic, Urology, Surgical clinic, Sri Lanka

Epidemiology of Urolithiasis in Central Province of Sri Lanka

W.M.S.N. Warnasooriya[1], A.U.B.P. Pethiyagoda[1]*, K. Pethiyagoda[2],
N.V.G.H. Erandika[1], I. Niyas[1] and M.D.L.G. Keeragala[1]

*[1]Department of Surgery [2]Department of Community Medicine
Faculty of Medicine, University of Peradeniya, Peradeniya 20400, Sri Lanka
pethiya@yahoo.com

Urolithiasis is a condition associated with calculi forming in the renal pelvis, moving into the ureters, bladder, and urethra. It is a highly prevalent state with a high recurrence rate that shows a large impact on the quality of life of affected people and the health economy of the country. The aim of this study is to investigate the epidemiological data of patients presented with urolithiasis during past 2 years to teaching hospital Peradeniya, Sri Lanka. This is a descriptive study conducted among the patients presented with urolithiasis during past 2 years at surgical unit, Teaching hospital, Peradeniya. Interview based questionnaire was performed among 452 patients. Questionnaire was based on the epidemiology of patients. Data were analyzed using Statistical Package for the Social Sciences (SPSS). The mean age of the study population was 42.83 ± 13.75 years, and the mean body mass index was 24.57 ± 3.73 kgm^{-2}. According to the results, there was a significant relationship between other comorbidities such as diabetes mellitus, hypertension, and ischemic heart disease with incidence of urolithiasis ($p=0.001$). The age ($p=0.01$) and gender ($p=0.001$) also showed a significant correlation with urolithiasis. There was no statistically significant relationship between family history ($p=0.4$) and ethnicity ($p=0.82$). Therefore, this study emphasizes that there is a higher tendency to increase urolithiasis with age and other comorbidities.

Keywords: Urolithiasis, Age, Gender, Family history, Comorbidities, Sri Lanka

Indications for Renal Transplants for Children in Sri Lanka

A.K.B.B.T.B. Samarasinghe[1]*, R.M.J.S.B. Rathnayake[1],
R.S. Thalgahagoda[2] and D. Keeragala[1]

[1]Department of Surgery
[2]Department of Paediatrics
Faculty of Medicine, University of Peradeniya, Peradeniya 20400, Sri Lanka
*bandula.s@gmail.com

End Stage Renal Failure (ESRF) is a major health problem. It poses different health challenges depending on the age. Adult ESRF is due to systemic illnesses and chronic kidney disease of unknown origin (CKDu). It is different in children and important to identify the causes for ESRF as management is different. The published data on this issue is scanty in Sri Lanka. This study was planned to identify different aetiologies of ESRF and their magnitude in children who underwent renal transplants. This retrospective study was conducted in the Teaching Hospital, Peradeniya. The data were retrieved from 2004 to 2020. Aetiologies were categorized to seven (glomerulonephritis, congenital anomalies of kidney and urinary tract (CAKUT), familial nephropathy, nephritic syndrome, cystic renal disease, renal paranchymal disease and other causes). It was analyzed according to the age [<10 y (group 1) and >10 y (group 2)] and gender. There were 131 transplants in 129 patients. Seventy-two were done for CAKUT [male=54, female=18; statistically significant (p=0.027)]. There was no significant difference between two groups of the same gender (p=0.331). Seventeen patients had transplants due to glomerulornephritis (group 1=7, group 2=10). Difference between groups was not significant (p=0.501). As the leading transplant programme in Sri Lanka, it represents national data. It is evident that the aetiology of paediatric ESRF patients who undergo transplantation is different from adults. However, it is in par with global data. In conclusion, most of the children who undergo renal transplants are due to CAKUT; and majority of them are males. The second commonest indication was glomerulonephritis where there is no significant difference between genders. Both these aetiologies, if detected early, could be managed properly either preventing or delaying the onset of ESRF. It is important to identify vulnerable children and treat them in order to reduce the burden on health care systems.

Keywords: ESRF, Children, Renal failure, Transplantation, Indications

Quality of Life of Patients with Lower Urinary Tract Symptoms with regard to Their Disease Condition

W.M.S.N. Warnasooriya[1], A.U.B. Pethiyagoda[1]*, K. Pethiyagoda[2],
N.V.G.H. Erandika[1], I. Niyas[1] and M.D.L.G. Keeragala[1]

[1]Department of Surgery [2]Department of Community Medicine
Faculty of Medicine, University of Peradeniya, Peradeniya 20400, Sri Lanka
*pethiya@yahoo.com

Lower urinary tract symptoms (LUTS) are prevalent in middle-aged and elderly men. LUTS of the middle-aged men are usually attributed to benign prostatic enlargement. A measure that addresses most bothersome symptoms and bothersome score may lead to improve outcomes and patient satisfaction towards the treatment. The objectives of this study were to assess the patient-reported, most bothered symptom and bothersome score in men with LUTS. This was a descriptive study conducted among 714 patients presented with LUTS at Surgical Clinic, Teaching hospital, Peradeniya. An interviewer-based questionnaire with International Prostate Symptom Score (IPSS) was used to assess the associated symptoms. Seven questions concerning urinary symptoms and one question concerning quality of life were included there. Data were analyzed by chi square test using SPSS version 20. The mean age of the study sample was 62.37 ± 13.15 years (16-94 years). There was a significant association between bothersome score and IPSS groups (mild, moderate, severe) based on total IPSS score ($p < 0.05$). The most prevalent bothersome symptoms of these patients were urgency (42.5%), nocturia (21.7%), and sensation of incomplete voiding (19.8%). Furthermore, patients reported that they experienced these symptoms more than half of the time; incomplete emptying (35.8%), increased frequency (34%), intermittency (36.1%), urgency (37.5%), weak stream (54%), straining (28%) and nocturia (17.2%). According to results it can be concluded that, the most bothersome symptoms were urgency and nocturia even though the frequency of occurrence of these symptoms were less; in particularly nocturia.

Keywords: Lower urinary tract symptoms, International Prostate Symptom Score, Bothersome Score, Bothersome symptom, Sri Lanka

A Randomized Controlled Trial Comparing Effectiveness in Bowel Preparation between Polyethylene Glycol Alone and with Phosphate Enema in Patients Undergoing Colonoscopy in Teaching Hospital Peradeniya

W.A.M.A.S. Athapaththu[1]* and E.M.U.J.B Ekanayake[2]

[1]Department of Pharmacy, Faculty of Allied Health Sciences
[2]Department of Surgery, Faculty of Medicine
University of Peradeniya, Peradeniya 20400, Sri Lanka
*anushikaathapaththu@gmail.com

The success of colonoscopy depends on pre procedure bowel preparation. If bowel preparation is poor, significant pathology may not be detected during colonoscopy. Although, Polyethylene glycol (PEG) is the commonly used regimen in pre procedure, sometimes it does not provide the anticipated bowel preparation. Therefore, some surgeons use Phosphate Enema (PE) in addition to PEG mainly based on expert evidence. The objectives were to obtain evidence on effectiveness of bowel preparation between PEG alone and PEG with PE in patients undergoing colonoscopy. Hundred and ten patients were randomly selected among the patients undergoing colonoscopy at Teaching Hospital Peradeniya and 55 patients were randomly assigned to a control group where the conventional method (PEG alone) was carried out and the other 55, into an experimental group where PEG + PE preparation was carried out. Quality of bowel preparation of each patient was evaluated using Ottawa Bowel Preparation Quality Scale. Patients who received PEG + PE combination had better bowel preparation in each part of the colon than patients who received PEG only ($p < 0.05$). Further, the number of the patients who had no or minimum amount of fluid in the colon was higher in the experimental group than in the control group. It is concluded that the PEG + PE combination was more effective than using PEG alone in bowel preparation for patients undergoing colonoscopy.

Keywords: Bowel preparation, Colonoscopy, Polyethylene glycol, Phosphate enema

Control of Inferior Mesenteric Artery: A Low-Cost Method

S. Sancheevan* and K.B. Galketiya

Department of Surgery, Faculty of Medicine, University of Peradeniya,
Peradeniya 20400, Sri Lanka
*ssancheevan@yahoo.com

Inferior mesenteric artery ligation is required in abdomino perineal resection (APR) and anterior resection (AR) for carcinoma rectum. When the procedure is done by laparoscopy the morbidity is reduced when compared to open surgery. Ligation and division of inferior mesenteric artery (IMA) is an important step of the procedure. In laparoscopic surgery this is often done by using a vascular stapler, the cost being about 75,000 LKR. Due to the cost, we looked at a low-cost technique using energy sources and clips. The recurring cost is for the titanium clips which is about 2,000 LKR. Objective of this study was to assess the safety and cost effectiveness of titanium clips for the control of IMA during abdomino perineal resection and anterior resection. All APRs and ARs performed in our unit since 2010 were included in the study. The IMA was dissected using ultrasonic dissector. Then bipolar coagulation was used on the IMA which shrinks the vessel. Once the diameter is reduced titanium clips were applied and vessel divided between clips with ultrasonic dissector which also has a vessel sealing effect. Sixty patients underwent procedures, 35 males and 25 females. The age ranged from 38 to 86.5. Fifty of the procedures were ARs and 10 were APRs. IMA was controlled by this technique in all patients, and it was successful in all. There were no cases with intraoperative or post-operative bleeding requiring another mode to control IMA. The success was determined by the fact that none of the patients in the study group requiring any other measures to control bleeding from IMA once the described procedure was carried out. Control of IMA by energy sources and titanium clips is safe and effective and is much less costly compared to stapling.

Keywords: Abdomino perineal resection, Anterior resection, Inferior mesenteric artery, Titanium clips

Antibacterial Activity of Different Compositions of Ethanol and Isopropanol in Hand Sanitizers

R.M. Kamal, H. Mudalige* and U. Bandaranayake

School of Science, Business Management School, Colombo 6, 10350, Sri Lanka
*heshani.m@bms.ac.lk

Hand hygiene is vital in the control of nosocomial and community spread infections. Alcohol-based sanitizers commonly contain ethanol, isopropanol and n-propanol at concentrations between 60-95%. This study explored the effect of altering ethanol and isopropanol compositions on the antibacterial activity of hand sanitizers. Hand sanitizer 1 (HS1) contained 40% each of ethanol and isopropanol giving a total alcohol concentration of 80% (v/v), while the Hand Sanitizer 2 (HS2) contained 42.5% of both alcohols, giving a total alcohol concentration of 85% (v/v). To analyse antibacterial susceptibility, well diffusion assay was performed using Mueller Hinton media. The zone of inhibition (ZOI) of HS1 was 23.5±1.41 mm against *Staphylococcus aureus*. No ZOI were observed against *Escherichia coli*. The ZOI of HS2 was 19.5±0.7 and 31.0±1.4 mm against *S. aureus* and *E. coli,* respectively. There was a significant statistical difference between the ZOI in relation to HS1 and HS2 for both *E. coli* (p=0.001; p< 0.05) and *S. aureus* (p=0.022; p<0.05). The HS2 was identified as more effective due to its broader antibacterial spectrum, and HS2 was subjected to a downstream hand swab analysis. The colony count method proved that HS2 reduced bacterial counts on hand surfaces from 1.093×10^9 cfu/mL to 2.2×10^5 cfu/mL. Additionally, biochemical tests confirmed the wide spectrum of HS2 activity against multiple bacterial species including Gram-positive and negative bacilli and cocci, lactose fermenters, oxidase and catalase producing bacteria. Broth macro-dilution was used to determine minimum inhibitory concentration (MIC) and concentration percentages of 20, 15, 10, 9, 8, 7, 6, 5,4,3,2 and 1of HS2 was analysed. The (MIC) of HS2 was 5% (2.5% ethanol and 2.5% isopropanol) against *E. coli*. It was lower at 4% (2% ethanol and 2% isopropanol) against *S. aureus*. The combination of ethanol and isopropanol produced higher ZOI and lower MIC values, implying the efficacy of antibacterial action.

Keywords: Well diffusion, Minimum inhibitory concentration, Hand swab analysis

Study of Analytical Parameters of Different Extracts of *Paederia foetida* L. Grown in Sri Lanka

S.D. Hapuarachchi[1]*, P.D.S.A. Silva[2], N.D. Kodithuwakku[1] and P.K. Perera[1]

[1]Institute of Indigenous Medicine, University of Colombo, Rajagiriya 10100, Sri Lanka
[2]Department of Pharmacy, Faculty of Allied Health Sciences, University of Ruhuna, Wellamadama, Matara 81000, Sri Lanka
**dr.sdhapuarachchi@iim.cmb.ac.lk*

Majority of population rely on Traditional medicine in which herbal drugs play a major role. *Paederia foetida* (*Prasarini*) belonging to family *Rubiaceae* is an important herb used in many Ayurveda preparations for asthma, diabetes, digestive and musculoskeletal disorders. It is also an ingredient of *Dasmularishta*. Hence, this study was conducted to determine several analytical parameters of different extracts of *P. foetida* leaves. Matured leaves were collected from Western Province, Sri Lanka, oven dried up to a constant weight at a temperature below 45 ºC and powdered. Extracts were obtained after cold maceration with methanol, acetone and hot water extraction as per WHO Guidelines. Each extract was subjected to preliminary phytochemical, physico-chemical and chromatographic analysis under analytical parameters. Phytochemical screening revealed the presence of alkaloids, tannins and flavonoids in all extracts while carbohydrates, reducing sugars, anthranol glycosides, cardiac glycosides, saponins, terpenoids, phenols, proteins and amino acids were detected only in methanol and aqueous extracts. Steroids and diterpenes were found only in acetone extract. Physico-chemical parameters including; total ash, acid insoluble ash, water soluble ash, loss on drying, extractability in methanol, acetone and water were determined as 8.64±0.06% w/w, 0.43±0.06% w/w, 4.49±0.13% w/w, 9.90±0.71% w/w, 25.16±1.39% w/w, 7.13±0.23 and 32.12±0.39% w/w, respectively. Under chromatographic analysis, High Performance Thin Layer Chromatography (HPTLC) was conducted. Methanol extract showed 8 peaks (R_f; 0.08, 0.20, 0.31, 0.48, 0.64, 0.65, 0.69, 0.77) while acetone extract showed 8 peaks (R_f; 0.06, 0.16, 0.22, 0.28, 0.34, 0.40, 0.74, 0.87) for the solvent system; n-hexane: dichloromethane: ethyl acetate (4:1:1). Reverse phase HPTLC fingerprint of aqueous extract showed 11 peaks (R_f; 0.06, 0.16, 0.20, 0.41, 0.49, 0.58, 0.62, 0.66, 0.67, 0.75, 0.81) with methanol: distilled water (4:6). Tests were done in triplicate and results were expressed as mean ± standard deviation. Hence, these analytical parameters can be considered as preliminary tools of authentication and standardization of *P. foetida* leaves.

Keywords: Analytical, *Paederia foetida* L., Physico-chemical, Phytochemical, High performance thin layer chromatography

Intra-Specific Diversity of *Piper longum* L. through Genetic Approach Using Nuclear ITS

M. Balatheepan[1,2], W.W.P. Rodrigo[1]*, B.J.G. Jayawardhana[1] and R.M. Dharmadasa[1]

[1]*Biotechnology Section, Industrial Technology Institute, 363, Bauddhaloka Mawatha, Colombo 00700, Sri Lanka*
[2]*Business Management School, 591, Galle Road, Colombo 00600, Sri Lanka*
*wwprodrigo@yahoo.com

Piper longum L. (Thippili) has an economic importance as an ayurvedic medicine. It belongs to the family Piperaceae. Although, there are some morphological differences among the populations, all are considered as a single species. Therefore, the main aim of this study was to identify the genetic variations within the *P. longum* L. populations using Internal Transcribed Spacer (ITS) region. Seven samples of *P. longum* were collected from different areas in Sri Lanka. Genomic DNA was extracted using cetyltrimethylammonium bromide (CTAB) method. PCR was carried out using ITS-S2F (5'ATGCGATACTTGGTGTGAAT3') and ITS4 (5'TCCTCCGCTTATTGATATGC3') primers. PCR products were purified and sequenced by Sanger sequencing. DNA sequences were analyzed by BioEdit sequence alignment software and the phylogenetic tree was constructed using neighbor-joining (NJ) method in Mega7 software. Three samples collected from Kalutara (TP1) and Gampaha districts (TP5 and TP6) resulted with ~500 bp PCR products and samples collected from Matale (TP2), Colombo (TP3 and TP4) and Kegalle (TP7) resulted with ~480 bp PCR products. Phylogenetic tree revealed two main monophyletic groups. First monophyletic group included TP1, TP5 & TP6 while the second included TP2, TP3, TP4 & TP7. *Piper longum* that fell in the first group has creeper plant nature with dark green leaves and dark green fruits. These plants consist of orthotropic and plagiotropic axis and fruits which develop only from orthotropic axis. *Piper longum* in the second group has erected plant nature with shiny green leaves and light green fruits which are present in orthotropic axis. Further, no differences were observed within the groups. However, sequence deletions and base pair differences were observed between the two monophyletic groups. Therefore, it could be concluded that the tested Sri Lankan *P. longum* populations can be divided into two phenetic groups based on morphological features and molecular data. Further studies with different molecular markers, different populations and more samples are necessary to confirm whether two phenetic groups can be classified as different species or subspecies.

Keywords: Genetic variation, *Piper longum*, ITS, Phylogenetic tree

Low Dose Image Enhancement Using Autoencoders

R.M.W.R. Bandara[1]*, C. Gunasena[1], P.M.P.C. Gunathilake[2] and R.D. Jayasinghe[1]

[1]Department of Oral Medicine and Periodontology, Faulty of Dental Sciences
[2]Department of Statistics and Computer Science, Faculty of Science
University of Peradeniya, Peradeniya 20400, Sri Lanka
*wikumroshan@gmail.com

Medical imaging plays a significant role in modern medicine to create a visual representation of the internal structures of the human body. Radiation dose received by the patients who undergo radiation scan is a primary concern during medical imaging, as radiation can cause cancers in the human body. Various dose reduction techniques have been proposed by several researchers in the past. This research proposes a method to automate the enhancement of the low dose dental panoramic tomographic (DPT) images using a convolution autoencoder and reduce the subjective interference of the resulting image and ultimately reduce the radiation dose received by the patient. Ethical clearance for the present study was obtained from the ethical review committee of the Faculty of Dental Sciences, University of Peradeniya. A total of 2151 DPT scans, acquired using a very low radiation dose, was used in this study. The average kilovoltage peak (kVp) value was 72.3, and the average milliampere-second (mAs) value was 6.95. The acquired images were manually processed to enhance the image quality using the image processing software, Rotograph EVO D 0051, installed with the scanner. A convolution autoencoder model was programmed using image processing libraries associated with Python language and Keras deep learning library. An autoencoder is an artificial neural network used to learn efficient data coding in an unsupervised manner. The model was trained using the downsized original and manually processed images. The best model was obtained using after 100 epochs and a batch size of 32. The predicted image was compared with the original and manually processed images using peak-signal-to-noice (PSNR) and structural similarity index measure (SSIM) values. PSNR values of both original-manually processed (10.917 dB) and original-predicted images (11.402 dB) indicate that the images have enhanced during the process. The SSIM value (0.91) between manually proceed and predicted images indicates that the two images are 91% similar.

Keywords: Deep learning, DPT, Medical imaging, Image enhancement, Autoencoders

Formulation and Validation of a Quantitative Method to Estimate Mammographic Breast Density

I.L.U. Chandrasiri[1]*, P.B. Hewavithana[2], A. Jayasinghe[1], B.S. Weerakoon[1], P.M.P.C. Gunathilake[3] and S.P. Abeysundara[3]

[1]*Department of Radiography/Radiotherapy, Faculty of Allied Health Sciences*
[2]*Department of Radiology, Faculty of Medicine*
[3]*Department of Statistics and Computer Science, Faculty of Science*
University of Peradeniya, *Peradeniya 20400, Sri Lanka*
**lakminichandrasiri@pdn.ac.lk*

Breast density estimation is important due to its strong association with breast cancers. This study aimed to formulate and validate a computer-based programme for the quantitative assessment of mammographic breast density (MBD). This semi-automated computer-based programme was developed to estimate the MBD using the ratio of the area of fibroglandular tissues to the total area of the breast in a digital mammogram where a manual threshold was applied to differentiate fibroglandular tissues from fatty tissues. As the first part of the validation, three experts applied the threshold individually on hundred mammograms and the agreement between the experts was assessed. For the second part of the validation, 400 digital mammograms categorized according to the Breast Imaging-Reporting and Data System (BI-RADS)were obtained from an online database. The mammograms consisted of left craniocaudal (LCC), left mediolateral oblique (LMLO), right craniocaudal (RCC) and right mediolateral oblique (RMLO) projections. The agreement between assigned BI-RADS categories and the measured MBD values were assessed for the above 400 mammograms. Results of the analysis, intra-class correlation coefficients (ICC), showed good agreements among three experts for LCC (ICC=0.858), LMLO (ICC=0.826) and RCC (ICC=0.752) projections while RMLO (ICC=0.272) projection showed a poor agreement. Significant positive correlations (polyserial correlation coefficients) were identified between the BI-RADS categories and the estimated MBD of LCC (r=0.8164, p<0.05), LMLO (r=0.8668, p<0.05), RCC (r=0.8512, p<0.05) and RMLO (r=0.8409, p<0.05). In conclusion, significant positive correlations were obtained for the measured MBD values and qualitative BI-RADS categories. Further, a good agreement among the experts indicates, less subjectivity and optimal reproducibility. Hence, the computer-based programme formulated in this study may be utilized to accurately determine the MBD in digital mammograms.

Keywords: Quantitative breast density, Breast Imaging-reporting and Data System, Breast density estimation, Digital mammography

Factor and Cluster Analytic Approach in Exploring Parameters of Mental Health: A Follow-up Study in Jaffna Society

C. Elankumara

Department of Economics, University of Jaffna, Jaffna 40000, Sri Lanka
elankumaran13@gmail.com

This study focuses on the nature of mental health conditions in post-war Jaffna society, which was carried out in 2018, more than one year prior to Coved 19 pandemic. This is a follow-up study of a previous study titled "Jaffna Socioeconomic Health Study 1999". The sampling unit of this study remains the same (1121 families of JSEHS-1999), but the study subjects are different. The sample was earlier drawn using two-stage stratified sampling. The new study subjects are changed as one of the siblings in the sampling unit, he/she has now become adult after 20 years and his/her spouse. A sample of 1036 siblings is available from the original study. A modified questionnaire was used to suit the present situation to collect follow-up updated data on mental disability measures. Specific measures of mental disabilities were formulated in four dimensions of symptoms; "Psychological", "Physiological", "Psycho-Physiological" and "Ambiguous". The data collected on these variables were coded according to the requirement of statistical analysis in this study. Outcomes of basic statistical analysis using exploratory data analysis and logistic regression analysis were reported in 2020. The objective of the present study was to explore additional in-depth parametric outcomes using factor analysis, cluster analysis and canonical variate analysis. Factor analytic approach on various mental health symptoms by 17 variables revealed that, the psychological variables: feeling lonely, failure of expectation, wondering un-worthwhile events, and restless formed a combined major factor determining the mental health and feeling un-happy, low spirit, and sleepless also formed individual minor factors in this context. Further, the variables of physiological, psycho-physiological, and ambiguous dimensions had formed individually gender specific two factor formation, within which the factors of wives, dominant over the factors of husbands. Considering the gender by combining all four dimensions together, we were able to explore eight factor formations with suitable characterization of mental health. Cluster analytic approach on the sampled couples against the mental disorder variables revealed that, there were three cluster formations when considering the 8 psychological variables together and the 9 variables of physiological, psycho-physiological, ambiguous dimensions together. Using canonical variate analysis and cluster wise descriptive statistics, we were able to clearly characterize the three clusters with degrees of mental health such as mild, average, and high mental health disorders. The various factors formulated, the sizes of the clusters and their characteristics have together explored the parametric scenario of mental health in Jaffna.

Keywords: Psychological, Physiological, Psycho-physiological, Ambiguous disorders, Factor analysis, Cluster analysis

Determination and Comparison of Phytochemical Composition and Antioxidant Activity of Different Parts of *Tylophoria pauciflora* Wight & Arn. Ex. Wight (Kiri Anguna) Plant Grown in Sri Lanka

W.M.R.R. Wijethunga* and S. Dias

[1]*Business Management School, Galle Road, Colombo 10350, Sri Lanka*
**rrwijethunga@gmail.com*

Reactive oxygen species (ROS) mediated oxidative stress plays a major role in the pathophysiology of most non-communicable diseases (NCDs). Epidemiological studies show a significant increment of these NCDs during the past three decades. The human body requires exogenous antioxidants to counteract the oxidative stress and therefore maintain homeostasis. Dietary antioxidants are the main source of these antioxidants. However, due to the lack of antioxidants in the modern diet, intracellular oxidative stress is not counteracted effectively, giving rise to NCD conditions. *Tylophora pauciflora* is a native Sri Lankan herb which can also be found in India and Burma. A preliminary study to determine the phytochemical constituents of the plant was carried out, as well as comparing the constituents of different edible parts. Leaves and stems from naturally grown *Tylophora pauciflora* was collected and samples were extracted using methanol. The extracts were subjected to DPPH (2,2-diphenyl-1-picryl-hydrazyl-hydrate) and ABTS (2,2′-Azinobis-(3-Ethylbenzthiazolin-6-Sulfonic Acid)) tests to determine the antioxidant activity. Total Phenolic Content (TPC) and Total Flavonoid Content (TFC) were measured using colorimetric techniques. Statistical analysis was done using IBM SPSS version 24. Leaf sample extracts showed a higher TPC (6.39 ± 0.78 µg/mL) compared to the stem sample extract (5.21 ± 0.25 µg/mL). Statistical difference between the two samples were not significant as the obtained p value 0.067 was higher than 0.05 significance level. Leaf sample extracts showed higher TFC (6.28 ± 0.07 µg/mL) compared to the stem sample extract (3.05 ± 0.098 µg/mL). Statistical difference between the two samples were significant (p value = 0.008). Leaf sample showed higher DPPH (62.72%) and ABTS (74.65%) activity compared to the stem sample DPPH (60.02%) and ABTS (63.59%) activity. Thus, it can be concluded that the plant leaves contain high antioxidant properties which can aid in supplementing the current dietary need.

Keywords: *Tylophora pauciflora,* Antioxidant activity, Traditional food, Plant extracts

Development of Virgin Coconut Oil-Based Topical Sunscreen Formulations Using *Leucas zeylanica* and *Ophiorrhiza mungos* Leaves

F.A.S.S. Pillay[1]*, R.A.H.M. Ranasinghe[1], W.K.S.P Perera[1],
N.A. Sanjeewani[1] and M.A. Siriwardhene[2]

*[1]Department of Pharmacy, Faculty of Allied Health Sciences,
General Sir John Kotelawala Defence University, Ratmalana 10390, Sri Lanka
[2]Department of Pharmacy and Pharmaceutical Sciences, Faculty of Allied Health
Science, University of Sri Jayawardenapura, Nugegoda 10250, Sri Lanka
fass.sheronsebastian@gmail.com

Over exposure to sun radiation causes skin diseases. Ultraviolet (UV) light of solar radiation causes sunburns, wrinkles, premature aging and cancer. Herbal sunscreen formulations are preferred because some synthetic ingredients can cause photo sensitivity reactions. Thus there is a high demand for natural sunscreen agents. *Ophiorrhiza mungos* (OM) and *Leucas zeylanica* (LZ) are herbs reported to possess sunscreen activity. Virgin Coconut Oil (VCO) is a natural oil which has been used for producing stable emulsion bases. The objective of the study was to evaluate the Sun Protection Factor (SPF) and carry out stability and characterization studies for VCO based cream formulations. The Methanolic extracts of OM and LZ were incorporated in to selected ratios of VCO, water and Tween 20® (T20). The excipients were Steric acid, Glycerine, Glycerol monostearic (GMS), and Triethanolamine (TEA). Samples were subjected to secondary homogenization. The most stable ratios were selected based on stability evaluation and characterization studies. SPF values were also evaluated for each formulations. The most stable ratio identified for each plant extract was 43% VCO, 25% water and 32% T20. The cream formulations were thermodynamically and kinetically stable for more than 120 days at room temperature (28± 2 °C). The SPF values of creams were above 36 and they showed higher SPF values compared with the pure leaf extracts of OM and LZ. Comparatively LZ creams showed higher SPF values than OM creams. All the creams were in o/w (oil in water) type and in the acceptable pH range for topical applications. Due to the consistency of the creams, they could retain on the skin for longer period. All the formulated creams composed with characteristic features which should possess in a standard sunscreen agent. Therefore, these creams can be further developed to well-established products in the market.

Keywords: Natural sunscreen, Sun protection factor, Stability evaluation, Characterization

Lipase Inhibitory Potential of Plant Material in Polyherbal Formula "*Lekhaneeya Dashakaya*"

W.N.H. Rodrigo[1,2] and W.I.T. Fernando[1]*

[1]Department of Biochemistry, Faculty of Medicine
[2]Postgraduate Institute of Science
University of Peradeniya, Peradeniya 20400, Sri Lanka
*irushikawit@yahoo.com

In the traditional ayurvedic system of medicine, number of medicinal plants and their formulations are used for treating hyperlipidemia and obesity. "*Lekhaneeya Dhashakaya*" (LD) has been described in classical ayurvedic text, Charaka Samhitha, as formula containing the ten most effective herbs that could be used to treat ailments related to hyperlipidemia. LD is used as a decoction or tea in ayurvedic practice to treat hyperlipidemia. In a previous study herbal tea and decoctions of LD showed inhibition of pancreatic lipase *in-vitro*. Therefore, medicinal plants in this formulation [*Acorus calamus* (AC), *Plumbago indica* (PI), *Cyperus rotundus* (CR), *Saussurea lappa* (SL, *Curcuma longa* (CL), *Coscinium fenestratum* (CF), *Aconitum heterophyllum, Picrorhiza kurroa, Pongamia glabra* (PG) *& Terminalia chebula* (TC)] purchased from a traditional drug store in Kandy, were screened to identify the lipase inhibition potential. The medicinal plant materials used in the formula of LD were subjected to extraction separately, with methanol and the resulting extracts were evaluated for their pancreatic lipase inhibitory potentials using Ellman's reagent, porcine pancreatic lipase and 2,3-dimercapto-1-propanol tributyrate substrate. Out of those 10 plants, eight plant extracts showed more than 50% inhibition at 10mg/ml concentration and other two plant extracts showed less than 30% inhibition. Rhizomes of AC, roots of PI, rhizomes of CR, rhizomes of CL, stems of CF, roots of PG, fruits of TC and roots of SL showed 81%, 75%, 65%, 62%, 62%, 60%, 58%, 53% inhibitory effect on pancreatic lipase, respectively. The positive control orlistat showed 98% inhibition at 1mg/ml. The mode of inhibition of the two plant extracts with the highest inhibition were analyzed (2.5 mg/ml – 10 mg/ml) and the enzyme kinetic studies demonstrated non-competitive inhibition on pancreatic lipase by *Acorus calamus* (IC_{50} value: 4.48 mg/ml) & competitive inhibition on pancreatic lipase by *Plumbago indica* (IC_{50} value: 6.25 mg/ml). Plant materials of *Acorus calamus* and *Plumbago indica* showed potential lipase inhibitory activity and these two plant material could be further purified to isolate lipase inhibitors.

Keywords: Lipase inhibition, *Lekhaneeya Dhashakaya*, *Acoruscalamus, Plumbago indica*, Enzyme kinetics

Computer-Aided Lung Nodules Detection for Computed Tomography (CT) Images

W.K.N.R. Chandrasiri[1]*, S. Kulatunga[1], R.D. Nawarathna[2],
U. Usanthan[1] and B. Mithilajanan[1]

[1]Department of Radiography/Radiotherapy, Faculty of Allied Health Sciences
[2]Department of Statistics and Computer Science
Faculty of Science, University of Peradeniya, Peradeniya 20400, Sri Lanka
*nrnish051193@gmail.com

Lung nodule is one of the most common lung diseases in the world. Its early detection is crucial in treating the patient successfully. Computed Tomography (CT) is one of the best modalities available for the detection of lung nodules. However, radiologists must read vast amount of image data to identify lung nodules in CT images which is time consuming. Therefore, a sophisticated Computer Aided Detection (CAD) system may assist radiologists to detect lung nodules automatically avoiding misinterpretation and with improved efficiency. This study provides an algorithm for automatic detection of lung nodules in CT images using image processing techniques. CT images containing lung nodules of 33 patients were collected from trusted web sources. The location of each nodule was obtained from a radiologist's opinion. Then, texture properties such as entropy, local entropy, solidity, eccentricity, local range and local standard deviation of image were assessed to detect the lung nodules. The effectiveness of extracted texture properties to detect lung nodules was assessed statistically. 73 out of 123 slices (59.3%) with lung nodules were detected correctly by this developed algorithm. In comparison, a similar study conducted in Japan reported an accuracy of 86%. According to the results of two samples T-test and the confidence interval (CI), only eccentricity and solidity features gave satisfactory p-values (0.938 and 0.172, respectively). Detection of lung nodules using eccentricity and solidity was satisfactory as p-values of each feature are greater than SI value (0.05). Thus, it can be concluded that the developed algorithm can detect lung nodules in CT images with moderate detection accuracy. As future work, this algorithm can be further improved by including additional features such as region properties of lung nodules.

Keywords: Computed tomography, Computer aided detection, Lung nodules, Eccentricity, Solidity

Antibacterial Activity of *Cuminum cyminum* (Cumin), *Jasminum auriculatum* (Jasmine) and *Carica papaya* L. (Papaya) against *Escherichia coli* and *Staphylococcus aureus*

S. Praveen* and B. Upeka

School of Science, Business Management School, Colombo 00600, Sri Lanka
*praveensathiya81@gmail.com

Antibiotic resistance is an emerging problem worldwide. Different plants could be used to develop antimicrobial agents against different microorganisms and thus the focus has shifted to derivatives of natural products. The study was performed to detect the antibacterial activity of *Cuminum cyminum* (Cumin) seeds, *Jasminum auriculatum* (Jasmine) flowers and *Carica papaya* L. (Papaya) leaves against *Escherichia coli* (ATCC 25922) and *Staphylococcus aureus* (ATCC 25923). The plant phytochemicals were extracted via cold maceration using ethanol as a solvent at concentrations of (v/v) 95% for *C. cyminum* and *C. papaya* and 80% for *J. auriculatum*. Antibacterial susceptibility was tested by using well diffusion assay. Broth macro dilution assay to determine the minimal inhibitory concentration (MIC) values and the minimal bactericidal concentration (MBC) tests to determine the lowest concentration of an antibacterial agent that required to kills the test bacteria were carried out. All the sample extracts used were effective against *E. coli* and *S. aureus* at a concentration of 100 mg/ml and 50 mg/ml respectively. There was no statistical significance observed for unpaired student's T-test conducted individually for each sample extracts against each bacterial strain for both concentrations (P value > 0.05). The MIC value of *J. auriculatum* extract was the lowest at 6.25 mg/ml while *C.cyminum* extract MIC was at 12.5 mg/ml and *C. papaya* extract showed highest MIC value at 50 mg/ml against both strains used. According to the MBC results, *J. auriculatum* extract showed lowest value also for MBC at 12.5 mg/ml and *C. cyminum* and *C. papaya* samples MBC values were evaluated as 100 mg/ml against *E. coli* and *S. aureus*. The analysis demonstrates that all the plant samples investigated in this study displays antibacterial properties against the bacterial strains used in this study and *J. auriculatum* observably has the most promising antibacterial potential. Further studies are required to evaluate the efficacy of these plant extracts against clinical isolates of the bacterial strains used.

Keywords: Antibacterial activity, Phytochemicals, *Cuminum cyminum*, *Jasminum auriculatum*, *Carica papaya* L.

Methotrexate-Loaded Halloysite Nanotubes as a Controlled Release Drug Delivery Formulation

L.R Sendanayake[1]*, H.A.D.B Amarasiri[1], A.C.A Jayasundera[1,2] and N.M Adassooriya[1,3]

[1]Postgraduate Institute of Science
[2]Department of Chemistry, Faculty of Science
[3]Department of Chemical and Process Engineering, Faculty of Engineering
University of Peradeniya, Peradeniya 20400, Sri Lanka
*lasanthasendanayake@gmail.com

Methotrexate (MTX) is a well-established drug mainly used to treat various types of malignancies. This narrow therapeutic drug has a capacity-limited and dose-dependent oral absorption. Therefore, development of a safe and effective oral drug delivery method for MTX to achieve maximum therapeutic outcome is a need. Halloysite Nanotubes (HNTs) are a promising material for the development of nanodrug formulations which is biocompatible and effective in controlled release. Aim of the study was to formulate a controlled release nanodrug delivery system using HNT and chitosan (CHN) to increase the oral bioavailability of MTX. Four different formulations were developed as HNT+MTX, HNT+CHN+MTX, {Etched} EHNT+MTX and EHNT+CHN+MTX. Prepared formulations were characterized using PXRD, SEM, FT-IR and Drug Encapsulation Efficiency (DEE) and, Drug Loading Efficiency (DLE) were calculated while comparing the *in-vitro* drug release profiles at pH 2.2 and 7.4. DLE of HNT+MTX, HNT+CHN+MTX, EHNT+MTX and EHNT+CHN+MTX were 13.81%, 36.63%, 23.16%, 45.18% and DEE were 29.07%, 78.76%, 47.49%, 82.36%, respectively. Based on DLE, DEE and SEM images, CHN coating and enlarged lumen due to selective etching with sulfuric acid of HNT had facilitated a high drug loading. EHNT+MTX formulation had a rapid MTX release behavior but with CHN coating, EHNT+CHN+MTX formulation had the best *in-vitro* MTX controlled release behavior compared to the other formulations by reaching a maximum (90%) percentage cumulative drug released amount over six hours through a slow release at pH 7.4, which mimic the pH of small intestine fluid, where optimum *in-vivo* MTX absorption occurs. EHNT+CHN+MTX formulation showed relatively the lowest percentage cumulative drug released amount at pH 2.2. According to the obtained results it can be concluded that coating with CHN gives a controlled release behavior to EHNT+CHN+MTX formulation at the target site and it shows promising DLE, DEE, and *in-vitro* MTX release characteristics compared to the other prepared formulations.

Keywords: Halloysite Nanotubes, CHN, Methotrexate, MTX, Etched HNT, Oral drug delivery

Evaluation of Antifungal Activity of Aqueous Extract of *Punica granatum* (L). Leaves against *Candida albicans*

M.M.M.R. Fernando[1], W.H. Sihara[1], H.M.D.N. Wickramanayake[1],
M.A. Siriwardhene[2] and D.N.A.W. Samarakoon[1]*

[1]*Department of Biomedical Science, Faculty of Health Sciences, Kaatsu International University, Battaramulla, 10120, Sri Lanka*
[2]*Department of Pharmacy and Pharmaceutical Sciences, Faculty of Allied Health Science, University of Sri Jayawardenapura, Nugegoda 10250, Sri Lanka*
nirmani@kiu.ac.lk

The use of plants in traditional medicine for the treatment of diseases dates back to thousands of years but their therapeutic potential has not yet been assessed fully through scientific methods. *Punica granatum* L. (family *Punicaceae*), commonly known as pomegranate is a well-researched plant in terms of pharmacological activities of its fruit and peels but is little known for the use of its leaves in traditional medicine as a treatment for superficial fungal infections. In the current investigation concentration dependent antifungal activity of aqueous extracts of *P. granatum* leaves against Candida albicans (ATCC 10231) was determined. The leaves were macerated in water in a ratio of 1:3 (w/v) to obtain the aqueous extracts. Antifungal activity against *C. albicans* was screened using the Agar Well Diffusion method. The Minimum Fungicidal Concentration (MFC) was determined by the broth microdilution method. The tests were conducted in triplicate and results were observed after a 48 hr incubation period at 37 °C. The results of the study showed a concentration dependent antifungal activity at 125, 250 and 500 mg.mL^{-1} concentrations of the aqueous extract. The highest activity was shown by 500 mg.mL^{-1} following 24 hr incubation. It had a significant mean Zone of Inhibition (mZOI) of 22.6 mm ($p<0.05$) when compared to the positive control, nystatin (mZOI=25.6 mm). MFC of *P. granatum* was observed at 62.5 mg.mL^{-1} whereas nystatin showed a MFC of 400 μg mL^{-1}. The current study revealed that the antifungal activity of aqueous extract of *P. granatum* leaves in MFC of 62.5 mg mL^{-1}, had comparable antifungal activity against *C. albicans*. This justifies the use of this plant in traditional medicine to treat superficial fungal infections. However, it would be important to conduct further studies on fractionation and characterization of antifungal phytoconstituents against *C. albicans*.

Keywords: Antifungal, *Candida albicans*, Phytoconstituents, *Punica granatum*

Comparison of Antioxidant Activity of Sri Lankan *Annona muricata* Fruit Pulp, Fruit Peel and Leaves

O.C. Pathirana[1], M.P. Paranagama[2]*, K.K. Wijesundera[1] and R.P.V.J. Rajapakse[1]

[1]*Department of Veterinary Pathobiology, Faculty of Veterinary Medicine and Animal Science*
[2]*Department of Basic Sciences, Faculty of Dental Sciences*
University of Peradeniya, Peradeniya 20400, Sri Lanka
**madhaviparanagama@gmail.com*

Soursop (*Annona muricata* L.) is a tropical plant getting popular globally as a nutraceutical to prevent numerous diseases including cancer, diabetes mellitus, heart and liver diseases. High content of natural antioxidants in *A. muricata* is known to play a significant role in alleviating these diseases. Even though its fruit pulp is commonly consumed by the general population in Sri Lanka, other parts of the plant are still underutilized. This study aimed to investigate the antioxidant activity of some underutilized parts of this plant (leaves and fruit peel) and compare it with that of its fruit pulp. *A. muricata* L. leaves and fruit were authenticated, air dried and extracted in hot water (1:6). The extracts were tested for antioxidant activity using the DPPH radical scavenging assay and the results are expressed as mean $IC_{50}\pm SD$ (n=3). The results were compared using one-way ANOVA followed by post hoc Tukey's test. Ascorbic acid was used as the standard. Our results showed that DPPH radical scavenging activity of *A. muricata* L. leaves (IC_{50}=1.21±0.02 µl/ml) and fruit peel (IC_{50}=1.39±0.01 µl/ml) were significantly higher than that of the fruit pulp (IC_{50}=80.97± 3.5 µl/ml) (P<0.0001). Based on this result, we conclude that the leaves and fruit peel of *A. muricata* L. are better sources of natural antioxidants than the fruit pulp. Therefore, further *in vitro* and *in vivo* studies are warranted to analyse these underutilized parts of *A. muricata* L. plant and develop marketable nutraceutical from them to prevent oxidative stress associated diseases.

Keywords: *Annona muricata* L., Antioxidant, DPPH, Nutraceutical, Soursop

Comparative Study on Antioxidant Potency of Methanolic Leaf Extract of Wal Lunu (*Zepharantheus roseus* and *Pancratium zeylanicum*): An Ayurvedic Remedy for Cancer Used in Sri Lanka

D.M.J.D.K. Dunukara[1], D.N.A.W. Samarakoon[1]* and D.I. Uluwaduge[2]

[1]*Department of Biomedical Science, Faculty of Health Sciences, Kaatsu International University, Koswatta, Battaramulla 10120, Sri Lanka*
[2]*Department of Basic Sciences, Faculty of Allied Health Sciences, University of Sri Jayewardenepura, Nugegoda 10250, Sri Lanka*
*29916dilhanidunukara@gmail.com

Cancer is the most dreadful non-communicable global epidemic, reporting 19.3 million cases and 10 million cancer deaths in 2020. Antioxidants are the body's defence against the undesirable effects of reactive oxygen species (ROS), which leads to cancer. When there are more ROS than antioxidants, free radicals can damage the body's fatty tissue, DNA, and proteins. Antioxidants control the above processes by scavenging the species, which initiate peroxidation, autoxidative chain reaction breakage, and peroxide formation. According to the information gathered from traditional medical practitioners in Sri Lanka, *Zephyranthes rosea* and *Pancratium zeylanicum,* both called "Wal Lunu" in Sinhala, are valuable medicinal plants used to treat cancer patients. Both, *Z. rosea* (Pink rain lily) and *P. zeylanicum* (Ceylon spider lily) belong to the family Amaryllidaceae. Plants belonging to Amaryllidaceae has biological activities like antibacterial, antifungal and antitumor. However, Wal Lunu species from two different environmental locations have not investigated for their biological activities. This study aimed to scientifically compare Wal Lunu species with different ecological exposure to validate authentic use by antioxidant activity. The Wal Lunu plants, *Z. rosea* was collected from the Kandy district and *P. zeylanicum* was collected from the Anuradhapura district. The methanolic leaf extracts were screened for antioxidant activity using DPPH (2,2-diphenyl-1-picrylhydrazyl) radical scavenging assay by UV double beam spectrophotometer. The leaf extracts of *Z. rosea* had an IC_{50} value of 0.0197g/mL, while *P. zeylanicum* had an IC_{50} value of 0.0201g/mL compared with the standard ascorbic acid (0.019g/mL). The antioxidant activity of the three highest concentrations (62.5×10^{-3}g/mL, 31.25×10^{-3}g/mL, 15.625×10^{-3}g/mL) of plant materials shows a significant correlation with standard according to the Tukey test in Anova. These experimental results revealed that even though Wal Lunu species were obtained from two districts of Sri Lanka, their leaf extracts possess similar potent antioxidant activity. Therefore, it can be further investigated for medicinal properties that can be used in cancer therapies.

Keywords: *Zepharnatheus roseus, Pancratium zeylanicum,* Antioxidant activity, DPPH

Comparison of Water Quality in a CKDu Hot Spot with a Reference Area Based on Topographic Point of View: A Study Based in Mathale District, Sri Lanka

W.P.R.T. Perera[1]*, B.T. Perera[2], S.D.I.A. Chandrasoma[2],
R.M.H. Rajapaksha[2] and J.A. Liyanage[2]

*[1]Faculty of Indigenous Health Science and Technology, Gampaha Wickramarachchi University of Indigenous Medicine, Yakkala 11870, Sri Lanka
[2]Department of Chemistry, Faculty of Science, University of Kelaniya, Dalugama 11600 Sri Lanka
ruwantharangaperera@gmail.com

When investigating the distribution of Chronic Kidney Disease of unknown etiology (CKDu) in Sri Lanka, continuous assessment of drinking water sources is critical, because most of the villagers are still depending on their traditional water resources. This study attempted to analyse the water quality of the dug wells and evaluate influence of the geographical distribution for water quality of sources (Dug wells) in those areas based on a CKDu endemic GN area and a reference area. Naminigama GN division was selected as the CKDu endemic (GN) division and Sulugune was selected as the reference based on data collected from Ministry of Health. Thirty dug wells were selected randomly in each area for the water sampling in July–2019 (dry season). pH, conductivity, DO and fluoride content were measured as on-site measurements. Concentrations of trace elements (cadmium, lead, chromium, arsenic, zinc, copper, iron) and major elements (sodium, potassium, and aluminum) were determined using ICP-MS-7800-Agilent (Germany) using two different standard series. In both areas, mean value of analyzed cations and fluoride have not exceeded maximum permissible limits. But long term exposure to trace elements via drinking water may be harmful. However, conductivity values of the reference area showed significant decrement than the endemic area. But most of the metals (Na, Mg, Ca, Zn, Cr, As, and Cd) were significantly higher in Naminigama GND and their water sources can be contaminated with trace element from the paddy areas via surface runoff. This trend may be due to the topographical difference of two areas. Because, in Sulugune (Reference) GND, their dug wells are located at higher elevation levels compared to the paddy areas and the endemic site exhibited an opposite pattern. Therefore, drinking water sources of the reference area may not expose to agricultural waste due to surface runoff.

Keywords: Water quality, CKDu, Topography, Trace metals

Mathematical Modelling and Simulation of Dengue Transmission in Jaffna Peninsula

V. Selvabavitha[1]*, M. Sangarthas[1], S. Nilakshman[1],
P. Kathirgamanathan[1] and S. Surendran[2]

[1]Department of Interdisciplinary Studies, Faculty of Engineering
[2]Department of Zoology, Faculty of Science
University of Jaffna, Jaffna 40000, Sri Lanka
*bavirathnam@eng.jfn.ac.lk

Dengue fever continues to be a significant concern that has posed a challenge to health authorities in Jaffna. It is commonly understood that the virus, mosquitos, and humans all play important roles in the spread of infection. In the Jaffna district, there were about 200 reported cases of dengue fever per 100,000 people in 2019. A better understanding of transmission dynamics of the dengue epidemic in Jaffna is very important for health management staff to prioritise on-site actions. Mathematical modelling can be used as a tool to understand the transmission dynamics and is helpful to identify the potential and intensity of the disease. This research describes the development of a mathematical model that will be used to study the transmission dynamics of dengue epidemic in Jaffna. The three- compartment (susceptible (S_h), infected (I_h), and removed (R_h)) model for humans and two-compartment (susceptible (S_v) and infected (I_v)) model for vectors with five nonlinear differential equations were used to formulate a mathematical model. The model was solved using inbuilt function "ODESOLVE" in MATLAB and then the stability criteria of dengue transmission in the Jaffna district was analysed. The model was validated using data collected by the Jaffna regional health authorities in 2019 with a re-breeding rate (R_0) value equal to 0.299973. Moreover, we showed that the real parts of eigenvalues of Jacobian matrix of the system at two equilibrium points are negative and thus, the model is asymptotically stable. Hence dengue infection rate in Jaffna in 2019 was stable and present no substantial concerns.

Keywords: Dengue transmission, Equilibrium, Re-breeding rate, SIR model, Stability

Causes of Death in Working Police Dogs during 2009-2019 Period

A. Dissanayaka[1], I. Jayathilake[2] and A. Dangolla[3]*

[1]Police Kennels Division, Kandy 20000, Sri Lanka
[2]Postgraduate Institute of Science, University of Peradeniya,
Peradeniya 20400, Sri Lanka
[3]Department of Veterinary Clinical Sciences, Faculty of Veterinary Medicine and
Animal Science, University of Peradeniya, Peradeniya 20400, Sri Lanka
*adangolla@gmail.com

The aim of this retrospective study was to identify probable causes of deaths in Police dogs in order to take appropriate preventive measures. One- to nine-year-old Police dogs, which died during 2009-2019 with recorded information, were used for this study. There were 227 such records, of which 187 were used for overall analysis, while the data on only 62 dogs were available for comparisons using chi square test at 5% significance level. The mean age at death was 6.1 years (n=187), while the deaths had increased from 2009 to 2018. A significant number of deaths (n=125) had been encountered in locally purchased dogs ($P<0.05$), while the deaths were most frequent in German shepherds (n=18) followed by Rottweiler (n=10), Doberman pincher (n=8) and Labrador retriever (n=8). Though not significant, renal failure (RF, n=48) was the most frequent cause of death ($P>0.05$). Other common causes were cardiac diseases (CD; n=27) and multiple organ dysfunctions (MOD; n=27). The collective number of deaths due to RF, CD and MOD were significant compared to all other causes ($P<0.05$). The explosive detecting dogs had died more often compared to those with other types of duties ($P<0.05$). Further, explosive detecting dogs had an elevated relative risk of 1.87 in contracting renal failure compared to those trained for other types of work. Reasons for relatively short life span and particularly for the deaths of explosive detecting dogs at their younger age with renal involvement could be revealed, if a prospective study is carried out among the police dogs.

Keywords: Police, Explosive, Dog, Renal failure

Negri Body Test (NBT) Using Seller's Stain as a Specific and Sensitive Test in the Diagnosis of Dog Rabies

R.M.T.M. Ramanayake*, W.R. Jayaweera, P.G.A.S. Palkumbura,
K.K. Wijesundara and G.S.P. de S. Gunawardena

*Department of Veterinary Pathobiology, Faculty of Veterinary Medicine and Animal
Science, University of Peradeniya, Peradeniya 20400, Sri Lanka
tharangaram@gmail.com

Rabies is an invariably fatal zoonotic viral disease of mammals including humans. Dogs are the major reservoir-vector of the disease and laboratory diagnosis is of paramount importance for the surveillance and control of dog rabies. This study was conducted to determine the specificity and sensitivity of the Negri body test (NBT) using Seller's stain. Impression smears from the hippocampus, cerebellum and brain stem of dogs (n=146) suspected of having rabies were stained with Seller's stain and examined for Negri bodies (NB) under oil emersion (x1000) of light microscope. As a control, all of the above cases were also subjected to the fluorescent antibody test (FAT), which is the gold standard test for the diagnosis of rabies. The results were analysed statistically using ANOVA with Graphpad prism software. Of the 146 cases examined, 46 (31.5%) were positive for rabies by FAT. Sensitivity of the NBT was 86.9%, as 40 of those FAT-positive samples also contained NB in all brain regions tested. There was a significant ($P<0.05$) difference between the number of NB in the hippocampus (28.95 ± 13.2) compared to the cerebellum (14.25 ± 5.2) and brain stem (14.75 ± 6.04). The sizes of the NB varied from 1 to 9 μm. However, there were no significant ($P>0.05$) differences between the mean sizes of the NB found in the hippocampus (3.8 ± 1.9 μm), brain stem (3.5 ± 1.5 μm) and cerebellum (3.4 ± 1.3 μm), None of the FAT negative smears contained NB indicating 100% specificity of the NBT. This study revealed that the hippocampus is the most appropriate region to collect samples for the diagnosis of dog rabies, and it appears that the specificity of the NBT using Seller's stain (100%) is comparable to the golden standard (FAT).

Keywords: Rabies, Negri bodies, Seller's staining, Sensitivity, Specificity

Hepatic, Renal, and Pulmonary Pathologies of Working Dogs in Sri Lanka

P.G.A.S. Palkumbura[1], R.M.T.M. Ramanayake[1], K.V.P.I. Tharanga[1],
D.M.A.P. Dissanayake[2], W.R. Jayaweera[1], G.S.P. de S. Gunawardena[1] and
R.R.M.K.K. Wijesundera[1]*

*[1]Deparment of Veterinary Pathobiology, Faculty of Veterinary Medicine,
University of Peradeniya, Peradeniya 20400, Sri Lanka
[2]Police Mounted Division, Kandy 20000, Sri Lanka
kavindra77@gmail.com

Working dogs play a major role in providing security services, detection of narcotics and explosives, and in tracking criminals. Due to their initial cost, extensive training, and value in the defence services, the prevention of early deaths is important. A retrospective study was conducted to identify work-related pathological conditions in working dogs in Sri Lanka, from fifty (n=50) necropsies performed at the Department of Veterinary Pathobiology, Faculty of Veterinary Medicine and Animal Science, from 2015 to 2020. Twenty-one dogs were used for detection of explosives, whereas 15 and 13 were used for detection of narcotics, and tracking, respectively. Histology slides were prepared and stained with haematoxylin and eosin. The major lesions of the kidneys were inflammatory cell aggregation (58%), tubular degeneration (76%), thickening of the basement membrane in the Bowman's capsule (46%), fibrosis (48 %), and interstitial haemorrhages (38%). Centrilobular necrosis (60%), inflammatory cell infiltration (44%), fibrosis (30%), dilation of sinusoids (66%), and congestion (40%) were observed in the liver. The major pulmonary lesions were inflammatory cell infiltration (32%), proliferation of Type II pneumocytes (22%) calcification (24%), oedema (78%), congestion (72%), and haemorrhages (56%). In the majority of cases (58%), the cause of death was renal impairment, followed by hepatic diseases (16%). Pulmonary lesions were either secondary to renal or hepatic failures or due to inhalation of noxious agents such as narcotics or explosives. Renal failure and other causes for deaths may be due to diet, training methods, working environment, prolonged dehydration, or chronic exposure to explosives and narcotics. Most of the dogs (68%) were under the age of eight years, suggesting that the early deaths are high in working dogs. Therefore, determination of underlying causes of deaths that shorten their life would allow preventive medications and implementation of management practices to increase longevity.

Keywords: Working dogs, Renal impairment, Hepatic diseases, Early deaths

iPURSE 2021 – 311   *Health and Society*

First Detection and Molecular Identification of *Babesia perroncitoi* in Pigs in Sri Lanka

R.A.S. Ranatunga[1], A.P. Bodahewa[4], K.H.A.T.D. Peiris[2], R.M.B.K. Rajakaruna[2], R.M.A.N. Senevirathne[2], A. Dangolla[2] and R.S. Rajakaruna[3]*

[1]Department of Molecular Biology and Biotechnology, Faculty of Science
[2]Department of Veterinary Clinical Science, Faculty of Veterinary Medicine and Animal Science
[3]Department of Zoology, Faculty of Science
University of Peradeniya, Peradeniya 20400, Sri Lanka
[4]Government Veterinary Surgeon, Teldeniya 20900, Sri Lanka
*rupika.rajakaruna@sci.pdn.ac.lk

Babesiosis is a globally distributed tick-borne disease frequently reported in canines and ruminants. The disease remains uncommon in pigs due to a minimal number of confirmed cases. Two species of *Babesia* have been identified in infected pigs: the large form, *Babesia trautmanni* and the small form, *Babesia perroncitoi.* We examined the blood samples of the domestic pig; *Sus scrofa domesticus* reared in a piggery at Talatuoya (Kandy District) for the presence of *Babesia* infections. Fifty blood samples from four categories of clinically normal pigs, including sows, weaners, fatteners, and boars, were collected from the auricular or jugular vein in November 2020. Thin smears were stained using Giemsa and observed for *Babesia* infections under the light microscope. Six microscopically positive samples were subjected to molecular analysis for confirmation of identification. Genus-specific primers were used to amplify a partial sequence of *18S rRNA* of *Babesia* using polymerase chain reaction (PCR), and the amplified products were visualized in ethidium bromide-stained Agarose gel (1%) electrophoresis under the UV illumination. Microscopical results revealed that a total of 23 (46%) samples (two sows, 12 weaners, nine fatteners) were infected with *Babesia spp.* and none of the boars were infected. The PCR results supported the parasite identification. The average diameter of the parasite (0.94±0.20 μm) indicates that it was *B. perroncitoi.* However, sequencing and phylogenetic analysis is required for the confirmation of the identity. This study provides the first record of porcine babesiosis in Sri Lanka. Currently, investigations are underway to determine whether the immunocompromised status of the pig due to an outbreak of Porcine Reproductive and Respiratory Syndrome (PRRS) has a connection to babesiosis.

Keywords: Porcine babesiosis, *Babesia peroncitoi, 18S rRNA*, Piggery farm

Common Bacterial Pathogens Associated with Different Wound Types from Dogs Presented to a Veterinary Hospital in Kandy

R.M.I.M. Rathnayake[1], D.M.I.S. Dissanayake[1], D.M.P.M. Dhanapala[1], R.M. Fuward[2], H.M.D.D.K. Pilapitiya[2], S.S.S.de S. Jagoda[1] and D.P.H. Wijesekera[1]*

[1]Department of Veterinary Pathobiology, Faculty of Veterinary Medicine and Animal Science, University of Peradeniya, Peradeniya 20400, Sri Lanka
[2]Government Veterinary Hospital, Getambe, Peradeniya 20400, Sri Lanka
*himsiya84uni@gmail.com

Bacterial wound infection in dogs has always been a challenging problem as well as a healthcare burden. It delays wound healing, impairs the cosmetic value, and increases health care cost. Proper management of these wounds depends on the knowledge on wound healing and the use of appropriate antibiotic treatment. However, this can be challenging due to the limited information available on the prevalence of bacteria among different types of wounds. Therefore, we investigated the bacteria found among different types of wounds in dogs and the antimicrobial susceptibility patterns of the most frequent isolate. Wound swabs were collected from 36 dogs presented to the Veterinary Hospital, Getambe and subjected to standard culture, morphological, and biochemical tests. Antimicrobial susceptibility test (AST) was performed using Kirby-Bauer disk diffusion method according to CLSI guidelines with amoxicillin (10µg), amoxicillin-clavulanate (10/20µg), cefuroxime (30µg), ciprofloxacin (5µg) and gentamicin (10µg). The most prevalent wound type was bite wounds, (14/36: 38.89%) followed by the lacerations (7/36: 19.44%). The least prevalent wound types were puncture wounds, road traffic accidents and post-surgical wounds. Among the total of 102 isolates, *Staphylococcus* spp. (33.33%) and *Streptococcus* spp. (17.65%) were the most frequently isolated Gram positives, while *Escherichia coli* (9.80%) and *Pseudomonas aeruginosa* (8.82%) were the respective Gram negatives. Majority of wounds showed mixed microbial composition, except 11.11% comprised only Gram positives while 2.7% contained only Gram negatives. Interestingly, pathogenic Staphylococcal isolates showed resistance against cefuroxime 7/9 (77.8%) and amoxicillin 5/9 (55.6%), while the highest susceptibility of 94.4% (8/9) was shown for both gentamicin and ciprofloxacin. Further, 55.6% (5/9) of the pathogenic isolates and 22.2% (2/9) of the nonpathogenic isolates showed resistance to at least two antimicrobials. The study shows a disparity in composition of bacteria among different wound types with *Staphylococcus* being the commonest one. Moreover, AST results substantiates the emergence of resistance among Staphylococcal isolates.

Keywords: Bacteria, Wound types, Dogs, AST

Health and Society

Profiling of Antimicrobial Resistance in *Escherichia coli* Isolated from Livestock, Poultry, Wild Animals and an Aquaculture Farm in a Defined Area in Polgahawela, Sri Lanka

B.M.Y.I. Basnayake[1], P.I.J.B. Wijewickrama[1], G.G.T. Nisansala[1],
D.M.P.M. Dhanapala[2], D.B.N. Pushpakumara[4], N.K. Jayasekara[3], R.S. Kalupahana[1],
A. Silva-Fletcher[5] and K.S.A. Kottawatta[1]*

[1]Department of Veterinary Public Health and Pharmacology [2]Department of Veterinary Pathobiology [3]Department of Basic Veterinary Sciences
Faculty of Veterinary Medicine and Animal Science, University of Peradeniya, Peradeniya 20400, Sri Lanka
[4]Department of Wildlife Conservation, Battaramulla 10120, Sri Lanka
[5]Royal Veterinary College, University of London, NW10TU, United Kingdom
*sarunika@yahoo.com

Antimicrobial Resistance (AMR) is a global challenge impeding the effective treatment of rapidly growing infections by pathogenic microorganisms. Use of antimicrobials in livestock is recognized as a major cause for AMR. We hypothesized that wild animals are exposed to antimicrobials through livestock and environment. One square kilometre area in Polgahawela was mapped for sample collection using GPS. This area contained an ornamental fish farm, cattle, goat and broiler farms and backyard poultry with associated wildlife; and a total of 127 faecal samples were collected from wild animals (n=56), livestock (n=13), poultry (n=15) and ornamental fish and aquatic environment (n=43). *Escherichia coli* (*E. coli*) was isolated from the above samples and antimicrobial susceptibility for 12 antimicrobials were tested following Kirby-Bauer method. *E. coli* was isolated from 71% (40/56) of wild animals, 86% (24/28) of livestock and poultry and 16.2% (7/43) of aquatic samples. *E. coli* from livestock and poultry showed the highest resistance to ampicillin (52.1%) followed by tetracycline (39.1%). These isolates also showed resistance against streptomycin (36.9%), nalidixic acid (36.9%), trimethoprim/sulfamethoxazole (36.9%) and ciprofloxacin (30%). Low levels of resistance (4-18%) were observed for ceftazidime, cefotaxime, chloramphenicol, imipenem and amikacin. *E. coli* from wild animals were resistant to ampicillin (18.9%), streptomycin (13.5%), tetracycline (9.4%), trimethoprim/sulfamethoxazole (6.7%), nalidixic acid (5.4%), ciprofloxacin (2.7%), ceftazidime (2.7%) and chloramphenicol (2.7%). Of the seven isolates of *E. coli* from the ornamental fish farm, 71.4% were resistant to ampicillin, 57.1% to tetracycline, 42.8% to nalidixic and 14.2% to each imipenem, streptomycin and chloramphenicol. The AMR levels in livestock, poultry and aquaculture farms were higher than wild animals. It is of great concern that AMR is detected in wild animals which shows the same profile as in livestock albeit at a lower level, providing some evidence to substantiate our hypothesis.

Keywords: Livestock, Aquaculture, AMR, Wildlife, Ecosystem

Antimicrobial Resistance of *Aeromonas* spp. Isolated from Freshwater Ornamental Fish Farming Environment in Sri Lanka

D.M.P.M. Dhanapala[1], R.S. Kalupahana[2], A.W. Kalupahana[1], D.P.H. Wijesekera[1], K.S.A. Kottawatta[2], N.K. Jayasekara[3], A. Silva-Fletcher[4] and S.S.S.de S. Jagoda[1]*

[1]*Department of Veterinary Pathobiology* [2]*Department of Veterinary Public Health and Pharmacology* [3]*Department of Basic Veterinary Sciences*
Faculty of Veterinary Medicine and Animal Science, University of Peradeniya, Peradeniya 20400, Sri Lanka
[4]*Royal Veterinary College, University of London, NW10TU, United Kingdom*
*Samanthikavet27@yahoo.co.uk

Fresh water ornamental fish industry plays a significant role in the economy of Sri Lanka. Intensification of production to cater increasing global demands has led the industry to increasingly rely on antimicrobials. Aeromonads are Gram-negative rods ubiquitous in fresh water environments and they are pathogenic to poikilotherms and humans. This study was aimed to evaluate the antimicrobial susceptibility of *Aeromonas* spp. isolated from ornamental fish farming environment against thirteen antibiotics. Twenty-one fish breeding farms in the Central, North Western, North Central and Western provinces were visited during July 2020 to January 2021. From each farm, a sample of effluent water, biofilm and pond sediment were collected. Samples were centrifuged and sediments were cultured on trypticase soy agar. Isolates were phenotypically identified as presumptive *Aeromonas* and genetically confirmed by polymerase chain reaction targeting *16SrRNA* and *gyrB* genes. A total of ninety-five *Aeromonas* strains were subjected to antimicrobial susceptibility testing using disk diffusion method. The prevalence of resistance for amoxicillin was the highest (96.8%), followed by enrofloxacin (61.05%), nalidixic acid (50.52%), erythromycin (32.6%), tetracycline (18.9%), nitrofurantoin (17.9%), imipenem (11.6%), chloramphenicol (11.6%), sulpha-trimethoprim (10.5%), rifampicin (5.3%), doxycycline (3.2%), gentamycin (1.05%) and ceftazidime (1.05%). Of all, 26.31% were multi-drug resistant (MDR). Their multiple antibiotic resistance index ranged from 0.23-0.53 suggesting high risk of contamination. Biofilms (56%) contained a higher prevalence of MDR isolates compared to pond sediment (32%) and effluent water (12%). Observed high levels of resistance against certain antibiotics (except for penicillins which is intrinsic) is probably a consequence of increasing and indiscriminate use of antibiotics. These findings indicate that ornamental fish farming environment remains a reservoir of MDR bacteria and highlight importance of judicious use of antibiotics in aquaculture.

Keywords: Aquaculture, Ornamental fish, Antibiotics, MDR, *Aeromonas* spp.

Platelet-Rich Plasma for Treatment of Chronic Wound in a Cat: A Case Report

H.D.S. Hewapathirana*, S. Kabilan, M.G.T.M. Prasadinie,
D.D.N. de Silva and H.M.S. Wijekoon

Department of Veterinary Clinical Sciences, Faculty of Veterinary Medicine and Animal Science, University of Peradeniya, Peradeniya 20400, Sri Lanka
*dhanushkahew@yahoo.com

Treatment and management of large and chronic skin wounds in companion animals pose a challenge due to complex debridement, site of the wound and ensuing systemic and local infections. The use of platelet-rich plasma (PRP) for tissue healing is a rapidly evolving and promising low-cost treatment modality with little side effects. Although, the application of PRP has been reported in humans, evidence of its use in companion animals is lacking. This clinical communication reports a successful use of PRP for treatment of a chronic skin wound in a 3-years old, cross bred cat. The cat was presented with a complaint of a non-healing skin wound in the right caudal flank for two years as a result of injection site granuloma. At the presentation, a chronic contaminated avulsion skin wound with the dimensions of 6.35 cm x 5.08 cm was observed. Due to the failure of responding to conventional treatments, a decision was made to use autologous PRP, which was prepared by using modified double centrifugation method. The PRP was infiltrated to the edges and on the surface of the wound at three-day intervals as the sole method of treatment. Granulation tissue formation, neovascularization, epithelialisation and marked reduction of wound diameter to 3.4 cm x 3.8 cm was observed within two weeks of treatment. Complete closure of the wound occurred by 3 months. The healing of wound probably through enhancing tissue regeneration by the effects of growth factors and antimicrobial peptides present in the PRP. This report suggests that PRP therapy could be used as an effective therapeutic option to manage chronic wounds in cats as the sole treatment modality. Further clinical studies with a larger sample size are needed to evaluate the true effectiveness of PRP on the healing of wounds in animals.

Keywords: Cat, chronic wound, Platelet rich plasma, Veterinary

Incidence and Management of Small Animal Fractures: A Retrospective Study of One Year (2018-2019)

S. Kabilan*, H.M.S. Wijekoon and D.D.N. de Silva

Department of Veterinary Clinical Sciences, Faculty of Veterinary Medicine and Animal Science, University of Peradeniya, Peradeniya 20400, Sri Lanka
*kabi1040@gmail.com

The aim of the present study was to evaluate a total of 118 fractures of dogs and cats of different breeds, ages and sexes admitted to the surgery division of the Veterinary Teaching Hospital, University of Peradeniya, Sri Lanka during 2018-2019. Thorough clinical, and radiographic examinations were performed in all animals, and trauma due to roadside accidents was the principal cause of fractures. Dogs accounted for 106 cases (89%) while cats accounted for 12 cases (11%). Incidence of fractures was higher in males (58%) than females (42%). Juvenile animals (<1 year; 44%) were found to be more susceptible and 46% of the dogs with fractures weighed 6-15 kg. Among all the fracture cases presented, mix breed cats and dogs (64%) were the most affected. Distribution of fractures was predominant in hind limbs (64%), specifically in the femur of dogs (32%) and cats (67%). Fractures in tibia-fibula (26%), radius-ulnar (17%), humerus (13%), distal appendages (7%) and mandible (3%) were also observed in both dogs and cats. Cases presented with multiple fracture sites (11%) were mostly represented by a combination of pelvic and femoral fractures. The fractures were reduced and fixed using different methods. Femoral, humeral and tibia-fibula fractures were predominantly corrected by internal fixation with intramedullary pin insertion. Ulnar-radius fractures were mostly managed by external coaptation with the use of Plaster of Paris casts and splints, while distal appendage fractures were mainly corrected using splints, soft roll and self-adhesive bandages. Coxo-femoral dislocations were managed by closed reduction under general anaesthesia and application of the Ehmer's sling, while mandibular fractures were corrected using cerclage wiring. This study revealed that young male dogs were more susceptible to bone fractures and hind limbs are more prone to trauma resulting in fractures compared to fore limbs.

Keywords: Fractures, Dogs, Cats, Limb, Intra-medullary pins

Health and Society

General Public Knowledge and Perception about Antimicrobials and Antimicrobial Resistance in a Selected Area in Gampaha District

K.W.M.Y.D. Gunasekara[1], A. Silva-Fletcher [2],
R.S. Kalupahana[1] and K.S.A. Kottawatta[1]*

[1]*Department of Veterinary Public Health and Pharmacology, Faculty of Veterinary Medicine and Animal Science, University of Peradeniya, Peradeniya 20400, Sri Lanka*
[2]*The Royal Veterinary College, London, NW1 0TU, United Kingdom*
*sandavphp@gmail.com

Antimicrobial resistance (AMR) has become a public health priority worldwide. Reducing the growth of AMR through improvement of public awareness and understanding of AMR is one of the goals of the World Health Organization. This study was designed to assess the awareness and knowledge of antibiotic usage and AMR among the general public in an urban area of Sri Lanka. A cross-sectional survey was conducted using a pre-tested, validated, self-administered questionnaire. Sample size was calculated based on the total population and random sampling was conducted using the electoral register for the year 2019. Three hundred questionnaires were distributed among people above 16 years of age and 210 questionnaires were returned giving a response rate of 71.2%. Data analysis was carried out with SPSS version 27. The majority of respondents were females (72.6%), married (74.9%) and (69.2%) believed that they had very good or good knowledge about antibiotics. Only 33.5% of the respondents were able to correctly identify at least one antibiotic from the given list, and 97 (53.3%) identified paracetamol as an antibiotic. A chi-square test revealed that respondents with higher education showed a better ability to identify antibiotics ($P<0.05$). A total of 43.6% of respondents thought antibiotics are effective against both bacteria and viruses. The respondents had poor knowledge of the action of antibiotics and assume that flu (50%), body aches (37.7%), and headaches (35.6%) can be treated with antibiotics. More than one third (39%) of respondents think that they have a good knowledge of AMR. The study highlights that the general public have poor ability in identifying antibiotics from commonly used medicines and a poor knowledge regarding the effectiveness of antibiotics and AMR. Therefore, it is important to enhance the awareness about antibiotics, correct antibiotic use, disposal and AMR among the general public in Sri Lanka.

Keywords: Antibiotics, Antimicrobial resistance, Awareness, General public, Sri Lanka

Perceptions and Handling Practices of Chicken Meat by Consumers in Gampaha District, Sri Lanka

K.W.M.Y.D. Gunasekara, A.M.H. Abeykoon and R.S. Kalupahana*

Department of Veterinary Public Health and Pharmacology, Faculty of Veterinary Medicine and Animal Science, University of Peradeniya, Peradeniya 20400, Sri Lanka
*ruwanikalupahana@yahoo.com

Chicken is the most popular type of meat consumed in Sri Lanka and it could play an important role in the transmission of foodborne zoonoses. Several studies have reported the occurrence of common zoonotic bacteria in chicken meat available in the local markets. However, Sri Lanka has a low number of reported foodborne illnesses, perhaps due to the proper hygienic practices and traditional cooking methods, besides poor surveillance. This research was aimed to identify chicken meat-handling and preparation practices by consumers in Dompe area in Gampaha District. A pre-tested and validated self-administered questionnaire was used to conduct a cross-sectional study. Three hundred and fifty questionnaires were randomly distributed among households, of which 255 were returned. SPSS (version 27) was used for data analysis. Results indicated that the majority of respondents (88%) did not like to purchase cooked chicken, while they (70.8%) preferred unfrozen fresh meat. Investigations into meat-handling practices from retail to kitchen indicated that 84.1% of consumers carried chicken in separate bags to avoid contact with other food items. Further, 56.8% used separate cutting boards for meat. Before cooking, 40.6% of the respondents washed chicken using salt or turmeric water, while 48.8% marinated chicken before cooking, using turmeric (38%) followed by vinegar. Most importantly, 91.8% of them cooked chicken for more than 30 min. About 57.5% of respondents were unaware of foodborne zoonoses, however 72.6% had a good perception on the safety of meat consumption. The results did not show any significant association of chicken meat handling practices with education level, age, or gender of the respondents. Only, 19.7% experienced illness after eating chicken. In conclusion, the satisfactory levels of hygienic practices on the handling and cooking of chicken meat may have helped to reduce the foodborne illnesses in the studied population. Since they have low awareness of foodborne zoonoses, measures must be taken to educate this population in this aspect.

Keywords: Chicken, Meat handing, Perception, Foodborne zoonoses

Prevalence of Larval Trematode Infections in Freshwater Snails in Kandy District and Its Significance on Cercarial Dermatitis

H.B.N.A. Mariyam[1], R.P.V.J. Rajapakse[1]* and K.L.T.D. Jayawardene[2]

[1]Department of Veterinary Pathobiology, Faculty of Veterinary Medicine and Animal Sciences [2]Department of Medical Laboratory Sciences, Faculty of Allied Health Sciences, University of Peradeniya, Peradeniya 20400, Sri Lanka
*jayanthar@pdn.ac.lk

Snail-borne trematode infections pose serious risks to humans and animals and cause major socio-economic problems worldwide. The planorbid freshwater snails are the intermediate hosts of schistosomes. In case of schistosomes of birds and mammals, the larval cercariae released from snail swim in the water and penetrate the skin of humans causing cercarial dermatitis, also called as swimmer's itch. This study investigated the prevalence of furcocercous cercariae in freshwater planorbid snails. Snail specimens were collected from 12 human-water contact sites that included rice-fields, river, streams and irrigation canals in the Kandy District. Snail samples were placed in dark area and exposed to sunlight in the early morning to stimulate the emergence of cercaria. Cercarial shedding was examined under dissecting microscope. Emerged cercariae were collected and morphological characters were recorded using camera lucida. DNA isolated from furcocercous cercariae was used to amplify part of the 28s ribosomal gene by PCR using LSU5 and LSU3 primers. A total of 435 snails were analysed with the positive rate of 7.1%. Of total positive snails, furcocercous cercariae was found to be predominant (38.7%). Further, three other types of larval trematodes (echinostome-cercariae, xiphidio-cercariae and amphistome-cercariae) were also shed by the snails examined. All infected snails were planorbid snails collected from four rice fields. The highest prevalence was recorded from rice fields in Wattegama (41.9%) and Gelioya (41.9%) followed by Aruppola (9.7%) and Nawalapitiya (6.5%). Single band at almost similar size was observed in the PCR amplification of DNA extracted from furcocercous cercariae. This preliminary study demonstrates that the larval trematodes are highly prevalent in the rice-fields in Kandy district. It also revealed that highest prevalent cercarial type was furcocercous, which is responsible for cercarial dermatitis in humans.

Keywords: Schistosomes, Planorbid, Dermatitis, Cercariae

Owner Misperception of Canine Body Condition Despite Guidance with 5-Point BCS Chart

A.T. Liyanage and H. Ariyarathna*

Department of Veterinary Clinical Sciences, Faculty of Veterinary Medicine and Animal Science, University of Peradeniya, Peradeniya 20400, Sri Lanka
*hsariyarathna@pdn.ac.lk

Obesity is increasing among dogs in many countries, while large pure-bred dogs are over-represented. However, many dog owners are unaware of this, partly due to misperception of the body shape of their dogs. Body condition scoring (BCS) is a simple, scientific method used by veterinarians to assess the body condition of dogs, but whether it can reduce owner misperception is unclear. Thirty-six large, pure-bred, dogs presented to the Veterinary Teaching Hospital, Faculty of Veterinary Medicine and Animal Science, University of Peradeniya, between January and February 2021 were included in the study. The owners were asked to determine the body condition of their dog without guidance, and then reassessed it using a five-point BCS chart from Royal Canin™ (1: emaciated, 2: thin, 3: ideal, 4: over-weight, 5: obese). The agreement between BCS scores determined by the owners with and without the guidance of BCS charts provided by the investigator was evaluated by Fleiss' kappa test. There was no agreement between owner estimates and those of the investigator, both without [kappa (κ) = -0.35] and with (κ = 0·038) the guidance of BCS charts, although the disagreement was slightly lower with BCS charts than without BCS charts. However, the percentage of owners who misperceived the body condition of overweight dogs by underestimating the BCS (12/12, 100%) was reduced to 58% (7/12) when BCS charts were used. Ninety-four percent (16/17) of the owners of underweight dogs misperceived the body condition of their dogs by overestimating the BCS while it was 76.5% (4/17) when BCS charts were used. Overall, the findings suggest that use of a standard five-point BCS chart does not improve accuracy of owner perception of body shape of their dogs although it is more helpful to reduce the misperception among owners of overweight dogs than underweight dogs.

Keywords: Body condition score, Obesity, Dog, Misperception

Renal Function of Haemoparasite Infected Working Dogs of Sri Lanka Air Force

P.S. Jayatilaka[1]*, D.T.J. Wickramarathne[2], K.A.N. Wijayawardhane[3], M.R.C.K. Mallawa[3], A. Dangolla[3] and R.S. Rajakaruna[4]

[1]Sri Lanka Air Force, Katunayake 11450, Sri Lanka
[2]Animal Clinic Alawwa, 60280, Sri Lanka
[3]Department of Veterinary Clinical Science, Faculty of Veterinary Medicine and Animal Science [4]Department of Zoology, Faculty of Science
University of Peradeniya, Peradeniya 20400, Sri Lanka
*vet_sam@yahoo.com.com

Haemoparasitism and renal diseases are common causes of deaths in working dogs in Sri Lanka Police and military services, especially in the explosive detecting (ED) dogs in the Department of Police. Renal injury leads to an elevation of protein in the urine. Therefore, the Urine Protein Creatinine (UPC) ratio is used as a gold standard in the diagnosis of renal injury. The UPC ratios were tested in the working dogs of the Sri Lanka Air Force (SLAF), and the values were compared between (i) the dogs with and without haemoparasitism; and (ii) the dogs involved in ED and guard dogs. A mid-stream sample of 10 ml urine was collected aseptically from each animal and was tested for protein and creatinine concentrations. Venous blood was collected from the cephalic vein, and the smears were stained with Giemsa or modified Wright's Giemsa and examined under the microscope. Fifty SLAF working dogs (28 ED, 22 guard dogs) with age ranged from 9 months to 11 years were included in this study. Six dogs showed nonspecific clinical signs of lethargy, weight loss and poor appetite, while all others were apparently healthy. Three haemoparasites, *Babesia gibsoni, Ehrlichia canis* and *Anaplasma platys* were identified in four guard dogs and seven explosive detection dogs. Among the haemoparasite infected dogs, a higher percentage (90.9%) showed an elevated UPC ratio (> 0.5) compared to uninfected dogs (*P*<0.0001). Among the uninfected dogs, there was no difference in the UPC ratio levels between the ED and guard dogs (*P*>0.05). The results show that the renal function was impaired due to the presence of haemoparasites, and not due to the type of work they carry out at the military services. Further studies are warranted to ascertain the possible confounders before extrapolating results to the dog community.

Keywords: Haemoparasites, Urine protein creatinine ratio, Working dogs, Explosive, Renal disease

Controlling Tick Infestations of Household Animals in Local Communities in Sri Lanka: Indigenous Knowledge and Home Remedies

S. Ariyarathne[1,2], G.C.P. Diyes[1,3] and R.S. Rajakaruna[1]*

[1]Department of Zoology, Faculty of Science [2]Postgraduate Institute of Science University of Peradeniya, Peradeniya 20400, Sri Lanka
[3]Department of Biology, University of Saskatchewan, SK, S7N 5E2, Canada
*rupikar@pdn.ac.lk

The periodic application of commercial acaricides and repellents is the most widely practiced method of controlling ticks in large-scale farms and domestic animals. At present, resistance to existing chemical products is widespread. Further, newer acaricides are expensive and residues can build up in agricultural products. Sustainable parasite control, such as integrated tick management by combining indigenous knowledge with reduced acaricide use is currently advocated by the FAO. An island-wide survey was conducted to determine home remedies and to investigate indigenous practices used by the local communities in controlling tick infestations in household animals. A total of 159 households in 15 districts participated in the survey of which, 40.4% used only commercial acaricides, 32.4% used only home remedies, 6.6% used both control methods, and the others (20.6%) removed ticks by hand. For dogs, home remedies were in commonplace (41.7%), while for cattle, 64.7% used commercial acaricides. Hand-picking (52.6%) of ticks was common for cats and goats. The traditional remedies (herbal preparations), such as dermal application of leaf extracts of *Azadirachta indica* (neem), *Ocimum tenuiflorum* (holy basil) and *Lantana camara* (lantana); and a dip preparation made from boiled roots, stems, and leaves of *Mimosa pigra* (giant mimosa), were used to treat both ticks and mange. In addition, applying crushed camphor balls (mothballs), engine oil ("*kaluthel*") and rubbing fresh cow dung were also practiced. Seeking veterinary care depended on the household income (logistic regression, OR=0.336, 95% CI=0.14, 0.81, *P*=0.012), but using commercial products or home remedies did not depend on the revenue (Chi-square test, χ^2=5.991, *P*=0.655). The use of home remedies was more widespread in rural than in urban districts. During the survey, incorrect usage of commercial products was noted. Further studies are required to assess the efficacy of home remedies, especially the herbal extracts.

Keywords: Indigenous knowledge, Integrated tick control, Socioeconomic, Acaricide

Application of PCR for Rapid and Confirmatory Detection of Common Food Borne Pathogens: *Salmonella*, *Staphylococcus aureus* and *Escherichia coli*

H.C. Gallage[1], W.M.D.H. Suranimala[1], W.A.S.M. Premaratne[2], R.S. Kalupahana[1],
H.M.T.K. Karunarathna[1] and K.S.A. Kottawatta[1]*

[1]*Department of Veterinary Public Health and Pharmacology, Faculty of Veterinary Medicine and Animal Science, University of Peradeniya, Peradeniya 20400, Sri Lanka*
[2]*National Livestock Development Board, No. 40, Nawala Road, Narahenpita, Colombo 00500, Sri Lanka*
*sarunika@yahoo.com / sandavphp@gmail.com

Foodborne infections pose a great public health risk as well as have a global-socio-economic impact. Detection of contaminated foods at the possible early stage is important to ensure food safety. International and national methods and standards are available to detect the microbiological quality of food for foodborne bacterial pathogens. Those culture based methods require many days, various selective media and series of expensive biochemical tests for confirmation. Therefore, the aim of this study was to apply a molecular technique (PCR) for the identification of common food borne pathogens. Initially the method was established using quality control (QC) bacteria: *Salmonella enterica* (received from WHO), *Staphylococcus aureus* (ATCC 25923) and *E. coli* (ATCC 25922). The QC strains were cultured on nutrient agar (NA) and the DNA was extracted from each of the above bacterial species by boiling method. PCR was done using the extracted DNA to amplify *invA*, *nuc* and *16SrRNA* genes specific for *Salmonella*, *S. aureus*, and *E. coli* by following published methods. Thereafter a modified PCR protocol, which omitted the step of DNA extraction, was tested to amplify above genes by directly applying colonies from NA to the PCR reaction mixture. For QC bacteria, both PCR protocols affirmed same results. Then previously archived *Salmonella* (n=7), *E. coli* (n=3) and *S. aureus* (n=1) strains, which were isolated from food samples by culture method, were subjected to both PCR protocols along with the QC strains. All isolates yielded positive results by both PCR protocols. This study revealed that both PCR protocols could identify food-borne pathogens by replacing series of biochemical tests. Furthermore, the modified PCR that does not need DNA extraction, could be utilized as a quicker and cheaper method to detect food-borne bacteria.

Keywords: PCR, *Salmonella*, *Staphylococcus aureus, E. coli*

Scoring Hip Radiographs of a Group of Imported Police Dogs: A Retrospective Study

C. Abeykoon[1], K.A.R.K. Perera[1]*, G.K. Dharmaratne[1], D.M.A.P. Dissanayake[2], H.M.S. Wijekoon[1] and D.D.N. de Silva[1]

[1]Department of Veterinary Clinical Sciences, Faculty of Veterinary Medicine and Animal Science, University of Peradeniya, Peradeniya 20400, Sri Lanka
[2]Police Kennels Division, Kandy 20000, Sri Lanka
*rkperera27@gmail.com

Canine Hip Dysplasia (CHD) is a common orthopaedic condition encountered among certain breeds of dogs such as Labrador retrievers, Golden retrievers, German shepherds and Rottweilers. The causes of CHD are multifactorial; a combination of hereditary and environmental factors. CHD is an abnormal development of the hip joint characterised by subluxation or complete luxation of the coxo-femoral joint accompanied by mild to severe degenerative joint disease (DJD) as the animal ages. The present communication reports the radiographical assessment of hip scores of German shepherds (8), Labrador retrievers (8), English Springer spaniels (7), Golden retrievers (6), Bull mastiffs (5) Alaskan malamutes (2) and Cocker spaniels (3) imported from the Netherlands. The dogs were aged 35-44 months, weighing 16.6–52.0 kg at the time of radiography; comprising 23 males and 18 females. The objective was to ascertain their suitability for intended purposes in the Police Kennels Division. Among the three globally accepted methods of hip scoring, namely, FCI, OFA, and the BVA/ KCHD, the present study adopted the FCI scoring system. The Norberg angle was measured in both left and right hip joints in extended views of radiographs of all animals using image processing software (FCR PRIMA V Console). Three radiographs were of poor diagnostic quality and thus not assessed. According to the FCI system, the Norberg angle should be $> 105°$ and between $105°\text{-}100°$ to be classified as good hips and to qualify a dog for breeding and other services with the prediction of no DJD. In this study, all animals had Norberg angles of $>105°$ (n=31, M=$109.15°\pm2.86°$) and between $100°\text{-}105°$ (n=7, M=$102.96°\pm1.33°$) thus providing evidence that all dogs imported to Police Kennels have good hip scores and are suitable for different duties such as tracking, criminal investigation, narcotic and explosive detection, and are also suitable to be used for breeding.

Keywords: CHD, DJD, FCI, Norberg angle, BVA/ KCHD

Screening of Filarial Parasites among Dog Population in Selected Disease Endemic and Non-Endemic Areas in Sri Lanka Using Microscopical and Molecular Methods

S.P. Rathnayake[1]*, T.G.A.N. Chandrasena[2], L.A.P.N.F. De Silva[3,] A.C.T. Wijerathna[2], P.A.D.H.N. Gunathilaka[2] and C.H. Mallawarachchi[4]

[1]Department of Animal Production and Health, Northern Province, Jaffna 40000, Sri Lanka [2]Department of Parasitology, Faculty of Medicine, University of Kelaniya, Ragama 11010, Sri Lanka [3]Department of Community Medicine, Faculty of Medicine and Allied Sciences, Rajarata University of Sri Lanka, Saliyapura 50008, Sri Lanka [4]Department of Parasitology, Medical Research Institute, Colombo 00800, Sri Lanka
*Sprath89@gmail.com

Zoonotic filarial infections show a rising trend in Sri Lanka with expansion to areas non-endemic for lymphatic filariasis (LF). The infections are caused by *Dirofilaria repens* and *Brugia* spp., which cause human subcutaneous and ocular dirofilariasis and brugian filariasis, respectively. The study was aimed to determine the prevalence of filarial parasites among the dog population in selected LF endemic and non-endemic areas in order to assess the public health risks posed to residents in the relevant areas. A veterinary clinic based descriptive study was conducted between August 2019 to February 2020 at Habaraduwa, Baddegama (Galle district) and Welioya (Mullaitivu district). The epizootiological data were recorded and microfilaraemia was detected by microscopy of Giemsa-stained thick blood smears. Differentiation of microfilariae was based on morphological characteristics, Polymerase Chain Reaction (PCR), DNA sequencing and phylogenetic analyses. Results were analysed using Minitab statistical software. A total of 295 dogs were screened. The prevalence for any filarial parasite was 60.9% (n=120) in Galle and 44.9% (n=44) in Mullaitivu. The prevalence of brugian filariasis was significantly higher among canines in Galle (29.9%) than in Mullaitivu (1.1%) (z=6.648, *P*< 0.001). However, there was no statistically significant difference in the prevalence of dirofilariasis between the two canine populations (Galle: 54.8% and Mullaitivu: 43.9%). Mono-infections with *D. repens (*61.9%, n=74) and mixed infections with *D. repens* and *Brugia* spp. (38.3%, n=46) were detected in Galle, while in Mullaitivu all positive canines had mono-infections. The PCR yielded the expected band sizes for *D. repens, B. malayi* and *B. pahangi*. Sequence analysis of 28 samples confirmed the presence of *D. repens, B. malayi* and *B. pahangi* in Galle and *D. repens* in Mullaitivu. This is the first documented evidence of *B. pahangi* in Sri Lanka. The potential risk of human dirofilariasis is high and widespread in Sri Lanka but risk of brugian filariasis is minimal in areas non-endemic for lymphatic filariasis.

Keywords: *Brugia malayi, Brugia pahangi*, *Dirofilaria repens*, Lymphatic filariasis, Zoonotic filariasis

LANGUAGE, CULTURE AND THOUGHT

'The Fox and the Lion': Sri Lankan Modern Drama and Its Orientation

S.L.P. Fonseka

Department of Fine Arts, University of Peradeniya, Peradeniya 20400, Sri Lanka
priyantha.fonseka@arts.pdn.ac.lk

The history of Modern Sinhala Drama, which arguably started with '*Maname*' by Ediriweera Sarachchandra, should be traced parallelly to the Sinhala Buddhist ideology and the cultural nationalist discourse which surfaced in early nineteenth century Sri Lanka. The genre 'Stylized Drama' used in *Maname* was also used in *Sinhabahu* (another work by Sarachchandra) and *Nari Bena* (by Dayananda Gunawardene) which then became the *stylistic norm* of authentic Sri Lankan drama. Thus, the greater portion of the local theater space was reserved or rather hegemonized by *Sinhabahu* (the son of the lion) and *Nari Bena* (Fox- the son-in-law), being the most distinct characters of the Sri Lankan drama arena. This hegemonizing of Fox and Lion made other contemporary drama invisible, which was catastrophic as it homogenized Sri Lankan drama as 'stylized drama'-centric. Therefore, this research intends to explore such unrecognized dramatic performances hidden under the shadow of Sarachchandra and Gunawardena's domination. The key to this work is an attempt to deconstruct the local dramatic art discourse in the 1960s and 1970s in order to examine ways in which the rise of stylized drama became a challenge to the local realistic theatre, and how this affected the development of cultural-intellectual discourse which should occur in the local theater. To examine this, this research cross analyzes the key scripts from Sarachchandra to De Silva, and the critical essays and related literature on those plays. Through those analyzes, Finally, the research examines the extent to which the dominant social and cultural discourses of the relevant decades have influenced these theatrical spaces and, how those discourses resulted in marginalizing theater forms that were alternatives to stylized form and theater forms that were shaped by ideologies that were different to the ones that influenced the stylized theater.

Keywords: Modern Sinhala drama, Stylized drama, Sinhala-Buddhist ideology, Nationalism

Translation of Tamil Dialects in Sri Lankan Context

P. Ramanadhan

Central Bank of Sri Lanka, Colombo 00100, Sri Lanka
priyanadhee@gmail.com

Translation is a mental activity. Catford (1995) states that it is "[c]ommonly considered as the process of replacement of a tactual material in one language by equivalent textual materials in another language". This definition shows that the writer is giving priority to the target process in defining the content and understands it as replacing equivalent words from the source language to the target language. Language and dialects are inextricably connected. Meanwhile, translation is a process in the sense that is an activity at the same time it is a new product since it provides us with another different culture. Further, culture and dialects are two important factors of a speech community, which play a significant role in the production of a successful translation. A dialect is a form of a language that people speak in a particular part of a country containing some different vocabulary. Generally, dialects create some confusion in the speaker's or listener's mind though it will not affect the meaning completely as dialects are always based on a language the community already uses. In Sri Lanka, among the Tamil society, one may find several regional and social dialects and it is the responsibility of the translator to figure out the meaning and the ways and means of translating those dialectal forms accurately. Therefore, the hypothesis of this study is that translators should be aware of the different speech communities. Accordingly, the present study discusses the Sri Lankan Tamil dialects while comparing different dialects used in the Sri Lankan Tamil society and the significance of the knowledge of Sri Lankan Tamil dialects for a translator. Further, this study will conclude with a discussion of the solution for the obstacles that occur due to the dialectal variations in meaning and the role of a translator who should search and study the dialects of a particular language.

Keywords: Translation, Dialects, Sri Lankan Tamil dialects, Speech community

Buddhist Identity Found in *Moggallāyana* Grammatical Tradition: A Study Based on *Kāladdhānamaccantasaṃyoge*

K. Muditha

Department of Pali and Buddhist Studies, University of Peradeniya, Peradeniya 20400, Sri Lanka
kosgamamuditha20@gmail.com

Pāli grammarians maintain their identity laying the foundation on Buddhist teachings, though they follow the footsteps of Sanskrit grammar. '*Jinavacanayuttaṃ hi*' is the Buddhist identity that is used by *Kaccāyana (Kacc.)* to empower all its exegeses. It is prominent that a unique grammatical tradition is followed by Pāli commentaries than of traditional grammarians even by way of denoting cases. However, when it comes to *Moggallāyana (Mogg.)*, it can be noted that not only the Buddhist utterances but also the commentarial explanations on them are considered deeply by the author while giving annotations to sort out their contextual implications. Hence, the focus of this study is to explore how *Mogg.* gave priority to highlight the contextual meaning of the canonical utterances considering commentarial and former grammatical interpretations. In this case, the author intends to comparatively examine the implication of '*kāladdhānamaccantasaṃyoge*' in *Mogg.* with both commentarial as well as *Kacc.* exegeses. As depicted by *Kacc.* the occurrence of the accusative in the contexts which are abstracted from the canon: '*pubbaṇhasamayaṃ nivāsetvā*', '*ekaṃ samayaṃ bhagavā*' and '*imaṃ rattiṃ cattāro mahārājā*' is used in the sense of locative *(tatiyāsattamīnaṃ ca)*. Meanwhile, the commentator partly agrees with the sense of locative, but he explains the reason for the accusative emphasizing exact contextual meaning. Yet *Mogg.* includes the same implication in the complete continuity *(accantasaṃyoga)* of the time and the action reflecting the contextual meaning and empowers '*bahulaṃ*' in this very aphorism leaving space for exceptions. Accordingly, it can be assumed that *Mogg.* has decided the place of canonical contexts in his exegeses giving priority to their original implications. Moreover, his comparative study on the explanations given by the commentators and former grammarians has allowed him to use optional markers in a wider sense compressing the aphorisms.

Keywords: *Moggallāyana*, Exegeses, Aphorism, Grammarians, Accusative

Sri Lankan Culture Revealed in the Mahavamsa

I.S. Dissanayake

*Department of History, Faculty of Arts, University of Peradeniya,
Peradeniya 20400, Sri Lanka
dissanayakeishini996@gmail.com*

The *Mahavamsa* was written by a Buddhist monk called *Ven. Mahanama* in the fifth or sixth century A.D. It is one of the most significant and oldest historical sources which contribute towards building a continuous history in Sri Lanka. The *Mahavamsa* reveals information about the culture, religion, and mythology of Sri Lanka before the introduction of Buddhism. Fundamentally, the *Mahavamsa* illustrates the enormous political, economic, social, and religious transformations that had appeared in the local society and culture after the introduction of Buddhism. The main objective of this research is to study the culture that existed before the introduction of Buddhism in the *Mahavamsa* and to study the various perspectives expressed by historians on this subject. The secondary objective includes a study of the important facts revealed in the *Mahavamsa* about cultural and religious changes that took place in Sri Lanka after the introduction of Buddhism. The research used primary and secondary data and collected primary data through interviews and primary sources. Secondary data were obtained from both published and unpublished sources. As further data were gathered, it was brought to light that since the *Mahavamsa* was written by a Buddhist monk, some shortcomings can be seen, though many other countries lack the resources to build a continuous history. Hence, the support given by the *Mahavamsa* to build a continuous history is invaluable. Nevertheless, the information revealed only in the *Mahavamsa* is not sufficient and it is clear that archaeological sources are also essential to build and ensure the validity of historical narratives.

Keywords: Mahavamsa, Buddhism, Culture, History, Sri Lanka

Biene beißen Beine: A Case Study on the Use of Tongue Twisters to Overcome Difficulties in Distinguishing Pronunciation of Orthographic <ei> and <ie> in the German Language

L.H.M.D.S. Lansakara

*Sri Lanka Institute of Advanced Technological Education,
Anuradhapura 50000, Sri Lanka
sachilansakkara@gmail.com*

Among the challenges encountered by Sri Lankan learners of German as a Foreign Language is the lack of competence in distinguishing the pronunciation of orthographic <ei> and <ie>. The purpose of this study was to use tongue twisters inclusive of words with <ei, ie> and examine the efficacy of the method in facilitating German language learners to overcome the challenge. Previous studies perceive tongue twisters as an ideal exercise to learn and improve pronunciation while enjoying it. The study also engaged in evaluating adult language learners' attitudes towards the use of tongue twisters in the learning process. The sample was thirty students following the Higher National Diploma in Tourism and Hospitality Management who learn German as a foreign language. During the research period, the students were regularly involved in practicing tongue twisters inclusive of words with <ei, ie>. Pre- and post-oral tests and a focus group discussion were applied in collecting data in the mixed quantitative-qualitative research approach. In analyzing the data MS Excel and the Qualitative Data Analysis process (Seidel, 1998) were used. Comparative analysis of the test results revealed that the students scored good grades in the post-oral test. They made few pronunciation mistakes and were confident in distinguishing between the <ei, ie> pronunciation in words during the post-test compared to the pre-test which was conducted prior to the application of tongue twisters in the learning process. The findings also revealed that adult learners perceive the use of tongue twisters in practicing German <ei, ie> positively and, they identify tongue twisters as an exciting exercise that assists them in overcoming the mispronunciations and improving their vocabulary skills while familiarizing them with the morphological and syntactic patterns of the target language. The outcome of this study further emphasizes the necessity of reappraising the use of tongue twisters in foreign language classrooms.

Keywords: German as a Foreign Language, Learner attitude, Pronunciation, Tongue twisters, Pedagogy

Implicit and Explicit Knowledge in Second and Third Language Acquisition

C. Gunawardena

Department of Modern Languages, Faculty of Humanities, University of Kelaniya, Kelaniya 11300, Sri Lanka
Humanities Research Centre, University of York, Yo10 5DD, York, UK
chandeera.gunawardena@york.ac.uk

Previous studies show that due to nonfacilitative first language (L1) transfer, second (L2) and third (L3) language speakers do not develop implicit knowledge of certain grammatical structures. Therefore, the aim of the present study is to determine whether L1 Sinhala speakers could develop implicit knowledge in L2 English and L3 French. Object pronouns are expressed overtly in English and French. However, Sinhala has overt and null object pronouns. The data was collected via an acceptability judgement task (AJT) and a production task (PT). The AJT tested the grammaticality contrast between grammatical object pronoun structures and ungrammatical null object pronoun structures in French and English. The PT was designed to elicit object pronouns in English and French. The AJT measured explicit knowledge, whereas implicit knowledge was measured by the PT. L1-Sinhala–L2-English speakers (n=28) and L1-Sinhala–L2-English–L3-French speakers (n=30) participated in the experiment. The L2-English speakers completed the English version of the AJT and PT. The L3-French speakers completed the French version of the AJT and PT. Under the facilitative transfer from Sinhala, L2 and L3 speakers would be target-like on object pronouns. On the other hand, under the nonfacilitative transfer, they would accept null object pronouns in French and English. It was also hypothesized that if the L2 and L3 speakers had acquired explicit and implicit knowledge of object pronouns, they would have similar results in the two tasks. In the AJT, the L2-English speakers differentiated between grammatical object pronoun structures and ungrammatical null object pronoun structures in English. Similarly, the L3-French speakers made a distinction between these two structures in French. However, in the PT, the L2-English speakers and L3-French speakers predominantly used null object structures in French and English. Therefore, the results suggest that implicit knowledge of object pronouns is still unavailable in L2 English and L3 French.

Keywords: L2 English speakers, L3 French speakers, Implicit knowledge, Explicit knowledge, First language transfer

Music Iconography in Sri Lanka: A Study Based on Archaeological Icons in Anuradhapura Period

J.C.R. Kumara

Department of Fine Arts, Faculty of Humanities, University of Kelaniya,
Kelaniya 11300, Sri Lanka
ruwankc@kln.ac.lk

This research examines Music Iconography as a source for the music history of Sri Lanka based on archaeological evidence during the Anuradhapura period. The premise of this research is whether the musical representation evidence (Iconography) based on archaeological information from the Anuradhapura period could be a source of music history in Sri Lanka. Music iconography is primarily visual representations or symbols related to music as a branch of the study of the history of music. It focuses on the content and subject matter, rather than the form or style of the images. The methodology followed for this observation is the description (the pre-Iconological level of description of the primary and natural subject matter, and the motifs or 'pure forms' that are carriers of primary and natural meanings), analysis (recognizes the conventionality of images and their themes, demanding knowledge of their literary and textual sources and defining a 'history of types') and interpretation (the intrinsic meaning or symbolical values of a work). The evolution and independent characteristics of Music in Sri Lanka during this period will be studied with the musical visual representation. Western and Indian researchers have studied the significance of music iconography and compiled new knowledge as well as new interpretations of ethno-musicology by conducting formal research. There is very little formal research on music iconography in Sri Lanka. Therefore, this research will be instrumental in incorporating information on Sri Lankan music iconography into the world's prevalent music iconography research and identifying the history, trends, and independent characteristics of Sri Lankan music. The impact of Buddhism on Sri Lankan music during several phases of the selected period was discussed in this research to identify its foreign elements. It can be concluded that the evidence found from the particular period have provided some independent and indigenous characteristics of Sri Lankan music.

Keywords: Music iconography, Music history, Sri Lankan music, Anuradhapura Period, Independent characteristics

A Tribute to the 'King': A Musicological Analysis of Songs Sung to Promote the Image of Former Sri Lankan President Mahinda Rajapaksa

U. Herath[1]* and M. Alawathukotuwa[2]

[1]Department of Performing Arts, Sri Palee Campus, University of Colombo, Horana 12400, Sri Lanka
[2]Department of Fine Arts, Faculty of Arts, University of Peradeniya, Peradeniya 20400, Sri Lanka
*uthpalah@spc.cmb.ac.lk

Setting a trend of composing songs for political leaders, a deluge of songs emerged between 2009 and 2016 promoting the image of former Sri Lankan President Mahinda Rajapaksa. These songs primarily highlighted his image as a heroic, kind-hearted, and authentic political leader, who is determined to protect and develop the country. Interestingly, this lyrical and musical identification of being an 'extra-ordinary leader' is constantly emphasised by equating him to ancient kings. Based on this, this study analyses selected fifteen Sinhala songs published in YouTube, Radio, and Television between 2009 and 2016 to examine how the melodies of songs sung to promote the image of former Sri Lankan President Mahinda Rajapaksa reflect his image as a 'righteous king'. As the concepts of *sīhaladīpa* and *dhammadīpa* had shaped the fundamental idea of a king's primary duty to protect pristine Buddhism and its guardians—the Sinhalese, royal ancestry, military prowess, possession of the tooth relic of Buddha—being a Buddhist and ascribed divinity became key characteristics of ancient Sri Lankan kings. When the songs' lyrics explicitly claim that Mahinda Rajapaksa is a heroic or *Ćkarawartī* king following those traits of a king, musical elements are used in two approaches to reflect it. One method is using musical elements to highlight the word 'king' in lyrics, and the other method is employing musical symbols. Accordingly, the ascending note pattern, frequent usage of higher octaves, echo effect, repetitions, or canonical imitations, sudden rhythmical or instrumental changes, singer's voice, and overall tonality are used to emphasise the word 'king', while *praśasti, gaman hēvisi pada, panćathūrya* instruments, and side-drums are used to connote divinity, royalty, Buddhist-ness, and military prowess respectively. Through the analysis of these musical aspects, it can be shown how music is used to strengthen the lyrical renditions of the royal image ascribed to former President Mahinda Rajapaksa.

Keywords: Mahinda Rajapaksa, Image, King, Songs, Musical symbols

A Research Study on the Differences of Chinese Pragmatics and Pragmatic Failures in Intercultural Communication

J.A.A.K.W. Jayasundara

*Department of Chinese Language and literature, Faculty of Liberal Arts,
Central China Normal University, Wuhan 430079, China
anjulakeshani123@gmail.com*

"Language" is the basic mode of communication between people, and it is also an important mechanism to express one's way of thinking and cultural connotation. In different cultural backgrounds, especially in countries like China, Korea and even Japan, people may use familiar terms to express contrasting meanings which would sometimes lead to language misunderstandings and pragmatic failure. Therefore, it is evident that cultural differences in countries have a profound impact on interpersonal communication and pragmatics. Based on the theory of pragmatics, this paper discusses the cognitive situation of Chinese pragmatics in cross-cultural communication, including its basic concepts, the influence of different cultures on Chinese pragmatics, pragmatic differences, and failures in cross-cultural communication and its causes and the effective methods of avoiding them. The research was conducted based on secondary data derived from reports published by various scholars, related websites, and books. The data gathered were analyzed qualitatively using descriptive statistics which is the fundamental research methodology of this article. The analysed data indicated that the time of speech, the content and the place of speech are the three main differences of Chinese pragmatics in intercultural communication. Meanwhile, the pragmatic failures were observed in the form of address, greetings, expression of gratitude, self-effacing, and when bidding farewell. The research indicated that foreigners' lack of cultural knowledge and being unaware of the correct usage of Chinese language directly led to pragmatic failure. The suggested solutions are understanding the Chinese culture, comparing Chinese language and mother tongue, learning the correct usage of grammar, and practicing Chinese pragmatics within an intercultural background as the methods of avoiding pragmatic failures. With an in-depth analysis of Chinese pragmatics in intercultural communication, it is hoped that this article would be beneficial for future researchers who are interested in "Chinese Pragmatics".

Keywords: Chinese pragmatics, Intercultural communication, Pragmatic differences and failures, Culture

A Study on How Non-Native Cultural Information in Reading Paragraphs Diminishes Students' Active Engagement

A.J.M.D.N. Penthenigoda

Department of English Language Teaching, Faculty of Business Studies and Finance, Wayamba University of Sri Lanka, Kuliyapitiya 60200, Sri Lanka
dharaninayanz@gmail.com

Integrating the learners' native culture in English Language learning does not alienate learners. However, integrating English culture in reading comprehension may estrange learners in the classroom, as students usually interact in the classroom by sharing their personal experiences or knowledge when the teaching materials are provided from a familiar context. Therefore, integrating foreign culture specially in reading activities, hinders the encouragement of the students to be active learners in the classroom. Using Vygotsky's socio-cultural theory as a theoretical basis, this study sought to understand the importance of integrating learners' native culture in language learning. This study was conducted at Saegis Campus Nugegoda. The participants were selected from a Diploma in an English programme, and they were in the age range between 18-25. The study showcased how the students interacted in the language classroom when they were provided reading materials related to a non-native culture. This action research was conducted to observe how contrastively they participated in the two different contexts. Two sessions were conducted by utilizing native cultural information and non-native cultural information in reading. A group of 22 students participated in the focus group discussion and 72% of the total disclosed how they were motivated to be interactive in the classroom, when they were provided with native cultural information. 28% of the students stated that integrating non-native culture in reading activities exposed them to a new culture. Consequently, it makes them passive learners in the classroom as the classroom context exposes them to an exotic environment. As the focus was to develop the students' interaction in the language classroom, the conclusion proposes the integration of students' native cultural information in reading activities to reduce their estrangement in the second language learning context.

Keywords: Native/Non-native culture, Cognitive development, Cultural integration, Social integration, Passive/Active learners

A Study on Emergence of Female Filmmakers in Sri Lankan Film Industry

N.K. Minuwangoda

Department of Fine Arts, Faculty of Humanities,
University of Kelaniya, Dalugama 11300, Sri Lanka
nishikanchana@gmail.com

Although the history of Sri Lankan cinema dates back to 1947, there is still a lack of female filmmakers and directors in the industry. The objective of this study is to determine the factors that contribute to the emergence of female film directors and their continued survival in the field. Interviews conducted with Inoka Sathyangani, who is still active in filmmaking, and Malini Fonseka, who has retired, have been used as primary sources and bibliographic websites have been used as secondary sources for this research. Although cinema is taught as a subject in Sri Lankan universities, it is limited to examination purposes and beyond that, there is no mechanism to produce female filmmakers thereby creating a vacuum of female filmmakers in Sri Lanka. In a context where Dr. Lester James Peiris strongly emphasized the need of a film school, the main purpose of this research is to show that the lack of such a school has made it difficult to create female film director personalities equipped with technical and aesthetic knowledge. Thus, the study also emphasizes the urgency of such a school. Further, the study reveals that there is a need for women to come together and build discussion forums on cinema and discuss issues related to cinema. The study argues that women need self-confidence to overcome social pressures and that it requires a change of attitude and a series of interventions at various levels of society. The basic conclusion of the research is that a woman needs a long-term professional commitment to survive in the field of cinema and to develop a personality capable of leading men.

Keywords: Challenges, Director, Female, Filmmaker, Sri Lanka

Suvisi Vivarana Dance in Sri Lanka: A Buddhist Religiotainment Performance Where Identities of Performers Became Fluid

S. Mantillake[1]* and P.K.G.I. Jayasinha[2]

[1]*Department of Fine Arts, Faculty of Arts*
[2]*Postgraduate Institute of Humanities and Social Sciences*
University of Peradeniya, Peradeniya 20400, Sri Lanka
*sudeshm@arts.pdn.ac.lk

This paper examines *Suvisi vivarana* dance, a performance practice that came to exist around the early twentieth century in *Sabaragamuwa* and spread to Central province. According to the Buddhist practice in Sri Lanka, *Suvisi vivarana* is a religious ceremony performed for twenty-four past Buddhas. In this, dancers recite how the last Buddha, Siddharta Gautama, received wishes (*varamas*) from earlier twenty-three Buddhas. As Buddhist temples lost their traditional patrons in the colonial period, *Suvisi vivarana*s were organized to attract donors and worshipers. Combined with other activities such as *wendesi* (auctions), *hitiwana kavi* (instant poetry), *gini keli* (fireworks), *viridu* recitations, *pinum* (acrobatics) in temple ceremonies, Suvisi is performed nightlong. Literature, archival records, interviews, and lived experiences were used to collect data in this research. We use Mikhail Bakhtin's articulation of Carnivalesque to analyze our data. We argue that *Suvisi vivarana* was a Buddhist religiotainment space where identities of the performers such as religion, caste, gender, and ethnicity became fluid. In contrast to the argument that Buddhism relegated performing arts, we demonstrate that Buddhist temples used *Suvisi* dance performances to develop their infrastructure by attracting donors through bridging religion with entertainment. Therefore, we define *Suvisi vivarana* dance as a form of Buddhist religiotainment performance. Although historically, performers from different castes performed in different spaces, *Suvisi* dance changed it. Although performers of different caste groups, ethnic groups did not perform together shoulder to shoulder during the Kandyan period, *Suvisi* dance attracted them to perform in one space. Contrary to the traditional ritual practices, female dancers also started to perform in public in *Suvisi* dance. This does not mean those female performers were received by society in the same way as their male counterparts. However, Suvisi vivarana dance as a religiotainment performance created a space that performers of different castes, ethnicities, genders performed together.

Keywords: *Suvisi vivarana*, Dance, Religion, Entertainment, Identity

The Good Governor: Cicero on Provincial Governance

S.W. Ekanayake

Department of Classics, School of Arts, University of Otago,
Dunedin 9016, New Zealand
ekasu924@student.otago.ac.nz

Cicero's works often capture the highly complex and nuanced nature of Roman provincial administration, thereby offering some of the most insightful primary source material on the subject. Here, Cicero's first letter to Quintus stands out as a possible 'treatise' on provincial governance, where he prescribes a strong moral code for his brother's conduct as a governor. While the pedagogical value of the letter is acknowledged by scholars, the letter warrants closer analysis, especially in constructing an 'ideal' for provincial administration. Accordingly, the current study attempts to delineate a 'model' of provincial governance as appears in Cicero's first letter to his brother Quintus, with particular attention given to the correlation between Cicero's 'ideal model' and the Roman self-image, and the extent to which they are dependent on traditional Roman moral virtues. This is done through the close reading of Cicero's first letter to Quintus as primary source material, and textual analysis of selected passages. Upon examination, Cicero's letter evidently points towards an 'ideal' of provincial governance, which is rooted in the traditional moral code *mos miorum*. Rome and its representative, the provincial magistrate, are considered 'guardians' or 'protectors' of the provinces rather than 'rulers.' Especially, the provincial governor is portrayed as the custodian (*custos*) of the province seeking the happiness and wellbeing of the people entrusted to his care. Such a conception of a strong ethical framework as a basis for governance is indeed significant for the justification of Roman imperialism, and to practically establish good governance in the provinces. However, it is also observable that despite the ideal model he held, Cicero never felt the need to address structural problems in the system, as the *imperium* of the provincial magistrate. Such inferences arising from Cicero's views thus help to better understand Roman provincial administration as well as Roman imperialism.

Keywords: Cicero, Governance, Roman provincial administration, Ethics

Abhinavagupta vs. Aristotle: A Comparative Study Based on the Concept of Catharsis

K. Seelananda

Postgraduate Institute of Humanities and Social Sciences, University of Peradeniya, Peradeniya 20400, Sri Lanka
seelanandakumburuwela@yahoo.com

Abhinavagupta is a well-known Sanskrit literary critic from Kashmir who lived between the 10th to 11th centuries CE. On the other hand, Aristotle, a Greek Philosopher, lived from 384 - 322 BC in Greece. Both of them have strived to examine the very nature of aesthetic experience. Aristotle refers to the level of aesthetic consummation as Catharsis. Abhinavagupta also elaborates on the level of Catharsis as one of the five phases in the process of the enunciation of sentiments. This study investigates if the Catharsis level intended by Aristotle coincides with that of Abhinavagupta. In the process of this research, comparative and analytical methods were used. Aristotle claims that emotions of pity and fear are essential causes that give rise to tragic pleasure. According to him, it is the highest level of aesthetic pleasure, which is the cause of the origin of Catharsis. However, the denouement state of the aesthetic pleasure of Abhinavagupta is not the level of Catharsis. According to him, the denouement state is the last/ fifth phase which is transcendental. Though Aristotle elaborates two sentiments as the causes for arising tragic pleasure, Abhinavagupta mentions nine sentiments and they are always pleasant. Conspicuous difference between these two is that, for Abhinavagupta, there is a good deal of sentiments at the level of Catharsis and that there is only one sentiment which stands above all sentiments, at his denouement transcendental level. Aristotle maintains that the state of Catharsis purifies our mind. However, according to Abhinavagupta, the connoisseur relishes ecstasy as a supermundane pleasure at the Catharsis level, and that his transcendental state is one-step higher than Aristotle's Catharsis level. Thus, we can conclude that the elaborations of the Catharsis of Aristotle are not similar to that of Abhinavagupta.

Keywords: Abhinavagupta, Aristotle, Catharsis, Transcendental, Ecstasy

The Syntax of the Vedda Language

M.G.L. Ananda

*Department of English and Linguistics, Faculty of Humanities and Social Sciences,
University of Sri Jayewardenepura, Nugegoda 10250, Sri Lanka
mlalithananda@sjp.ac.lk*

This paper is an inquiry into the syntax of the Vedda language conducted in accordance with Noam Chomsky's (1980-) Principles and Parameters (P&P) framework, and the cartographic approach (Rizzi 1997), (Cinque 1999). Its overall objective is to examine the word order and configurationality, phrase structure, clause structure, anaphoric relations, negation and NegPs, Heads and Head positions, movement, Topic, Focus, and other relevant syntactic phenomena in Vedda language. The study attempts to understand the extent to which the Vedda language could be described from a generative syntactic perspective. Though not formulated as a comparative study, where relevant, a comparative perspective with Sinhala is adopted for clarification and explanation. The field research was carried out in the Dambana administrative division in the Uva Province of Sri Lanka where the Vedda settlements are officially located. The sample consisted of 05 Veddas who are native speakers of the Vedda language. The data were recorded during two field visits. The data analysis was carried out with attention to the syntactic phenomena mentioned above. The most important conclusions that could be arrived at during the study are; that despite the availability of many scrambling opportunities, the Vedda language remains configurational; that it does not allow certain word orders present in the Sinhala language; that it is strongly Head final as the Sinhala language; that it does not have an articulated Complementizer domain (C domain)) or an articulated inflectional layer (Tense periphery); that their Neg(ative) marker serves a number of modal functions in addition to Neg marking; that both Focus and Wh- are located in the Focus Head; and that, on the whole, the syntax of the Vedda language largely aligns with the syntax of the Sinhala language.

Keywords: Vedda language, Syntax, Generative perspective

Religious Tension Depicted in Editorial Cartoons of Sri Lanka

K. Dambagolla[1]* and P.J.A. Karunanayake[2]

[1]*Postgraduate Institute of Humanities and Social Sciences, University of Peradeniya, Peradeniya 20400, Sri Lanka*
[2]*Social Scientists' Association, Colombo 00700, Sri Lanka*
*kalpidambagolla@gmail.com

Respecting and accepting other cultural practices and human rights is a noble human quality even in an extremely critical condition. But recent events related to burial and cremation practices during the COVID-19 epidemic in Sri Lanka show a lack of ethnocultural and religious sensitivity. This situation is a negative output of a long-lasting tension between the religious majority and minorities. Activists including editorial cartoonists are attempting to make positive contributions to address this issue. Here, the editorial cartoon is seen an influential mode of commentary, critique or protest. Simply, it sums up current events of the country using a visual vocabulary familiar to the readers. This study used critical content analysis of editorial cartoons to examine how cartoonists depict the current discourse related to religious tension in Sri Lanka. Editorial cartoons of mainstream news sources in all three languages are taken as primary sources of the study. Then, the perspectives of editorial cartoonists on religious tension in relation to the recent events from 2019 are critically analyzed. In the selected cartoons, Sri Lankan cartoonists have conveyed the different depictions of religious tension through symbolism, labelling, exaggeration, analogy and irony. Religious symbols, religious leaders and politicians are often used in these cartoons. Mainly the politician is depicted as a problem creator while religious leaders are depicted as influencers who cause problems. However, this study emphasized the important role of the cartoonist as a representative of society, and to be so, they have used satirical caricatures to raise a voice against increasing religious tension. Evidently, in some cartoons, an overall negative portrayal of religious minorities can also be observed. Even the same incident related to religious tension was interpreted differently by different cartoonists. Editorial cartoons, therefore, leave space for the reader to engage in the discourse by reflecting their perceptions and experience.

Keywords: Cartoonist, Editorial cartoons, Religious tension, Subjectivity, Symbols

From Coconut Oil to Engine Oil: Shifting Aesthetics of Playing Ceremonial Drums (*Mangul Bera Vādanaya*) in Kandyan Tradition

C. Bandara[1]* and S. Mantillake[2]

[1]Department of Performing Arts, University of Colombo, Sri Palee Campus, Wewala, Horana 12400, Sri Lanka
[2]Department of Fine Arts, University of Peradeniya, Peradeniya 20400, Sri Lanka
*ruwansiri1971@gmail.com

Mangul Bera (*MB* hereafter) *Vādanaya* (playing ceremonial drums) of Kandyan tradition has become ubiquitous to the extent that there is hardly any official ceremony in Sri Lanka without it. Whether it is lighting of an oil lamp or cutting a ribbon, *MB* is there. Beyond the coconut oil lamp, it has even gone to promote engine oil in Havoline oil commercial. This paper examines the shift of the aesthetics of playing *MB* in the last few decades when it became a commodity in the culture industry. When *MB vādanaya* becomes a commodity, we argue that acoustic-organic unity, the flow, the meanings, and the primary purpose have changed. In this process, drumming has been framed into specific beats, and therefore, it has become mechanical that limits drummers' creativity and individuality. We used observations, interviews, lived experiences, and ancient treatise *Hōrābaranaya* for this study. Immanuel Kant and Theodor Adorno provided us a theoretical framework. Four complete sequences of drum beats (*vattam*) of *MB* were played in rituals in the Kandyan regions. *MB vādanaya* consists of a combination of drumming sequences played according to a particular beat or without a beat. Drumming sequences that do not require a particular beat are called *sangamāna pada*. Combining drumming sequences that have a beat and that do not have a beat creates a holistic auditory experience and sonic pleasure. This experience enhances human-divine and human-human relationships in rituals. *MB* sounds traditionally have been composed based on the theory of *suba ghana* to create an auspicious effect. According to the theory, sounds "*ta*" and "*jin*" were not played together. However, most drummers today do not seem aware of this or/and do not care about auspicious elements in *MB*. It has become just a piece of culture industry that can be hired and used for any purpose.

Keywords: Kandyan Mangul Bera, Ceremonial drums, Aesthetics, Commodity, Change

Thinking through Dancer's Body: A Comparative Study of Kandyan Dance and Bharatanatyam

H. Niriella* and S. Mantillake

Department of Fine Arts, University of Peradeniya, Peradeniya 20400, Sri Lanka
*hasanthicniriella@gmail.com

This paper examines the dancer's somatic experience in Kandyan dance and Bharatanatyam. Both Kandyan dance and Bharatanatyam are generally considered vigorous dance forms. Many scholars have visually analyzed these two dance forms elaborating their gestures, movements, costumes, music. In contrast, by comparing the two dance forms, this paper contributes to the bodily aesthetic understanding of these dance practices using *somaesthetics*, a field of theory and practice dedicated to thinking through the body, developed by pragmatic philosopher Richard Shusterman. Shusterman's *somaesthetics* poses questions for dancers to contemplate on their bodily practices and propose interpreting their dance through the physical body and the lived, sentient, intentional, body that involves mental, social, and cultural dimensions. Since we have learned and practiced these two dance forms for more than fifteen years, as researchers, we have primarily used our bodily archive, lived through experiences in Kandyan dance and Bharatanatyam. Focusing on dance training and popular public performances, we demonstrate the benefit of somatics in dance training for both dance practices. Traditionally both these dance practices had holistic dance training. However, in the current dance education in public schools and private classes, students are always asked to follow the teacher's movements. In Kandyan dance, students are asked to observe and imitate teachers. In Bharatanatyam, apart from imitation, students are instructed to imagine the meanings of the literature recited while training and performing. In both practices, dancers were predominantly trained to perform outwardly. They were asked to focus on how they look on stage, but not how they feel in our bodies. In this process, while the dancer achieves technical precision, the dancer's body often becomes an object. However, through mindful movement sequences, dancers can sense, feel, and think through their bodies more consciously both in their dance training and performances.

Keywords: Somatics, Somaesthetics, Dancer's body, Kandyan dance, Bharatanatyam

A Study on the Effectiveness of Terminology Translation through Google Translate

A. Nanayakkara

*Department of Linguistics, Faculty of Humanities, University of Kelaniya,
Dalugama, 11300, Sri Lanka*
amaya95d@gmail.com

Machine translation (MT) is an ever-improving discipline of translation studies which refers to fully automated software that operates without human intervention which can translate source language (SL) texts into target language (TL). Being a popular MT platform that offers translations across many languages, Google Translate is prevalently believed to be more effective in technical translations (TT) than in other genres of translation. Terminology stands out as a pre-eminent component of technical translation in different disciplines. This study investigates the effectiveness of Google Translate in technical translation by analysing its quality in translating terminologies. Both qualitative and quantitative methodologies are employed in conducting the research where fifty simple and compound sentences containing terminology related to Commerce were translated from English to Sinhalese through Google Translate. The translated terminology was isolated and reviewed for accuracy based on the Trilingual Glossary in Commerce by Educational Publications Department. The translations were dichotomised as accurate and inaccurate translations based on their level of relevance to the corresponding glossary terms. 34% of the Sinhalese translations by Google Translate proved to be accurately translated, whereas 66% proved to be inaccurate. In identifying the eminent procedures of translation followed in the two dichotomies, established equivalence and generalisation were observed in accurate translations. In inaccurate translations, neutralised borrowings and literal translations were the evident procedures, whereas erroneous translations and unintelligible translations in English and Sinhalese intermingled letters were also observed. The study indicated that despite the perception that Google Translate is relatively effective in technical translation, most of its terminology translations are inaccurate due to the unavailability of corresponding TL terminology in the corpora. In order to improve the quality of translation in Google Translate, the need for exchange between computer-based translation tools is emphasised where online dictionaries and online terminology databanks can be merged with Google Translate corpora.

Keywords: English, Google Translate, Machine translation, Sinhala, Technical translation, Terminology

Youth Aspirations and White Magic

I.M. Dissanayaka[1]* and W.S.N. Siriwardhana[2]

[1]Department of Demography
[2]Department of Sociology
Faculty of Arts, University of Colombo 00700, Sri Lanka
*imashamdshn@gmail.com

White magic is a nonviolent tactic and belief that positively influences the mode of thought and the expectations of persons in everyday life. The expectations of the youth in any society are built in proportion to the expectations of society. Expectations become the main challenge they face in building a modern identity. This research was conducted on the research question of why young people turn to witchcraft to achieve their aspirations. A purposive sample, fifty young people (Age 21 – 30) who visited the *Isurupura Pattini Devalaya* in Anuradhapura with the idea of succeeding their aspirations was taken as the sample. Data were obtained through interviews and direct observation. The main purpose of the research was to identify the factors that influence young people to turn to white magic in order to achieve their aspirations, despite the existence of standard and mainstream methods. Among the sub-objectives was to identify the aspirations of the youth and the hopes achieved through them. Here the youth recognized the tendency to turn to white magic for their own aspirations. Confession, *Bodhi Pooja*, *Sethkavi*, use of *Yanthra* and spun threads, and amulets were identified as the main forms of witchcraft. Respondents reported that they gained determination, guidance, safety, impulse control, and mental healing through the use of machines and spun yarn. The functional basis they expect through the use of white magic was important here. The unique recognition here was the focus of this study which also pursued a scientific solution or standard approach; which focused on sorcery while receiving mainstream treatment, especially for chronic diseases. In conclusion it was clear that despite the awareness of the use of new technology and new global patterns, to achieve expectations they confidently turning to white magic with the belief of non-violence.

Keywords: Aspirations, White magic, Mainstream

Re-Creation of Human Subject within Televised Reality Programs: A Critical Analysis of *The Voice* Aired on *Sirasa* Television

M.M.S.L. Yalegama* and M.I.L. De Zoysa

Department of English Language Teaching, University of Peradeniya, Peradeniya 20400, Sri Lanka
**shanilkiyalegama@yahoo.com*

Televised reality shows have gained prominence within various private television channels across Sri Lanka. One such reality programme is *The Voice*, a singing competition aired on *Sirasa* Television, which consists of a multitude of novice singers performing in front of four judges who are professional musicians in Sri Lanka. Once the song is performed, the judges would give their comments and the performers, if selected, are given the option of engaging in further training with one of the singers. The structure of the program dictates that the judges market themselves in front of the performer thereby giving him/her the option of choosing a coach (who will have to be one of the four judges) of his/her choice. Midst various controversies and criticisms questioning the reality of this program, it has gained popularity within the public. When this program is looked upon critically, the notions promoted by the judges in the form of "image building" and "creating a brand" attribute the individuals with the quality of a good that should be best sold in the open market which tends to dehumanize the human subject. Furthermore, the language used by the judges in describing the contestant's singing and appearance border on sexualizing the human subject and promote traditional gender norms. Therefore, the main research question used in this study was to critically examine how language used by the judges within the context of this reality programme re-creates the human subject and how that creation is aligned with the neo-liberal market requirements operating within showbiz. The data was mainly gathered through watching the recorded programme on YouTube and the videos were analysed using the poststructuralist means, mainly deconstruction. The findings of this study portray how the performer is made to "recreate/reinvent" his/her subjectivity to suit the heavily marketized consumerist neo-liberal world ethos.

Keywords: Deconstruction, Human subjectivity, Market, Neo-Liberalism, Reality programs, Showbiz

Suddhe Poya or Kiri Poya Belonging to Pasdun Korale

L.B.K. Lakshan

Department of Fine Arts, Faculty of Humanities, University of Kelaniya,
Dalugama 11600, Sri Lanka
lkavindu099@gmail.com

The *Kiri Poya* or *Suddhe Poya* is a unique ritual in *Pasdun Korale*. The purpose of this research is to identify the features, and the present status of this ritual. This anthropological study is qualitative in nature. Secondary data was collected from the library and field studies. Primary data was also collected by interviewing 10 families that practice this ritual yearly. According to Folklore, it is believed to have started around the year 1215 during the reign of *Parakramabahu*, the leader of the Southern Province, during the reign of Minister *Devapathiraja*. The ritual is performed on the day of *Esala Poya* under the patronage of the God *Kataragama* and goddess *Pattini*. Ancient Brahmin houses used to celebrate this in a very festive manner. On the day prior to the Poya day, the houses are washed, cleaned with yellow liquid, a lamp is made and sea sand was spread around it. Confectionery and processed milk are set aside for the gods on the evening of the full moon. The ritual ends with a prayer to the god *Kataragama* and blessings for the well-being of their family. The family members then spread banana leaves in the middle of the living room and eat milk. This paper examines the question of whether this ritual, which was based on the priesthood, is still practiced today or not. This ritual is now practiced without understanding its real meaning and its importance. Also, the majority of the new settlers who came to the area do not perform this ritual. There is a tendency for entertainment to go beyond the clergy, and personal attitudes have changed. Social change has been central to this. The study concludes that this has become a meaningless ritual aimed solely at preserving traditions that comes from the past.

Keywords: Kiri Poya, Rituals, God of Kataragama, Folklore, Esala Poya

Blend of Formal and Informal Language Registers in the Diaries of Administrators: A Comparative Study of the Diaries of Sir John D'Oyly, William Reginald Bibile *Ratemahaththaya* and Leonard Woolf

A.J.M.N.M. Jayaweera

Department of English, Faculty of Arts, University of Peradeniya, Peradeniya 20400, Sri Lanka
nishjay37@gmail.com

In this study, the researcher has analysed the use of unique language registers in the diaries of three colonial administrators. They are the *Diary of Mr. John D'Oyly* (1810-1815), *The Diaries of William Reginald Bibile Ratemahaththaya* (1899-1913) and Leonard Woolf's *Diaries in Ceylon* (1908-1911). D'Oyly, Bibile and Woolf were interpreters for the crown labouring in the larger socio-political network of the British colonizers, the native elite and the masses. As interpreters located in a colonial context, D'Oyly, Woolf and Bibile had access to a privileged position limited to the speakers of English. Hence, English is the language of written expression in their official and personal records. Diaries are usually seen as subjective records. The diaries of D'Oyly, Woolf and Bibile have unique language registers. Specifically, the language used in their diaries is a merger of an objectivist language expected from official records and a subjective and personal language register. This blend of the impersonal with personal prejudices and attitudes of the authors is an indicator of the play of objectivity and subjectivity during the power play in administrative communication. This study invites the researchers in the Humanities and Social Sciences to approach the knowledge produced by administrators and interpreters from a fresh perspective. It invites them to see the practice of writing as a complex intellectual activity with contextually "appropriate" doses of objective or subjective language use. The methodology involves a qualitative study rooted in library-based research. It encompasses a comparative analysis of the above mentioned diaries and other historical records. The theoretical foundation of the research is in English Studies, Linguistics and Discourse Analysis.

Keywords: Writing**,** Subjectivity, Objectivity, Hybrid administrators, Interpreters

Rise of Kandyan Dance in 1940s and 1950s: Contribution of Uncommon Patrons

R.W.R.G.G.J. Prasantha[1]* and S. Mantillake[2]

[1]*Postgraduate Institute of Humanities and Social Sciences*
[2]*Department of Fine Arts, Faculty of Arts*
University of Peradeniya, Peradeniya 20400, Sri Lanka
*janaka523@gmail.com

After the 1950s, Kandyan dance became the national dance of Sri Lanka and was widely popularized through public education and cultural festivals. This paper examines the events between the 1940s and 50s that were crucial to the rise of Kandyan dance. Although the state took the role to promote Kandyan dance after the 1950s, the contribution of individuals is vital during the 1940s. Complicating the popular narrative that it was Sinhala traditionalists who supported Kandyan dance, in this paper, we argue that uncommon patrons who were Europeans, Christians, and Burghers have contributed to the rise of Kandyan dance significantly during the 1940s and 1950s. Historical records such as logbooks, photographs, newspaper articles, programme notes, manuscripts in archives, and private collections have been studied for this research. In addition, interviews were conducted with dancers and their family members. The findings of this research provide a new interpretation to the history of Kandyan dance. Individuals such as the British politician Lord Viscount Soulbury who also became the Governor of Ceylon, British art collector Martin Russell, Rev. Lakdasa De Mel, the Bishop of Kurunegala, Christian politician George E. de Silva and his Burgher wife, Burgher intellectuals Fred Fogl, and artists such as Lionel Wendt, George Keyt, Harold Pieris were patrons of Kandyan dance during the 1940s and 1950s. Notably, these individuals supported *Amunugama Madyama Lanka Nritya Mandalaya*, arguably the first-ever Kandyan dance and art school (*kalāyatanaya*) officially recognized in 1949 which was ceremonially opened by Governor Soulbury. George Keyt designed the invitation for the opening ceremony. Long before even the Sinhala nationalist government introduced Kandyan dance to the school curriculum, it was introduced to missionary and Christian schools in Kandy such as Trinity, Highschool, Hillwood, and dancers from hereditary dance families were appointed as teachers.

Keywords: Kandyan dance, Patrons, Europeans, Christians, Burghers

"Happily Devoted to the Domestic Sphere": Exploring Sri Lankan Women's Groups on Social Media and Their Associations with Discourse of Happiness

R.L.A.N. Ranaweera

Department of Language Studies, Faculty of Humanities and Social Sciences,
The Open University of Sri Lanka, Nawala 10250, Sri Lanka
rlara@ou.ac.lk

Social media groups devoted to motherhood and domesticity are a relatively new phenomenon in Sri Lanka. I observed a few prominent social media groups found on digital media identifiable as Sri Lankan which were purportedly devoted to Housekeeping and mothering. My objective has been to question how women in Sri Lanka negotiate their identities as women and sometimes as mothers within these social media groups in a backdrop of global neoliberal and post-feminist trends. Being able to relate to "common" emotions and "common" affective cultures often point at a desire to belong and to claim membership of a certain circle. I have explored the affective clues which affirm a sense of belonging to such groups which claim to "support" women, with Laurent Berlant's concept of "Intimate Publics" in mind. I have looked at how positive thinking and the "Happiness discourse" employed in the posts of these groups impact women participating in the activities of the groups. I have particularly focused on the intersections between the pressure to become "happy and content" women and post-feminist insistence on finding fulfillment through individual endeavors and how these are reflected in the narratives of these groups. The discourse of achieving one's full potential through positive thinking is prominent in the posts shared by this group. I argue that this reflects the postfeminist insistence on cultivating and perfecting the right kind of affective disposition to survive in neoliberal societies. I propose that the narratives in these digital women's groups resonate with global post-feminist and neoliberal tendencies such as the focus on the individual and the pressure to present a perfect image of one(self) and the life one leads.

Keywords: Women's groups, Social media, Domestic sphere, Affect, Post-feminism, Happiness

A Critical Discourse Analysis of Multilingualism in
The Ministry of Utmost Happiness by Arundhati Roy

S. Sivaji

Department of English Language Teaching, Faculty of Arts, University of Colombo, Colombo 00700, Sri Lanka
ssivaji@delt.cmb.ac.lk

This paper attempts to analyse the linguistic devices used in the text *The Ministry of Utmost Happiness* by Arundhati Roy through a critical discourse analysis. Borrowing from Kachru, this paper considers the linguistic devices used in this text as code repertoire and under which code switching, code mixing, borrowing, vehicular matching, and translation are analysed. Resultantly, this paper will explore how these devices bring out the fragmented identities of the marginalized groups in India. The novel does not deploy a linear narrative but rather a complex mixture of various registers from five different languages. They are English, Urdu, Hindi, Malayalam, and Kashmiri. Therefore, this paper addresses this novel as a polylingual discourse. Through intense scrutiny of the structure, form, and registers of the polylingual discourse, which is fragmented and unwieldy, this paper will illustrate how the author projects the failure of the state in protecting the rights of the minorities and the political agenda of the *Hindutva* regime. The first section of this paper introduces the topic which is followed by a brief introduction to the novel. The second section details the methodology used in this paper; critical discourse analysis and the third section elaborates on multilingualism, code repertoire, and polylingual discourse. The fourth section presents Anjum and how she uses Urdu, Hindi, and English to demonstrate the shared pain and trauma of the marginalized groups. The fifth section focuses on Tilo's and Musa's linguistic discourse and elucidates Moosa's linguistic engagement, his patriotism for Kashmir, etc. The final section of this paper will present the conclusion derived from the critical discourse analysis of the novel.

Keywords: Critical discourse analysis, Multilingualism, Code repertoire, Polylingual discourse, Vehicular matching, Translation

Study of the Salient Features of *Pasan Gee* in Wahakotte

S.M.D.N.K. Senevirathne

Department of Fine Arts, Faculty of Arts, University of Peradeniya,
Peradeniya 20400, Sri Lanka
nirosenevi@pdn.ac.lk

"*Pasan*" is a type of religious songs related to Christian tradition. It is the chant on the passion of Christ during the period of lent from Ash Wednesday to Palm Sunday. The word "*Pasan*" can be only found among Sri Lankan Catholics. However, there are correlated words referring to "*Pasan*" in Portuguese, Latin and English languages. The English word "Passion" stands for the musical setting of the suffering and crucifixion of Christ, based either on biblical texts or poetic elaborations. This incident in the life of Jesus became a major traditional event among the Sri Lankan Christian community and it created a distinct musical style. This research mainly focused on examining and protecting the unique features of the "*Pasan gee*" in the village *Wahakotte*, (situated in *Matale* district, Central Province) where King Rajasinghe II (1635-1687) settled down the captive Portuguese people who fought against him. These Portuguese people were Roman Catholics and earned their living by interacting with the established Buddhist community. Prose of *Pasan* verses is included in the book named "*Deshana namaye pasan potha*" (Nine Sermons Passion Book), written by Fr. Jacome Gonsalves who arrived in Sri Lanka during the Dutch era. The subject matter of *Pasan* songs is the passion of Jesus and the lamentation of his mother, Mary. The verses are composed with Sinhala and Sanskrit words and sung in sorrowful tunes. These songs are transmitted orally from one generation to another. This qualitative research was mainly based on primary and secondary data sources including literature review, discussions, participant observations and personal interviews. *Pasan* singing in *Wahakotte* is a significant event and it has some unique features. Today, chanting of *Pasan* is fading away from many Catholic communities due to various reasons. This research provides insights on identifying idiosyncratic features of *Pasan gee* singing in Wahakotte.

Keywords: *Pasan gee,* Sri Lankan Portuguese, Village Wahakotte, Fr. Jacome Gonsalves, Unique Features of *Pasan gee*

Ritual-Based Theatrical Methodology for Enhancing Political Consciousness in Sri Lanka

C.P. Gunamunige

*Department of Fine Arts, Faculty of Arts, University of Peradeniya,
Peradeniya 20400, Sri Lanka
priyanka.chamila@gmail.com*

The concept of *counter-hegemony* of Antonio Gramsci *(Adamson, 1983)* is significant for Sri Lanka where the hegemony relies on pre-democratic ideology. Introducing a democratic *counter-hegemony* against the racist, religious ideology is vital for Sri Lanka. Theatre would play a crucial role in making this democratic counter- ideology. However, building a counter ideology using theatre would be problematic because of the distance between the theatre and the people. Antonin Artaud *(Artaud 1994)* remarked that the public moves away from the theatre since it solely depends on the text. Hans-Thies Lehmann *(Lehmann, 2006b)* elaborated on the significance of *performance textuality* that does not depend on the script. The text-based theatre repeatedly addresses selected audiences who are conscious of the matter of pre-democracy in Sri Lanka. That is why the structure of ritual base theatre is important in this research. The main objective of this research is to suggest ritual structure as a medium to approach the people for enhancing the political consciousness. This research found that the rituals like *18 Sanniya* builds the relationship with the audience by gestures and movements rather than text. Even the dialogues used therein have no high literature in them. According to the traditional discourse, the hidden objective of the *18 Sanniya* is to undermine the dominance of the demon using gestures and simple conversation. There is strong evidence that a socio-political message can be conveyed consciously or unconsciously to the society using the structure of the rituals. A large crowd gathers to see events such as *Gammadu* and *18 Sanniya* since they have a high cultural value in the rural environment. This cultural value is significant to bring the audience back to a performing space. This paper was conducted based on field research and using the theories of the *avant-garde movement* and *post-Marxism*.

Keywords: Ideology, Performance textuality, Democracy, Avant-Garde, Rituals

Sinhala-English Code-Switching in Text Messaging: A Study Based on Undergraduates of Two State Universities in Sri Lanka

S.T.A. Wickramasinghe

Department of Interdisciplinary Studies, Faculty of Engineering,
University of Sri Jayewardenepura, Ratmalana 10390, Sri Lanka
sajini1995@gmail.com

This study examines the phenomenon of Sinhala-English code-switching in mobile text messaging among undergraduates of two state universities in Sri Lanka. The key objectives of this study are to identify the empirical idea of code-switching and bilingualism, to identify the factors that affect code-switching and to identify functions of code-switching and how it can be used for effective communication. The research questions are directly reflective of and based on the key objectives acting as mini components of the research questions of the study. The current study aims to investigate functions performed by code-switching and factors affecting code-switching in text messaging among undergraduates. A mixed methods research design was adopted. A sample of 40 male and female undergraduates was selected from University of Colombo and University of Kelaniya for this study. A corpus of 1500 text messages was collected and a content analysis was carried out in order to explore functions of code-switching. A questionnaire based on five hypotheses with regard to social factors and social dimensions was distributed in order to examine factors affecting code-switching. The questionnaire included fifteen Likert scale questions. The data was analyzed through the correlation analysis to study the strength of the relationship between the two variables using the SPSS software. Findings of the study revealed eight functions of code-switching and five factors affecting code-switching in text messaging among undergraduates. The study revealed that the undergraduates exhibit the ability to move back and forth between the two codes depending on their communicative needs and code-switch the most when using academic and technical terms, and for various sociolinguistic functions. The results of this research represent an essential step towards understanding the functions of Sinhala-English code-switching in computer-mediated communication.

Keywords: Code-switching, Text messaging, Undergraduates, Bilingualism, Factors, Functions

Language, Culture and Thought

Influence of Impressionism in Digital Photography

M.M.S.B. Manamperi[1*], D.C.V. Fernando[1],
G.V.H.M. Madhumali[3] and D.S.A. Munasinghe[2]

[1]Department of Fine Arts, Faculties of Humanities
[2]Department of Archaeology, Faculty of Social Sciences
University of Kelaniya, Kelaniya 11600, Sri Lanka
*[3]Department of Geography and Environmental Management, Faculty of Social Sciences
and Languages, Sabaragamuwa University of Sri Lanka, Belihuloya 70140, Sri Lanka*
*sachithbm@gmail.com

Impressionism is a 19th-century art movement. Characteristics of Impressionist paintings include relatively small, thin brush strokes, open composition, the depiction of light, ordinary subject matter, the inclusion of movement, and unusual visual angles. The research question was to investigate how impressionism can be recreated in Digital Photography. In the 1890s, a group of photographers formed a movement called Pictorial Impressionism and they aimed to bring Impressionism to photography through a range of post-camera treatments such as combining multiple films slides to one another to create multiple exposure photos. The new technology of the camera and using some of the similar ideas combined with the camera can introduce impressionism to photography. Further, it expects to show the photographs through the lens by using new technologies which are drawn on the canvas by brushers of impressionism painters. The study was conducted under the qualitative research method based on textual studies and painting, photography-based sources, and some experiments on taking photos using some techniques such as using slow shutter speed combined with camera movement, multiple exposures, seeking various colors and reflections to get impressionism photographs. Therefore, this research shows impressionism photography through a new dimension by studying impressionism artists and their creations. We also examined the importance of digital postproduction, especially using color enhancements to balance and harmonize colors in evoking emotions. Research objectives were to identify the influence of impressionism on photography, to explain the technical procedure of impressionism photography both digital and Manual, and to identify contemporary digital impressionist photography trends worldwide. The conclusion of this study is impressionism photography is a creative and artistic style of spontaneity and control, but most of all freedom. Being relaxed about photography means, there will be more openness to ideas and creativity. This unstructured approach to photography is a means of letting curiosity lead to discovery.

Keywords: Colour photography, Digital photography, Impressionism, Photography lighting, Slow shutter photography

Fundamentals of Sustainable Development: A Philosophical Study with Reference to Taoism and Confucianism

N.M.B.P.K. Karunathilaka

*Department of Philosophy, Faculty of Arts, University of Peradeniya,
Peradeniya 20400, Sri Lanka
buddhinipoornima@gmail.com*

Sustainable development is one of many important topics to be discussed in the last few decades. The topic first emerged in 1987 with the report, *Our Common Future* by the United Nations. Sustainable development has been expressed under four areas: Economics, ecology, politics, and culture. It is possible for us to fulfill seventeen sustainable development goals (SDG) by 2030. Both Confucianism and Taoism developed from the hundred schools of thought in the ancient Chinese tradition, and have been revived as alternatives to the western idea of sustainable development. Even today, underneath the Chinese tradition, it is possible to find the foundations of these teachings. The research problem of this study is to inquire whether it is possible to use Taoism and Confucianism teachings to achieve SDG Goals. The objectives of this study are to explore the wisdom of Lao Tzu and Confucius respectively, to identify their connection to modern sustainable development, inquire the issues related to sustainable development and to give suggestions that can be used to enhance the effectiveness of the process of achieving SDG goals through the light of Taoism and Confucianism. *Tao Te Ching*, *Analects*, and the report *Our Common Future* have been used as primary sources in this study. In this study, the textual, descriptive, and comparative methods have been used as methodologies. Confucian principles such as governance, education, social morality, humanness, filial piety, duty, and loyalty along with the teachings in *Analects* and the *Taoist* principles as *Tao* and *Te*, *Wu Wei*, *Ziran*, and the three treasures, along with the teachings in *Tao Te Ching* are used in this study to derive both Confucianism and Taoist principles towards sustainable development.

Keywords: Sustainable development, Taoism, Confucianism, SDG goals

Aesthetics Emerging from Tension between Existentialism and Marxism as Depicted in Dharmasena Pathiraja's Cinema

E.S.A. Mahagamage

Postgraduate Institute of Humanities and Social Sciences, University of Peradeniya, Peradeniya 20400, Sri Lanka
erandamahagamage@gmail.com

'What is human existence?', the dialogue in the philosophy turned to art, raises a basic question. A fundamental argument of existentialism is that it opposes any kind of system. In this way, in the continental philosophy, there is a tense relationship between Existentialism and Marxism. That is, Existentialism rejects any form of systematization. Behind this opposition in particular is the opposition to rational understanding of human existence and the expectation of the complete freedom of the individual. Marxism is opposition to class society, liberal democracy, and capitalism. Although Existentialism does not agree on these issues, it does have a vague connection to Marxism. The works of thinkers such as *Jean-Paul Sartre, Merleau-Ponty and Friedrich Nietzsche* were used as the theoretical backdrop to the research. The writings of *Herbert Marcuse* were also utilized to broaden this conversation. Literature review and content analysing were the methodology of this research. *Dharmasena Pathiraja*'s cinema is known in Sri Lanka as a leftist cinema. But our view is that his cinema combines Existentialism with Marxism and builds an aesthetic. In his cinema, we can see the Existentialist approach in the young couple who are looking money for abortion in the film *Para Dige* (1980), as well as in the character of Weerasena in the film *Bambaru Avith* (1978) and in the soldier in the film *Soldadu Unnehe* (1981). They raise the question of existence. Also, Pathiraja's cinema is oriented towards the Marxist view of class inequality. Therefore, I would argue that Pathiraja's cinema is in a middle ground between constitutionalism and Marxism.

Keywords: Existentialism, Existence, Marxism, Systematization, Capitalism

iPURSE 2021 – 358   *Language, Culture and Thought*

Learner Invisibility as Success Factor in Online ESL/ESP Learning

R.I. Vithanage[1]* and N.M. Kalugampitiya[2]

[1]Department of English Language Teaching
[2]Department of English, Faculty of Arts
University of Peradeniya, Peradeniya 20400, Sri Lanka
*ramya_vithanage@yahoo.com

During the Covid 19 pandemic, many courses/programmes conducted in physical classroom settings were moved to online platforms. This sudden and abrupt move posed many unexpected challenges to both students and teachers; at the same time, it has opened interesting new avenues for the learning/teaching process. The present study focuses on a course in Business English conducted in Kandy under a grant from the State Department of the United States. This course, which was of 12 week-duration and had a studentship of 24 (19-35 years of age; post-GCE [A/L] to professionals; lower-middle class to middle class), met for a total of 24 hours (2 hours per week) via Google Meet, with the video facility switched off, while the lesson materials and assignments were posted on Google Classroom. Although the facilitator (36 years old, middle-class, female, Sinhala-English-Tamil competent) started the course with doubts about the future of the endeavour, the course turned out to be successful—relatively more successful than the in-person courses conducted in the previous years under said grant. The students showed greater active participation in class discussions and demonstrated enthusiastic engagement in journal entry assignments, which they submitted on a weekly basis. The end-course survey completed by all the students and the informal interviews conducted with 8 randomly selected students pointed to the invisibility of the learner in online learning as a primary reason for the higher success rates. This aspect was further probed in a subsequent informal focus group interview (FGI) conducted with the 8 students interviewed previously. Basing itself on existing literature/theoretical premises on the extra-linguistic value associated with English in Sri Lanka, the paper discusses the insights that this 'discovery' provides into the position of English and the nature of ESL/ESP (English as a Second Language/English for Specific Purposes) education in the country.

Keywords: Online learning, Student identity, Learner invisibility, ESL, ESP, Google Meet, Google Classroom

A Comparative Study Based on Two Translations of *Lovada Sangarava* Translated by Bhikkhu K. Nanananda and Kiri Banda Arawpola

S.A.T.A. Senevirathne[1] and I.H. Ihalagama[2]*

[1]Department of Official Languages, Rajagiriya 10107, Sri Lanka
[2]National Institute of Business Management, Kurunegala 60000, Sri Lanka
*harshiniihalagama@gmail.com

This research is conducted to identify various techniques used by two different translators when translating *Lovada Sangarava* into English. *Lovada Sangarava* written by Venerable Weedagama Maitraeya Mahathera is considered one of the major literary works that contains teachings of Buddhism for a better life. In this study two translations of *Lovada Sangarava* by Bhikkhu K. Nanananda and Kiri Banda Arawpola have been considered to analyse the effectiveness of the techniques used in the translations. This study answers the research question what kind of techniques have been used when translating the poems from Sinhala to English and how effective are they in comprehension of their meanings. Further, this research aims to identify different translation strategies used, meanings of the poems and the impact of the translation on the reader when understanding the message conveyed. Both qualitative and quantitative approaches were utilized when conducting the research. To identify the translation strategies and the differences in the two translations, comparative and content analyses were conducted. Then, 40 poems selected randomly were given to a selected group of readers to determine their effectiveness in relation to the level of comprehension. According to the findings, the translator Bhikkhu K. Nanananda has given much attention in communicating the message rather than the structure of the poems. Thus, the translator has converted the poetry into prose emphasizing the moral message. In contrast, the translator Kiri Banda Arawpola has focused on the presentation and used several complex words and phrases that are not familiar to ordinary readers and he has attempted metrical translation although it has not been successful. Moreover, many borrowed terms can be identified in both the translations. Further, the majority of the readers found the translation by Bhikkhu K. Nanananda simple and easy to understand because of the structure and the words used. Accordingly, when translating a literary work, appropriate techniques should be used considering different aspects such as the audience, nature of the text and the objective of the original author.

Keywords: Strategies, Translation, Effectiveness, Poems

Meaning-Based Approach to the Study of New Varieties of English

N.M. Kalugampitiya

*Department of English, Faculty of Arts, University of Peradeniya,
Peradeniya 20400, Sri Lanka
ranga.kalugampitiya@arts.pdn.ac.lk*

The claim that Sri Lankan English (SLE) is a legitimate variety of English has gained popular and scholarly attention over the years. The scholarly contributions made by a number of Sri Lankan scholars in the field have resulted in establishing SLE as an area of academic focus. The fact that the English Honours programmes of a number of leading universities in the country have given a significant place to the idea of SLE in their curricula indicates the important position that SLE has come to occupy in the local academic setting. A strong case has already been made for SLE as a legitimate variety of English, which is equal to, and sometimes even more dynamic and resourceful than, the so-called standard varieties of English. Nevertheless, the idea that SLE, like many other NVEs, represents a 'deviation' from the 'standard' varieties of English and that the former is largely inferior to the latter defines the general perception regarding SLE to a great extent. The paper argues that the perceived inferiority of SLE in particular and the NVEs in general is an inevitable outcome of the employment of the structure-based approaches to the study of NVEs, which treat language primarily as form/structure. It explores how a meaning-based approach could be used to dispel the idea that the NVEs are degenerated forms of English. It specifically looks at the concept of fulguration proposed by Thiru Kandiah (1998) as a useful framework for such a meaning-based approach to the study of SLE.

Keywords: Sri Lankan English, NVEs, Fulguration, Error, Language structure, Semantics, ESL

A Critique on Leonard Woolf's Reinforcement of Orientalist Stereotypes

K.G.D.W. Nandasena

Faculty of Arts, University of Peradeniya, Sri Lanka
dinisinandasena@gmail.com

Edward Said argues that "the relationship between the Occident and the Orient is a relationship of power, of domination of varying degrees of hegemony". He claims that the colonial discourse is fundamentally based on binary type of thought grounded on dichotomies such as "self/other", "colonizer/colonized" and "east/west". This binary way of construction implies a hierarchical conception, according to a superior status to the colonizer/"self" and a subordinate status to the colonized/"other". Although Leonard Woolf does not reinforce these orientalist stereotypes intentionally, a thorough analysis of his fictional and non- fictional work can reveal that his writings bring out his internalized conceptions as Freudian slips. The dehumanized portrayal of the colonial subjects in Woolf's work can be read along the aforementioned notions of the theory of orientalism. The colonizers are always presented as primitive, barbaric creatures who are intellectually void and are more often than not likened to animals. The vast intellectual disparity between "the self" and "the other" is openly emphasized by Woolf. He presents the village which is a microscopic representation of the "colony" / "the orient" as a land of mysticism and superstitions. Objectification of "the other" as exotic is also another primary orientalist stereotype that can be found in Woolf's work. These representations, although done "unconsciously", can be identified as a part of the political agenda of which Woolf is also a part. The political motive behind the reinforcement of orientalist stereotypes is to justify imperialism and the "civilizing mission" which was projected as the "White man's burden". This paper discusses a few of such orientalist stereotypes which are reinforced by Woolf in "Village in the Jungle", "A Tale Told by Moonlight" and in his autobiography; "Growing".

Keywords: Orientalism, Freudian slips, Stereotypes, Imperialism, Binary

Guttila Kāvyaya: Insights to Re-Imagine Modern Sinhala Literary Culture

C. Somirathna

Faculty of Graduate Studies, University of Kelaniya, Kelaniya 11600, Sri Lanka
c.somirathna@gmail.com

The 9th century poetic text Siyabaslakara carefully adopted the *Kāvyādarśa of Dandin* (7th c.) with the intention of laying a foundation to form a Sinhala poetic tradition which is culturally familiar to the local while absorbing elements from metropolitan traditions. *Guttila Kāvyaya,* composed by Rev. Weththewe in the 15th century, is one of the most controversial literary texts in Sinhala literary history which, in a way, exemplified the project of *Siyabaslakara* and also extending it by significantly deviating from the norms of classical Sinhala literary tradition and being open to both local and metropolitan traditions. Written in the end of precolonial period, re-appropriating both the Sanskrit as well as folk literary traditions, *Guttila Kāvyaya* provided insights into an upcoming issue in the field of local literary tradition, namely, the challenge of creating "our own" literary tradition, amid the tension between different political and literary ideologies such as nostalgia for old traditions and equaling Western values to modernity within the discourse of colonialism and postcolonialism. The comments and criticism on this text since the latter half of the nineteenth century, by prominent critics such as James de Alwis, Batuwantudawe Pandituma, W.F. Gunawardhana, Ediriweera Sarachchandra, Martin Wickramasinghe, and Gunadasa Amarasekere in the Sinhala literary culture demonstrate this fact. Thus, *Guttila Kāvyaya* makes a significant contribution to enrich the discourse of modern Sinhala literature and criticism by demonstrating the ways in which we can understand and learn from different literary traditions without suppressing the local tradition. This qualitative research explores how *Guttila Kāvyaya* provided insights for the creation of modern Sinhala literary culture and what present-day literary persons can learn from it regarding dealing with literary knowledge coming into the Sinhala literary tradition from elsewhere.

Keywords: *Guttila Kāvyaya*, Postcolonialism, Sinhala literary culture, Modern Sinhala literary criticism, Re-appropriation

Language Power Game: Towards a More Inclusive Approach in English Language Testing

S. Marasinghe

Postgraduate Institute of Humanities and Social Sciences, University of Peradeniya, Peradeniya 20400, Sri Lanka
sachini_marasinghe@yahoo.com

The field of English language testing has been gaining traction over the years in an increasingly globalized world. The demand for English language testing is such that it has become a commercially lucrative industry with tests being conducted/taken for purposes of immigration, higher education, employment, etc. This phenomenon of English language testing sheds light on the hegemony of English as well as the hegemony of testing itself as will be examined in the paper. Both the English language and the processes of testing can be used as tools of social control and domination as has been demonstrated throughout history. Regarding English language testing specifically, critics have noted that while much is being said about the need for expansion and diversity in English language teaching and learning, the discussion on diversity in English language testing falls far short of this. The study examined preparation and testing materials for the International English Language Test (IELTS) and the Test of English as a Foreign Language (TOEFL), two hugely popular and widely accepted tests in the field. Testing materials geared towards preparing students for university entry (hence, only the Academic Module of IELTS) were examined to better understand the gatekeeping mechanisms taking place through language assessment. The need to go beyond expectations of a native-like "standard" version of language in testing and preparatory materials was identified. The study was conducted from the point of view of a Sri Lankan English speaker but its implications may be relevant to test takers from a variety of contexts. Fairness and justice are essential qualities in the field of testing; especially in a context where the test score has many real-life implications as is the case with IELTS and TOEFL. The creation of a more inclusive and more expansive space within which one can demonstrate one's English proficiency is thus recommended.

Keywords: Language testing, English, Hegemony, Power

Reconstructing Situated Learning Theory in an ESL Classroom

R. Alfred

Department of English Language Teaching, University of Jaffna,
Jaffna 40000, Sri Lanka
riophilla@univ.jfn.ac.lk

Situated learning theory is an alternative theory to dominant cognitive perspectives on learning. This theory outlines that knowledge should be delivered in authentic contexts of practice for effective learning, wherein, students engage in increasingly more complex tasks within social communities. ELT practitioners have remarked that this theoretical approach has flourished as an engine for regenerating the understanding of, and prescriptions for, how knowledge is developed and organized within workplaces. This further suggests that learners should be involved in authentic settings of daily practice, applying knowledge, and making use of artifacts in productive but low-risk ways. This also requires social interaction and collaboration within the "community of practice". In a process that usually occurs unintentionally, the learners gradually move away from this community to become engaged in more dynamic and complex activities and transition into the role of expert. To explore the theory and reconstruct it in her classroom, the researcher attempts to find out the practicality of this learning theory in the classroom. Using a mixed method approach, the researcher employed an intervention with the undergraduates of the University of Jaffna who offer Translation Studies as their core subject. The participants of the research were administered open ended pre-questionnaires and post-questionnaires before and after their intervention. Pre-tests and post-tests were also conducted. To investigate the perspectives of the teachers, another questionnaire was administered. The data collected from both the questionnaires, and pre- and post- test marks were used to analyze the findings. The marks were compared using SPSS software and the text in the questionnaires were decoded and analyzed. In the analysis it was found that the students diffuse, produce and transform their knowledge through situated learning strategies. The final results show that situated learning theory makes learning meaningful and the methods encourage students' learning and are 'promising' from the perspectives of teachers as well.

Keywords: Interaction, Learning, Practicality, Productive, Situated learning

Understanding the Need to Integrate a Gender/Feminist Perspective as a Key Element in Framing/Shaping English Language Teaching/Learning (ELT/L) Experience, Trajectories, and Outcomes

O.P.S. Anuradha* and J.A.K.M. Jayasinghe

Department of English Language Teaching, University of Peradeniya, Peradeniya 20400, Sri Lanka
*shani.uop@gmail.com

Building on the argument that ELT/L is not only a linguistic process but also an ideological one, and that the very nature of the ELT/L classroom makes it an ideal space to drive values-based education, this study emphasizes the need for ESL textbooks to engage students in a process of uncovering and confronting gender inequities while developing positive attitudes towards the ELT/L process. This is a qualitative study that builds on a parallel research study conducted with the intention of promoting critical pedagogic practices in ELT/L where it was observed that school ESL textbooks (grades 03, 05, 07, 08, 10, 11) not only fail to combat prejudices and biases against women, but also actively promote and perpetuate gender inequalities, reinforce gender stereotypes with regards to division of labour in private/public spaces and career choices and aspirations, and often characterize women as incapable of agency. This study (1) identifies and analyses problematic gender depictions in ESL textbooks, (2) illustrates why the ESL classroom is an ideal space to drive a values-based pedagogy and (3) discusses how the absence of gender sensitive content can affect all educational outcomes, based on the authors' experience as teachers and material designers. Owing to the Free Education Policy in Sri Lanka, in 2019, 50.2% of all school students and 66.4% of graduates were female. In such a context, it is doubly problematic that textbooks not only fail to include gender perspective into the curricular content but also actively promote and reinforce hegemonic patriarchal values and discriminatory treatment that disfavour students' learning experiences and negatively influence their career prospects and attitudes. Thus, this paper urges ELT/L practitioners and curriculum developers to redesign school ESL textbooks by integrating a values-based pedagogy that fosters gender equity as it will assist Sri Lanka to reap higher socio-political and economic benefits while aspiring to gender justice.

Keywords: ELT/L, ESL textbooks, Gender, Social transformation, Socio-political and economic benefits of education

Innocuous Representation of Problematic Art: Evaluating New Guises of Scientific Racism in an Exhibition of an Exhibition

L.D. Tennakoon

*Department of English, Faculty of Arts, University of Peradeniya,
Peradeniya 20400, Sri Lanka
layanvitennakoon@gmail.com*

The Field Museum of Natural History, Chicago opened the exhibition, *Races of Mankind* in the Hall of Man in 1933 that displayed 104 sculptures of Malvina Hoffman. The sculptures were of "racial types" from around the globe. Accusations of scientific racism followed this exhibition due to the display of non-whites in "primitive" setups. In 1969, this ethnographic display was shut down. However, in 2016, the museum re-opened it in a new guise; *Looking at Ourselves: Rethinking the Sculptures of Malvina Hoffman*. The seemingly profound task of the new exhibition was to address the impact of Hoffman's work on racial ideologies of the time, and to examine its relevance today when campaigns such as the *Black Lives Matter* Movement have gained traction. The purpose of this study is to analyze whether the new exhibition feeds into the reenactment of the colonial story under a different narrative. The location of the exhibit in the museum, the statements of the new curator, the preoccupations of spectators then and now of the body and genitalia of the racial other and the distorted origins of some of the fabricated sculptures and labels are factors that reveal this new form of racial fetishism. Assessments were made under the theoretical frameworks set forth by Coco Fusco in *English is Broken Here*, where she talks about the effects of the fabricated exhibition, *The Couple in a Cage: Two Amerindians Visit the West* on a 1990s' audience. Similar to Fusco's experiment, the new exhibit "invents" the racial other. Data and media were collected from the museum site as well as online sources to postulate the idea that even today, in one of the largest cultural institutions of the world, racial othering and racial fetishism take place to satisfy the whims of a predominantly Western audience under the facade of multiculturalism.

Keywords: Ethnographic display, Neocolonialism, Racial othering, Scientific racism

Grief as an Emotional Consequence of Civil Wars: A Comparative Study of Latin and Sri Lankan Poetry

P.G.D.A.I. Dhanapala

Centre for Classical Studies, Research School of Humanities,
Australian National University, Canberra ACT 2600, Australia
anushka.dhanapala@anu.edu.au

During the long years of Roman civil war (88-31 BCE), people suffered both physically and emotionally. It is believed that these sufferings ended with the victory of Augustus following the battle of Actium. There arises, however, a question about the attention drawn towards the long-term emotional suffering of the people during and after the Roman civil war. In just the same way, Sri Lankans suffered from warfare for nearly thirty years (1983-2009). Despite the attempts made to rebuild the country, there are complications in the emotional wellbeing of the Sri Lankan citizens affected by this war. In such a context, this study investigates the portrayal of grief resulting from civil war in Latin and Sri Lankan poetry and compares those representations in order to examine the emotional commonalities experienced by both poets and their contemporary society, despite the differences in culture and era. The study is based on a close analysis of selected poetry from Latin poets Vergil, Horace, and Propertius, and Sri Lankan poets Jean Arasanayagam, Kamala Wijeratne, Vivimarie VanderPoorten, and Sumathy Sivamohan. The close reading and comparison of selected poetry reveals that people suffer grief created by wars in similar ways, and that these intense sorrows cause rage, vengeance and anxiety, all of which are harmful to both individuals and the society. Nostalgic expressions and mourning for losses caused by the wars are also common in both cultures, with Latin and Sri Lankan poets using poetry as a medium to mourn their own losses, overcome trauma, and furnish emotional support. Thus, regardless of the difference in culture and era, people equally suffer due to the emotional complications created by wars and the contemporary poets have attempted to highlight the importance of addressing these issues to prevent their continuing effects.

Keywords: Grief, Civil wars, Rome, Sri Lanka, Poetry

Investigation of Ceylon Counterfeit Stamps Issued during British Colonial Period

D.Y. Ellawela

*Faculty of Graduate Studies, University of the Visual and Performing Arts,
Colombo 00700, Sri Lanka
dulshan49@yahoo.co.uk*

Forgeries and counterfeits have been associated with the philately industry since the beginning of stamp manufacturing. The majority of fakes in the philatelic market today are re-gummed, reperforated or bear forged overprints, and surcharges. The term "Postal counterfeit" is generally applied to a recreation of stamps for deceiving the government revenue. Most of the falsifications, especially those of uncommon stamps, are worth just a fraction of the genuine stamp value. The objective of the research is to evaluate the counterfeit stamps circulated in Sri Lanka, which had been used to swindle the original stamp issued during the British colonial timeframe from 1857 to 1948. The investigation has mainly focused on the counterfeit stamps published by the Department of Post of Sri Lanka, in their publication of 'Postage Stamps of Sri Lanka volume 1' and those stamps were mathematically evaluated against the genuine stamps with the elements of the artwork. For the process of the investigation on the aforementioned counterfeit stamps, particularly the veritable philatelic has been used from the collection that is in the author's possession. This paper evaluates the philosophical and aesthetic segments utilized in creating stamps as well as how those depictions had been embraced and assimilated in the process of counterfeiting. Furthermore, the techniques used to counterfeit the Ceylon Colonial stamps will be identified. Subsequently, the forged stamps will be identified and the identification techniques will be used to eliminate such counterfeits. In addition, further evaluation was done on Ceylon fake stamps and elaborated on the techniques that had been used for faking the stamps of the aforesaid timeframe and circulated among philatelists. The outcome of this research will enable to reveal the counterfeited stamps issued during the British colonial period and to take proactive measures to avoid their circulation.

Keywords: Counterfeits, Forgery stamps, Fake stamps, Error stamps, Perforation

A Philatelic Study during British Colonial Period in Ceylon
(Pre-Independence Period 1857-1948)

D.Y. Ellawela

*Faculty of Graduate Studies, University of the Visual and Performing Arts,
Colombo 00700, Sri Lanka
dulshan49@yahoo.co.uk*

When Ceylon was a British crown colony, the portraits of their monarch were utilized as the icon of Ceylon's postal identity in stamps that were published during 1857 and 1929. A wide variety of stamps has been issued including revenue and telegraph stamps until the affirmation of autonomy in 1948. The research examines the emergence, designs, printing, themes, and varieties of Ceylon postage stamps which were issued during the aforesaid time frame. The objective of the research is to evaluate the philosophical and aesthetic elements utilized in creating stamps and to show how those depictions have been embraced/assimilated. Moreover, the study also revolves around the occurrence of design analysis and blunders in stamp creation. Further, it investigates and reassesses the printing process used in publishing the Ceylon postage stamps with the help of three recovered historical printing plates from the author's collection. The principal goal of this research is to explore the philatelic history throughout the time frame of British occupancy, and the research hypothesis will be based on 15 years of antecedent studies gained through the accumulation of stamps and philately materials. The analysis is mainly predicated on visual evidence and literary proof. The outcome of this research will enable the classification of the Ceylon stamps that were published during the colonial timeframe on its shading assortments. In addition, new valuation formulas have been tabulated with key properties of a stamp and it will override the non-systematic evaluations, and also, the aforesaid tables will be introduced to the Department of Post of Sri Lanka. Additionally, the outcome of the Ceylon revenue stamps assessment will empower to catalogue the revenue stamps for the first time in Ceylon Philatelic history.

Keywords: British colonial, Postal stamp, Revenue, Telegraph, Valuation

Language, Culture and Thought

Impact of Digital Sound Recording Techniques on *A cappella* Music

R.M.J.D.K. Rathnayake* and M. Alawathukotuwa

*Department of Fine Arts, Faculty of Arts, University of Peradeniya,
Peradeniya 20400, Sri Lanka
dilushirathnayake13@gmail.com

The term *a cappella*, which means in the manner of the chapel, is derived from the Italian language. The usual application of this musical style is to choral music composed to sing without any instrumental accompaniment. The technological advancement acquired in the field of sound recording technology during Mechanical, Electronic, Magnetic sound recording eras altered the gospel music based traditional choral *a cappella* for new avenues to merge with the Digital sound recording technology creatively. The main objective of this study is to examine how *a cappella* music has been modified with the advancement of sound recording technology. In this case study, primary and secondary sources have been utilized to collect data. Compared to the early sound recording techniques and technologies, it is visible that the digital sound recording technology has dramatically changed the way of performance and production pattern in the field of music. As a result, *a cappella* choral tradition has also transformed to perform *a cappella* music individually rather than clinging to a choir, to record in-depth vocal spectrums due to the high-fidelity level in capturing sounds, to do recordings and make videos for *a cappella* versions via cloud computing and using mobile applications available for iPhones and androids. All these conversions resulted to emerge a new trend called Techno *a cappella* music style in the world. It came in to existence along with the advancement in sound recording technological methods such as multi track recording, overdubbing and also audio editing under the Digital Audio Work Stations (DAWs). Although these technological methodologies depict a massive contribution to popularise and uplift *a cappella* choral tradition, it relinquishes the exuberance embedded in live *a cappella* singing due to the gigantic involvement of technology. Finally, this study proved that the application of digital sound recording techniques has transformed *a cappella* music field in drastic ways.

Keywords: Techno *a cappella*, Digital sound recording, Overdubbing technique, Digital audio work stations, Performance

*Walauwa*s and Kandyan Dance: Development of Tricks and Tactics in Kandyan Dance between 1900 and 1950s

S. Mantillake[1]* and A.P. Sirisena[2]

[1]Department of Fine Arts, Faculty of Arts
[2]Postgraduate Institute of Humanities and Social Sciences
University of Peradeniya, Peradeniya 20400, Sri Lanka
*sudeshm@arts.pdn.ac.lk

Walauwas are the residence of Kandyan aristocrats (*radala*). It has also been operated as a cultural site where dance and drumming were showcased. After the 1870s, Kandyan dance that was only performed in rituals such as *Kohomba kankariya* became a source of entertainment for foreign and native dignitaries. British colonial officers, European entrepreneurs, and Kandyan aristocrats set the stage for the profane aspect of Kandyan dance by bringing it to the entertainment arena. This paper examines the interaction between aristocrats and hereditary dancers when they performed in *walauwa*s, focusing on the period 1900-1950s. This research bridges methodological approaches from ethnography and history. In-depth interviews, lived through experiences were put in discussion with historical records and analysed incorporating postcolonial theory. We argue that dancers introduced tricks, gestures, and tactics such as erotic movements, ridiculous drumbeats, vocal improvisations to attract the audience that contributed to the development of the entertainment aspects of Kandyan dance. We also demonstrate how the competition among dance *parampara*s set up by *walauwa*s became heated, and sometimes male dancers were criticized by rival dancers for trying to attract the female aristocrats of *walauwa*s by performing tricks (*prayōga*) that do not exist in the tradition. The findings of this research enrich the current understanding of the aesthetics of Kandyan dance, mainly its entertainment aspects developed in the colonial condition. Through dance events in *walauwa*s, parameters for attractive dances were set up, and performers were encouraged to find new ways to attract their audience. In these events and competitions, dance families who predominantly performed in popular entertainment events received the audience's attraction than the members of the families primarily performed as ritualists. While aristocrats set them up for the competition to get the best performances, dancers also used this opportunity to express themselves and bargain their demands. These interactions happened in an atmosphere of fun, wit, and ridicule.

Keywords: *Walauwa*s, Kandyan dance, Tricks and tactics, Ridicule, Competitions

Language, Culture and Thought

A Feminist Approach to Modern Outcry of Social Activism within Coeval Capitalistic Regime – In Relation to Joker (2019)

J.M.A.K. Jayakody

Department of Languages, Faculty of Social Sciences and Languages, Sabaragamuwa University of Sri Lanka, Belihuloya 70140, Sri Lanka
ashajayakody511@gmail.com

The movie 'Joker' (2019) by Todd Phillips is an authentic portrayal of Penny Flake's psychological dilemma and her own victimization within contours of Hegemonic Capitalism that becomes a catalyst in inflaming the revolutionary instinct of Arthur. In Capitalist and Marxist dimensions, the movie exemplifies catastrophic consequences of Hegemonic Capitalism and the extreme trampling of the ordinary. The major objective of the study is to derive the impact of Capitalistic notions and the socio-political upheaval through a feminist perspective of Arthur's mother, Penny Flake. The research is predominantly qualitative in nature and the researcher deployed theoretical interpretations of John Stuart Mill and Karl Marx. According to the major findings of the study, the entire calamity of Arthur's life is woven around Penny's tale of Arthur's fatherhood. Penny's neurological disorder followed by her continuity of sending letters to Thomas Wayne reinforced the ambiguity inculcated by the powerful as saviors of the ordinary. Penny's over-confidence on Thomas Wayne characterized through her addiction to watch programmes of Wayne exemplifies her 'entrapment within contours of capitalism'. (Marx:1932) The deep vacuum left by the absence of the father figure and his inability to acclaim his position as a stand-up comedian motivates him to compensate through a revolution. The pathetic condition of his mother and the utile veneration of the affluent was amalgamated with Wayne's refusal of fatherhood that granted a culmination of a revolution that motivates to free from 'burdensome constrains of economy that surpasses opportunities and resources for individuals to act independently.'(Mill:1986). In a Marxist perspective, this depicts the revolution of the working class that overthrows the capitalist class and size to grant the control of economy articulated through deaths of Murray and Wayne. The findings of the study are reminiscent of the inequality and subjugation incorporated with the Capitalistic regime which is a ubiquitous approach.

Keywords: Capitalism, Feminist, Suppression, Socio-political, Revolution

Influence of Parents' Educational Condition on Students' English Language Speaking Skills in Higher Educational Institutions: A Case Study Based on Advanced Technological Institutions, Dehiwala, Galle, and Kandy

E.P.M.U. Edirisinghe

Sri Lanka Institute of Advanced Technological Education, Colombo 00100, Sri Lanka
madhawi@sliate.ac.lk

This research intends to study the influence of parents' educational level on students' English language speaking skills in Higher Educational Institutions. This is a case study based on three Advanced Technological Institutions (ATI) which come under Sri Lanka Institute of Advanced Technological Education. The parents' educational level refers to the educational qualifications based on the educational framework in the country, specifically Certificate level, Diploma level, Degree level and above. Many researchers of Asian and African continents proved that the parents' educational level makes a significant impact on students' language competence, and this research shows the situation in Sri Lanka. The objective of the study was to examine the impact of parents' educational qualifications on students' English language speaking skills. A sample of 300 students from ATI Dehiwala, Galle and Kandy, representing five Higher National Diploma courses was selected using a random sampling method. A Likert scaled questionnaire, oral test marks of the students, and structured interviews with the English and non-English academic staff have been used to gather data. The data was analysed using descriptive and correlation analysis. In the descriptive analysis, the central tendencies were used to describe the set of data, and correlation analysis was applied to investigate the impact of the two variables. The descriptive analysis shows that less than 20% of the parents have obtained higher education. The correlation analysis revealed that the impact between the parents' educational qualifications and students' English-speaking skills was not significant (.956), however, there was a positive correlation between the two variables (0.03). The lecturers' views illustrated that there was a positive relationship between the parents' education level and the students' language competence. These findings proved that the parents' educational condition makes an insignificant impact, and in the case of ATIs, most of the parents are incompetent in English to actively participate in the students' language proficiency.

Keywords: English, Impact, Parents, Speaking, Students

A Critical Study on the Impact of the Dutch on
Traditional Food Culture of Sri Lanka

N. Sugatharakkhitha[1][*]and A. Wimaladhammika[2]

[1]Department of Pali, Faculty of Language Studies, Buddhist and Pali University,
Homagama 10200, Sri Lanka
[2]Department of Pali and Buddhist Studies, Faculty of Humanities and Social Sciences,
University of Sri Jayewardenepura, Nugegoda 10250, Sri Lanka
[*]*sugatha.lk@gmail.com*

Traditional and indigenous foods of Sri Lanka have a well-reputed, unique and long history. This food culture was further enriched due to the colonial experience as Sri Lanka was a colony under the Portuguese, the Dutch and the British. When taking the land size of Sri Lanka into consideration, it can be seen that Sri Lanka has a great variety of foods. The Dutch were invited by Sri Lankans as their protectors in the intention of fighting off the Portuguese. This study explores the impact of the Dutch colonization on the traditional food culture of Sri Lanka. The study was carried out on a mixed sample comprised of 20 Sri Lankans representing both Dutch Burghers who are an ethnic group in Sri Lanka that descended from the Dutch, and the other Sri Lankans residing in Colombo. The research methodology includes a comprehensive questionnaire that was handed over to the sample to obtain both qualitative and quantitative information on the impacts of the Dutch on the traditional foods in Sri Lanka. The results revealed that the various food items which were influenced and survived from the traditional Dutch culinary can still be seen in contemporary Sri Lanka. These foods include *kokis,* which is a type of hard cake or crispy cookie that is made of coconut milk and rice flour, the *lamprais* and other culinary wonders such as *Sukiri* (Sugar Lumps), *Pani-Kaju* (Nut Toffee) and *Ismoru* (Beef Curry). Furthermore, the research revealed that colonization had an impact on the loss of traditional knowledge pertaining to preparation, production, processing, harvesting and the use of food and other food-related practices of pre-colonization. Nevertheless, Sri Lanka's unique island status with its wealth of fauna and flora which are the basic elements of foods, and the Dutch colonial dynamics have resulted in a rich and diverse food culture as a part of Sri Lankan identity and a noteworthy impact on the food culture in Sri Lanka.

Keywords: Dutch Burghers, Culinary, Traditional, Dutch, Food culture

Effect of Two Different Music Genres on *in-vivo* Germination of Tomato (*Solanum lycopersicum* L.) and Mung Bean (*Vigna radiata* L.) Seeds

H.A.T.U. Indrachapa[1]*, M. Alawathukotuwa[1] and C.K. Beneragama[2]

[1]*Department of Fine Arts, Faculty of Arts*
[2]*Department of Crop Science, Faculty of Agriculture*
University of Peradeniya, Peradeniya 20400, Sri Lanka
*tashikaudeshanisa80@gmail.com

Auditory cues are widely known to have either positive or negative impacts on plant growth and developmental processes. An experiment was conducted using tomato (*Solanum lycopersicum* L.) and mung bean (*Vigna radiata* L.) seeds germinated in acoustically shielded, partially thermally insulated, dark and humid growth chambers prepared for the purpose. The seeds were subjected to Tetrazolium test to assure the viability of the selected seeds. Each species of seeds was exposed to "Canon in D (Pachelbel's canon) cello and piano", a Western classical music piece and the "Rag Behag", North Indian Classical music genres for 12 hours from (8.30 a.m. to 8.30 p.m.) and for 24 hours. The selected music pieces of the two genres were within the same frequencies (D major Chord) and rhythms. The selected pieces of music were played using similar sized speakers to maintain equal sound levels. One untreated (no music) group was kept as a control. Germination-related parameters were measured until 5 days. The experiment was replicated three times to assure the reproducibility. The data was analysed using the SAS software. The results revealed that the Eastern classical music piece (played for 12 hours) has made a positive impact on all germination-related traits tested in mung beans, and the Western classical music piece (played for 12 hours) was the most effective on tomato seed germination. The results depict the influence of different music genres on the biological systems. The seed germination of both the species was suppressed when the musical pieces were played for 24 hours. The results of the present study support the applicability of the use of seed germination as a bioassay in healing energy studies for music therapy in the future.

Keywords: Seed germination, Tetrazolium test, Music therapy, Music genre

Memory and Built Space: Reaction of Contemporary Sri Lankan Visual Artists

S. Kirubalini

Department of Fine Arts, Faculty of Arts, University of Jaffna, Jaffna 40000, Sri Lanka
Kiru.nathan12@gmail.com

Contemporary Sri Lankan visual artists represent social and political issues around them through individual or collective experiences and memory. Meanwhile, the art forms are also wide-ranging based on the theoretical and conceptual approaches of each artist. Themes of many contemporary artists are related to narrating "Memory of war and violence" in different ways. In our country, many studies have been done on the relationship between memory and the field of arts. A Virtual Museum has also been initiated to bring art initiatives and multimedia resource material together in one place. Memory studies is one of the interesting topics in humanities and social science studies. Without memory, humans cannot exist; we relate our memories not only with objects and people, but also with space and architecture, space and architecture can have an impact on individual memories as much as on collective memories. In this background, this research is focused on the relationship between memory and visual artwork by six selected contemporary visual artists from Tamil speaking regions of Sri Lanka. The aim of the study is to analyse the relationship between the representations of each artist and memories behind the built spaces such as memorials, public buildings and houses or which were considered as house. The research extensively focused on the ways in which the artists embody memories through book art, installation, drawing, collage and mixed media, and the social, political, personal background influenced on their art works. The author comes from an Art History background and has attempted to answer these research questions using pictorial and analytical works from multidisciplinary approaches and applying memory theory. This Research paper reveals how the narrative of a built space has been transformed by artists and how the artists (re)visit, (re)shape, (re)store and (re)build memory.

Keywords: Memory, Personal, Collective, Context, Built forms

A Personal Overview of Online Language Teaching: Possible Ways of Minimizing Challenges When Teaching an Online ESL Class

W.S.A. Wanniarachchi*, J.A.K.M. Jayasinghe and R.I. Vithanage

Department of English Language Teaching, University of Peradeniya, Peradeniya 20400, Sri Lanka
*sahan.anushka55@gmail.com

The abrupt transition from face-to-face classroom teaching to online teaching during the Covid-19 pandemic changed many aspects of teaching in general and language teaching in particular. In this present paradigm shift, based on the premise that teaching itself is an experiment, this study proposes some suggestions to shape online language teaching into a more innovative and successful endeavour ensuring that virtual English as a Second Language (ESL) classes are a safe and an enabling learning space for students. The study focuses entirely on a personal overview of the online language teaching experience of two ESL Instructors and a Lecturer attached to the University of Peradeniya. Focusing on their perceptions and teaching experience, the study presents a demonstration of an online/smart device-friendly ESL grammar lesson modelled addressing the issues faced in a virtual classroom with possible suggestions to minimize said issues such as lack of participation, interaction, motivation etc. The study also provides suggestions for successful rapport building through formal/informal surveys on students. Online teaching platforms may not necessarily provide a friendly site for rapport building; however, the teacher must achieve this target in order to make teaching successful. Therefore, it is essential for the teacher to have a clear understanding about his/her students in terms of the 'extra-linguistic' baggage they carry. Having some idea about these attitudes will enable the teacher to adapt a more sensible approach to cater to student needs. The study concludes with the hope of facilitating the teaching learning process through modelling lessons to suit online platforms and through formal/informal surveying. It is expected that these aspects would foster positive attitudes, the ability to adapt to different situations, and the ability to reflect on and learn from experience related to teaching in online platforms.

Keywords: English as a Second Language (ESL), Online teaching, Rapport building, Teacher responsibility

Possibilities and Limitations of Sri Lankan Ritual Theatre for Conveying Alcohol-Related Health and Social Messages in a Community Intervention

N. Galkandaarachchi[1]*, S. Mantillake[2] and L. Senarathna[3]

[1]*South Asian Clinical Research (SACR)*
[2]*Department of Fine Arts, Faculty of Arts*
University of Peradeniya, Peradeniya 20400, Sri Lanka
[3]*Department of Health Promotion, University of Rajarata, Mihintale 50300, Sri Lanka*
nalingalkandaarachchi@gmail.com

The role of Sri Lankan ritual theatre in delivering public health messages to communities has been highlighted in previous studies and they discuss the ritual theatre's potential to reach communities effectively. This paper examines the possibilities and limitations of using Sri Lankan ritual theatre for conveying alcohol-related health and social messages (ARHSM hereafter) to rural communities. Selected ritual theatre forms were combined with modern theatre forms to develop a community intervention in Anuradhapura district. The study's theoretical framework was developed based on the Social cognitive theory and Extended elaboration likelihood model (E-ELM). Ritual theatres can raise the subtle issues of the village and discuss them dramatically. Empirical data and literature show that *Sanni Yakuma* and *Kolam* share similar characteristics, and they can be used as a theatre model to convey ARHSM. With the long-standing history of the rituals, this model can be culturally more appropriate. The interactive nature of the characters with the audience facilitates the role of them as Spect-actors. Such a role creates an opportunity for the audience to engage with the play and increase acceptability effectively. Despite of all these potentials, certain features of traditional ritual theatres such as 'humour' can be problematic for a theatre model when it focuses on complex issues such as alcoholism. When the theatre performances execute humour but not empathy on characters who have already faced social and health problems, the intended messages may not be conveyed effectively and may also create discrimination. For example, *Bada Daru Kolama* (the pregnant woman) and *Biri Sanniya* (the deaf demon) portray the main character as a fool in *Kolam* and *Sanni Yakuma*. Hence, elements such as humour in ritual theatre need to be carefully integrated to theatre-based interventions such as for conveying ARHSM as they discuss sensitive and complex issues.

Keywords: Ritual theatre, Modern theatre, Edutainment, Public health

Role of University Libraries as a Foreign Language Learning Center for Students: With Special Reference to Academic Libraries in Sri Lanka

R.A.P.S. Senevirathna[1]* and L.H.M.D.S. Lansakara[2]

[1]*Main Library, University of Ruhuna, Matara 81000, Sri Lanka*
[2]*Sri Lanka Institute of Advanced Technological Education,*
Anuradhapura 50000, Sri Lanka
*saku@lib.ruh.ac.lk

An academic library effectively contributes to the education, research, publication and knowledge preservation of a university. The key role of a library is to organize the information sources and assist the classroom-based learning, self-studies, research and publication. A library directly benefits the teaching-learning process as well. 'The library has shifted from a reading and book storage site to a center of interactive learning'(Steelcase, 2010). Presently, students are focusing more on learning and improving their knowledge on relevant foreign languages. The purpose of this study was to examine the availability of opportunities for the university undergraduates to learn different foreign languages, and whether the students were satisfied with appropriate information sources available in university libraries. An online questionnaire (Google form) was distributed among 180 undergraduates representing three State universities in Sri Lanka. The sample was selected through the non-probability purposive sampling method. The findings revealed that students are challenged by the unavailability of foreign language learning courses in most universities. Further, the participants also revealed that the students who are not learning a foreign language as a co-subject don't have time to spend in following a foreign language course. Scarcity of relevant foreign language books was also pointed out by respondents. It is recommended that universities introduce foreign language courses giving all undergraduates the opportunity to learn at least one foreign language during their period of study at a university. Furthermore, creating a digital collection inclusive of soft copies of literary texts written in different foreign languages is also recommended. Increasing online library service facilities, developing the audio and video resource collection of the library to offer students the opportunity to learn foreign languages through self-studies, has also been advocated through this study.

Keywords: Foreign Language Learning, University library, Language learning center, Information sources, Library facilities

Improvisation: A Tool to Increase Confidence Level in Speaking among Young English as Second Language (ESL) Learners

H.A.R. Aloka

Department of English Language Teaching, Faculty of Humanities,
University of Kelaniya, Kelaniya 11300, Sri Lanka
rajini.aloka@gmail.com

Many students in the Sri Lankan education system have recognised the need to learn English as it is considered a lingua franca in today's world. Yet, generally, due to psychological factors like inhibition, fear of making mistakes, and language difficulties, most learners find speaking in English challenging, and tend to be silent in English speaking classrooms. In that regard, improvisation as a drama activity can be used as an effective tool to boost the confidence level of the ESL learners. This paper presents a qualitative research on discovering the factors that lead to the development of confidence in speaking among young learners when utilizing improvisation in the ESL classrooms. The study particularly focuses on young learners primarily since none of the previous studies have investigated the effectiveness of improvisation in confidence building in speaking among young ESL learners. Thus, the study covers a lacuna in the field of ESL in Sri Lanka. Fifteen young ESL learners from age ten to twelve, studying for Cambridge Movers level examination and their teacher were the participants of the study. Prior to the intervention, a pre-interview session was held. The research was conducted in five sessions: a two hour session per week for a duration of five weeks. During the five weeks, the sessions were handled by the Cambridge teacher while the researcher remained as an observer. At the end of the intervention, a post-interview session was held. The findings of the study (through thematic analysis of the data) indicate that improvisation improves the confidence of young ESL learners due to three major factors: cooperative learning environment, non-threatening environment, and situational authenticity.

Keywords: ESL, Improvisation, Co-operative learning, Situational authenticity, Language anxiety

A Stress-Free War: Under-Representation of Post-Traumatic Stress in Sri Lankan Fiction on Armed Conflict

E.D.K. Seneviratne[1]* and V.K. Perera[2]

[1]Department of Sociology, Faculty of Arts, University of Colombo 00300, Sri Lanka
[2]The Australian National University, Canberra, ACT 2601, Australia
*esh.sen@hotmail.com

An exploration of contemporary conflict narratives focused on the Sri Lankan civil war suggests that writers do not adequately situate aspects related to stress disorders or related complications arising from conflict-induced post-traumatic conditions. The present study is anchored on two inquiries: primarily, it investigates the social, cultural, and creative reasons that contribute to a notable absence of post-traumatic stress disorder (PTSD) or related/relatable conditions in conflict-narratives. Concurrently, the study also aims at contextualizing this narrative-absence within the broader clinical and pedagogical discourse related to PTSD awareness in Sri Lanka. The study is instructed by two mutually-dependent methodological approaches which incorporate a close textual reading of selected conflict-related fiction, biography and memoir by Sri Lankan writers. It also consists of a qualitative analysis of related literature from a psychosocial approach. The study associates feedback and insights obtained through representative unstructured interviews with literary experts and professionals in psychosocial health. While previous studies have proposed a lack of public awareness and institutional support in the recognition and treatment of PTSD in Sri Lanka, the present study is focused in understanding how a community (such as writers) with high cultural literacy and social empowerment often downplayed, deselected, or showed scant sensitivity to PTSD as a post-conflict possibility. The study also emphasizes the place of PTSD as a cultural production and how literary narratives of the kind explored in the study contribute to the construction of a war narrative from which compelling social crises faced by combat-returnees and other victims are erased or suppressed.

Keywords: PTSD, Psychosocial health, Sri Lankan fiction, Sri Lankan war, Conflict-narratives

An Alternative Reading of the Figure of *Yasodara*

S.L. Amaranayake

Department of English Language Teaching, University of Peradeniya,
Peradeniya 20400, Sri Lanka
sachinie@mgt.pdn.ac.lk

Yasodara is a female figure that is discussed as one of the major characters in Buddhist narratives. She is introduced as the wife of Prince Siddhartha (the Buddha) who is said to have been born on the same day Prince Siddhartha was born. The figure of Yasodara is being continuously revisited and referred to (directly and indirectly) in Buddhist literary narratives. Her figure plays the role of a certain kind of "model" for females in contemporary (Sinhala Buddhist) literatures, in relation to the universal male model, Siddhartha. It is to be noted that two perspectives are often discussed in research in relation to the Yasodara figure: some identify her to be a docile wife, whereas a few attributes her with the characteristics of a "radical intellectual". This study examines and analyzes how Yasodara is represented in the selected modern-day narratives such as *Yasodaravata* (author anonymous), *Ama Wessa* (Jayasena Jayakody) and *Bava Tharanaya* (Martin Wickramasinghe) in an effort to understand how they identify, frame or delimit the position/ role of women by using the character of Yasodara as a guide for "moral" and "right" behaviour of women. The study also focuses on the possible ideological interpellation achieved by the dominant gender norms put into circulation by the contemporary narratives on Yasodara. While examining the common projections that are associated with the Yasodara figure, the study aims at producing an alternative reading of the character of Yasodara – using the "docile *but* deserted wife" point of view – thus presenting her as an agentive female figure whose individuality and agency have not been sufficiently addressed so far in the existing research/ literatures.

Keywords: Yasodara, narratives, Dominant gender norms, Individuality and agency, Ideology

Effectiveness of Using Animations versus Language Games for Teaching Verbs to ESL Learners

G.A.G.H. Ganepola

Aquinas College of Higher Education, Colombo 00800, Sri Lanka
gaviganepola@gmail.com

Competency in the English language is regarded as an important factor by the present society due to globalization. Therefore, the ESL/EFL speaking countries tend to focus more on developing the English knowledge of the learners using various methods deviating from the traditional teaching approaches to enhance the interest and motivation of the learners towards the learning process. A significant amount of research has been carried out to investigate the effectiveness of using different tools such as video clips, stories, animations, etc. Yet, fewer studies focus on investigating the most suitable tools that can be used for teaching different components of the language such as grammar, vocabulary, reading skills, oral skills, etc. Some of the ESL learners find learning 'verbs' difficult, confusing, and hard to remember which is a crucial part of grammar. Thus, this research used two methods; miming as a language game and animation which are proven to be effective by the previous research and focused on finding the more effective method out of the two for teaching action verbs for ESL learners. This paper deals with finding the answers to the research questions by experimenting on a group of forty students of grade four and another group of forty students of grade ten of Ambaraluwa Maha Vidyalaya, Sri Lanka. Two grades were used to find out whether there is any difference in the result due to the age group. Pre-tests and post-tests were used as the data collection methods and statistical analysis using SPSS t-tests and ANOVA were used for analyzing the data. The research highlighted that the students showed more interest in using animation rather than using miming as a language game which denotes that the learners of both age groups prefer methods that include technological devices over engaging in language games.

Keywords: Animations, Language games, Effectiveness, Verbs

Globalization and Re-Negotiation of Space and Belonging: A Study of Films *Parasite* by Bong Joon-Ho and *The White Tiger* by Ramin Bahrani

P.L.D. Boteju

Department of English, Faculty of Humanities, University of Kelaniya,
Kelaniya 11600, Sri Lanka
lihiniboteju@gmail.com

This research study attempts to examine the impact of globalization on the re-negotiation of space and belonging represented in the cinema of the global south. Perceived as one of the most contentious concepts within postcolonial studies, the framework of the centre and periphery has been deconstructed and reimagined within the discipline of globalization, where the new global landscape is characterized as extremely complex, overlapping and disjunctive. Following the waves of decolonization and the surge of cross-border movements, social theorists have diagnosed globalization as a disappearance of space that has engendered a tension between cultural heterogenization and cultural homogenisation within the global geo-political and socio-cultural arena. This is best epitomised via the cinema of the global south, where visual texts such as *Parasite* (2019) directed by Bong Joon-Ho and the Netflix cinematic adaptation of Aravind Adiga's novel *The White Tiger* (2021) directed by Ramin Bahrani investigate the forces of globalization, while signifying the manner in which the spaces of the centre and periphery remain in flux, immersing its inhabitants within a perpetual state of ambivalence of belonging/ non-belonging. This study argues that the normative centre-periphery spatialisations are impermanent and can be subverted via the examination of the geographical, ontological, ideological and imaginative spaces explored in the cinematic texts. Accordingly, this research study will conduct a textual-analysis while employing the theoretical perspectives from the discourses of globalization and postcolonial studies by Arjun Appadurai, Homi K. Bhabha and Benedict Anderson to destabilise the centre-periphery constructions portrayed in the said films. Therefore, this study attempts to comparatively analyse the cinema of the global south to expound upon the ways in which globalization has rendered global spaces as fluid, challenging one's belonging to such spaces.

Keywords: Globalization, Global South, Centre-periphery, Space, Belonging

Students' Perception on the Use of Zoom Technology for French Language Teaching: With Special Reference to Students in French Language Institute of Alliance Française de Kotte

R.S. Samarasinghe

Department of Modern Languages, Faculty of Humanities, University of Kelaniya, Kelaniya 11600, Sri Lanka
rasanjanasandamini@gmail.com

The online distance French language learning via zoom has become essential in the present day due to the COVID-19 pandemic in Sri Lanka. The objectives of this research are to examine the students' perception on the use of zoom technology for French language teaching and to find out socio-political and economic reasons behind their perception. The study is done with twenty Sri Lankan Sinhalese female students from the pre-intermediate level classes at the French language institute of Alliance Française de Kotte. The data were collected through questionnaires with open ended questions and interviews conducted via zoom. The method used is qualitative research where the data were analysed thematically focusing on the data driven themes. The findings of the study indicated that the majority of the students considered the use of Zoom in French language teaching as effective and efficient in terms of time and the current situation of the world. Even though technical issues, lack of collaboration, identity, expectations and distance are considered to be the major challenges in using Zoom technology for French language teaching, most of the students agreed that teaching French language via Zoom can help them in practicing language skills, acquiring new vocabulary and improving their understanding of the contents of the lesson. However, the results implicated the necessity to blend with classroom-based approaches rather than simply making zoom a substitute. In a time where the world is trying to cope with the COVID-19 pandemic, the study carried out is significant in developing strategies to teach French language effectively while identifying students' perception and to manage the challenges that they face while using zoom technology in French language learning.

Keywords: French language, Pandemic, Teaching, Zoom

Translation Techniques in Humour Translation: With Reference to 'Pride and Prejudice' and Its Sinhala Translation *Prēmayaka Arumaya*

K.L.S. Sewwandi

Department of Linguistics, Faculty of Humanities, University of Kelaniya,
Kelaniya 11600, Sri Lanka
suzan.liyanage@gmail.com

Literary translation is a creative process which involves translation of prose, poetry, and drama. Since literature is an embodiment of human emotions and feelings, translation of literary works is considered a challenging task. Translation of humour is one such area that is of paramount importance in translating literature. Jane Austen's Pride and prejudice which has been translated into many languages around the world is considered as a literary work rich with humor. The present study was focused on identifying the translation techniques that have been employed by Sita Kulatunga when translating humorous content into Sinhala. It also seeks to examine the techniques of humour namely; character caricatures, irony, and satire employed by the source writer in delivering humour. A qualitative methodology was employed, using existing theories of translation and excerpts containing humour in the translated text. The findings show that the technique 'literal translation' has been frequently employed by the translator. Since Sinhala is a language with diglossia, the use of high and low variety of language to emphasize humour portrayed by specific characters according to their social status was identified. Moreover, the translator has used colloquial terms and expressions in order to make the humorous content familiar to the target reader. The present study will provide insights into further research on translation techniques and their effectiveness when translating literary works rich with humorous content.

Keywords: Humour, Translation, Techniques, Literary translation

A Critical Evaluation of Techniques Used in Teaching English Grammar in ESL Classrooms in Sri Lankan Universities against Theoretical Perspectives in Focus on Form Approach

C. Arsakulasuriya[1]* and H. Alahakoon[2]

[1]Department of English and Linguistics, Faculty of Humanities and Social Sciences, University of Ruhuna, Matara 81000, Sri Lanka
[2]English Language Teaching Unit, General Sir John Kotelawala Defence University, Ratmalana 10390, Sri Lanka
**chandulaarsakulasuriya@gmail.com*

This study aims to critically evaluate the Sri Lankan ESL (English as a Second Language) university lecturers' teaching techniques in teaching English grammar in ESL classrooms against the teaching techniques theorized in Focus on Form approach. There is a huge research gap on studies done on teaching English grammar in Sri Lankan context. The majority of studies done on teaching grammar in Sri Lanka are restricted to error correction and interlanguage. The study assesses qualitative and quantitative data retrieved from structured questionnaires and interviews from the research informants of the study, university ESL lecturers. Focus on Form (FonF) is an approach which differs from Focus on Forms which is used in rote learning or grammar translation method or Focus on Meaning which is used in Communicative Language Teaching method. A preliminary research has identified that the course books and learning materials used in ESL classrooms in Sri Lankan universities are significantly informed by Focus on Form (FonF) approach. The findings of the study prove that dictogloss and interaction enhancement are the most popular grammar teaching techniques in ESL classrooms. The participants' responses show that the use of both explicit and implicit text input and both production based and comprehension based approaches work better for ESL students in Sri Lankan universities than the use of one single input and approach. The responses also show that the lecturers' predominant focus in teaching grammar is on the use rather than grammatical rules or meaning.

Keywords: Focus on form, English as a Second Language (ESL), Sri Lanka, Universities, Teaching grammar

Portals, Colonnades and Facades as Expressions of Dominant Taste?

G.R. Dissanayaka

Samkathana Research Centre and Archives, Faculty of Humanities,
University of Kelaniya, Kelaniya 11600, Sri Lanka
gangarajinee@gmail.com

The research is based on the process of preparing a natural cave for use and converting it into a temple. Among the research done on temples in Sri Lanka, Portals, Colonnades and Facades are discussed as ancillary parts. Both architectural research and art historical research has been done, but no research has been conducted from a socio-political perspective on patronage and frontal appearance. The research question here is whether there were socio-political interests that went beyond the mere religious need to create a cave temple, how was a cave converted to a religious space given the fact that the entire surface was uneven and had to be reshaped and the impression the *Viharaya* gives to a visitor when approaching it through jungle on an upward climb. The entrances were often not visible from below. How they were refurbished with a colonnade displaying a fascination for Colonial Architecture as seen in the example at Dambulla, is another concern of the research. Taking examples from *Mogao* in China, *Pindaya* in Myanmar, *Phnom Chhngok* in Cambodia, *Pakou* in Laos, *Aurangabad* and *Ajantha* in India, either a rocky area, a ridge or an existing natural cave was carved out to serve as religious space. Sri Lankan Cave Image Houses are the only caves carved out of granite or gneiss and are unique among the world heritage of Cave Image Houses. We concentrate on five Cave Image Houses selected from three provinces as a sample. The cave temples of *Dambulla, Selawa, Lenagala, Nuwarakanda* and *Ridigama* (*Ridi Viharaya*) have been identified by us as the façade and entrance displaying the power and identity of the sponsor. According to theory, the relationship between a place and a person and his taste is explained as an interdependent process, and this can be very clearly compared with the architectural creations at cave temple complexes. We note three ways of demonstrating power and prestige of the Cave Image House: Making the cave look bigger by constructing an overall veranda creating a vestibule or colonnade, constructing a two-section hipped "Kandyan Roof" constructing a high wall or a row of pillars covering the older walls, enlarging the entrance and the doorway and adding an impressive Makara Torana visible only from the vestibule or veranda. They represent the prevalent taste of the society at the time.

Keywords: Portals, Colonnades, Facades, Colonial architecture, Power

Implications of Multimodal Tasks in Teaching Critical Reading

M. Arivarasy

Department of English Language Teaching, University of Jaffna,
Jaffna 40000, Sri Lanka
arivarasy13@gmail.com

The term multimodality refers to the use of two or more modes in communication and meaning construction. The integration of multimodality into pedagogic practices implies a change of paradigm on how meanings are represented and constructed. University undergraduates rely on critical reading to fulfill different types of academic activities. Most of the L2 readers do realize the complexities and challenges of reading in different genres. This research focuses on teaching news item to students which is a kind of genre covering core academic knowledge, life and career skills, and information, media and technology skills. This study aims to find out whether the application of multimodality to teach critical reading specifically teaching news items is effective among students. For this research, fifty-four second year social science students from the Faculty of Arts were selected. The researcher chose recipient analysis and data were collected from questionnaires, focus group discussions and reflective journals. The researcher chose the agenda setting theory and recipient theory. Application of multimodality scaffolds students to access the meanings by introducing the functions of the texts as well as highlighting the strategies used in these texts. Though the multimodal approach creates the environment of critical thinking, there are often major conflicts of expectation. The affective domain and the territory of engagement are at the heart of classroom management. Engagement is often affected by 'teacher-space' and 'learner-space' in the classroom. Multimodal activities are seen as trivializing the seriousness of education. These methods are justified as irrelevant to students to some extent and also these practices in education are affected by the institutional context. Through this study, the author hopes to provide some suggestions for the application of multimodality in teaching critical reading and how to overcome challenges in the implementation.

Keywords: Genre, Multimodality, Affective, Domain

SCIENCE, TECHNOLOGY AND INDUSTRY

Plant Growth-Promoting Rhizobacteria Isolated from Paddy Soils: Exploration of Iron-Chelating Ability and Phyto-Beneficial Traits for Biofortification of Rice

H.K.T. Dinushka, B.L.W.K. Balasooriya*, M.P. Dassanayaka and S. Amirthalingam

Department of Biotechnology, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP) 60170, Sri Lanka
*wajirab@wyb.ac.lk

Plant growth promoting rhizobacteria (PGPR) are able to enhance the plant growth through diverse mechanisms. The use of PGPR is a promising technique in biofortification of rice. Some PGPR inhabit in paddy soils produce iron chelating organic compounds known as siderophores under iron stressed conditions. The objective of the study was to isolate and identify rhizobacteria from the rhizosphere of *Oryza sativa* and screen for plant growth promoting traits especially iron chelating activity, so that they can be exploited as potential bioinoculants for biofortification of rice. In this investigation, rice rhizosphere soil samples were collected from different paddy fields in Kurunegala and Gampaha districts and 21 isolates of bacteria, coded as Ib 01-Ib 12, Mb 01-Mb 05 and Mk 01-Mk 04 were isolated and characterized morphologically. All the isolates were screened *in vitro* for their plant growth promoting activities *viz.* siderophore production, phosphate solubilisation and indole acetic acid (IAA) production. Chemical natures of siderophores were detected using Arnow's test and Tetrazolium salt test. Phosphate solubilisation ability in Tricalcium phosphate (TCP) and Eppawala rock phosphate (ERP) were estimated using molybdenum blue method. Their iron chelating ability was tested using ferrozine assay. All the isolates showed positive PGPR activities and iron chelating ability. Significant amount of IAA ranging from 0.2118 µg/ml to 2.6422 µg/ml was produced by the isolates. TCP and ERP solubilizing abilities of these isolates were 57.89 µg/ml to 268.39 µg/ml and 0.1048 µg/ml to 3.037 µg/ml   respectively. Average iron (II) concentration made available in the medium was 0.4 ppm. Based on consolidated positive PGPR traits of isolates, five potential PGPR (Mb 04, Ib 05, Ib 08, Ib 10, and Ib 11) were selected. This investigation revealed potential PGPR with significant traits which can be utilized as potential biofertilizer for biofortification of rice using an environmentally friendly approach.

Keywords: Biofortification, Iron, Plant growth promoting rhizobacteria, Rice, Siderophores

Autonomous Weeds Identification and Watering System for Cabbage Crops

D.D.B. Senanayake

Department of Science and Technology, Uva Wellassa University of Sri Lanka,
Badulla 90000, Sri Lanka
durangadbs@gmail.com

In agricultural industries, weeds are identified as one of the major problems and it will equally affect the Sri Lankan agricultural sector which is gaining more income to the Sri Lankan GDP. Nevertheless, most of the farmers still use traditional weed removal methods in Sri Lanka and it is time-consuming and needs a lot of human workloads. In this techno-centric current world, Autonomous weeds identification and watering system for cabbage crops identified as a novel method for the Sri Lankan plantation industry which is using machine learning technology and image processing to control weeds in the crops. This system was trained with OpenCV using a thousand images to identify cabbage crops from weeds and algorithms including non-diagonal classifications were used for classification. The autonomous system (robot) can move through the crop lines and also, it was trained for path identification and it indicates about the weeds and watering will be done according to the identification. Trial runs were done using a prototype with hundred different samples and around 91% of identification accuracy was achieved in different scenarios. This concept identification will enhance the cabbage crop cultivation, cost, and time reduction of the farmers compared to the existing traditional methods in Sri Lanka. Simplistic design and adaptability for different farmlands are the uniqueness of this and it makes it easy to use in different conditions. Furthermore, it will develop with the robotic arm for weeds removal in the future with this weeds identification. Results manifest that farmers can use this system for their crop cultivation as an effective method in Sri Lanka.

Keywords: Machine-learning, Image processing, Weeds, Crop cultivation, Cabbage plantation

Science, Technology and Industry

Early Vegetative Growth of Chili (*Capsicum annum*) Varieties under Reduced Nitrogen Levels Provided through *In Vitro* Culture

A.S. Jathunarachchi, P.I.P. Perera*, A.S.A. Salgadoe and D.R. Gimhani

Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP) 60170, Sri Lanka
*prasanthi@wyb.ac.lk

Nitrogen (N) is an essential macronutrient for plant growth. Therefore, efficient N management is essential for yield increments in commercial agriculture. However, application of excessive N fertilizer increases the cost of production, in addition to its negative impacts on the environment and thus on human health. Ground water pollution is one such long-term environmental impact, very much evident in regions including Kalpitya, Sri Lanka where intensive agriculture is practiced. Use of long term sustainable strategies including identification of germplasm with low nitrogen sensitivity could be one of the best solutions to face the said issue. Thus the present study was conducted to screen four commercial chili varieties (*Galkiriyagama*, MICH HY 2, *Devnur* Deluxe and Kodian Hot) for early growth under four N levels [875 (control), 656.25, 437.5 and 218.75 mg/L NH_4NO_3] supplemented in half-strength Murashige and Skoog (MS) media under *in vitro* conditions. Two factor factorial experiment in Completely Randomized Design with 30 replicates was used. Vegetative parameters of seedlings including number of leaves, number of roots, shoot length and root length were recorded after 30 days of culture initiation. An interaction effect was not observed among the tested factors. A significant difference was observed among tested genotypes ($p<0.0001$) and the variety MICH HY2 performed better over the others for all the parameters except root length. The N levels affected on the growth performance of the genotypes ($p<0.001$) where the performance of the first three levels were comparable for all parameters whereas the level of 218.75 mg/l gave the lowest. Variety *Galkiriyagama* showed the lowest sensitivity showing a significant difference only for shoot length whereas in MICH HY2 and Denur Delux showed for number of roots and root length. Kodian Hot was identified as the most sensitive variety for the available N levels. Therefore, the varieties *Galkiriyagama* and MICH HY2 were selected as the best performers for further studies on selecting the genotypes for tolerating lower N levels.

Keywords: Chili (*Capsicum annum*) variety, In vitro screening, Ground water pollution, Response for nitrogen

Effect of Potassium Polyacrylate Super Absorbent Polymer in Increasing Water Holding Capacity of Coconut Husk Chips-Based Growing Medium

W.A.K.P. Wijayasinghe* and H.M.I.K. Herath

Department of Plantation Management, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP) 60170, Sri Lanka
*k.wijayasinghe@gmail.com

Coconut husk chips and coco-peat are popular growing media in greenhouse agriculture due to their unique features. However, maintaining desired electrical conductivity (EC) and water retention properties is challenging. This study aims to enhance the properties of these media by incorporating Potassium polyacrylate (PKA) super absorbent polymer (SAP) to obtain the benefit of improving water retention properties. Three different types of coconut husk based growing media [100%, 80% and 50% coco chips (CC) (7-8 mm)] at two levels of initial electrical conductivity, high (HIEC) (0.5dS/m<EC) and low (LIEC) (0.5dS/m>EC) were tested in the experiment. Each of the combinations was incorporated with five levels of SAP (PKA) as 0% (control), 1%, 2%, 3% and 4% using an experimental design of three-factor factorial with three replicates. The properties of SAP was quantified by analyzing pH, EC, water holding capacity (WHC) and moisture content (MC). After the incorporation of SAP the conditions of growing media were evaluated for the above parameters and bulk density (BD). Results revealed that the performance of SAP added growing media had significantly higher WHC, EC and MC (P<0.05). The WHC of the media was independent of the status of pH and BD while it changed with the composition and the percentage of SAP incorporated. The highest WHC of 1%, 2%, 3% and 4% of SAP added treatments were reported in 50% CC growing medium as 533.91%, 574.97%, 576.93% and 580.70% respectively while the control had 536.83% WHC. The statistically significantly highest WHC were observed in 3% and 4% of SAP added treatments with compared to the control. However, EC of 0%, 1%, 2%, 3% and 4% of SAP added treatments were 1.89dS/m, 2.0dS/m, 2.21dS/m, 2.74dS/m and 2.33dS/m respectively, significantly different with each other. Even though WHC was higher in all 3% and 4% SAP added treatments, the EC has increased to an undesirable level in HIEC. Therefore, the best combination is LIEC 50% CC with 3% and 4% SAP as they showed the desired level of EC with higher WHC.

Keywords: Super absorbent polymer, Coconut husk chips, Growing medium, Water retention capacity

Morphological and Molecular Characterization of Traditional Rice Variety *Dahanala*

V. Koodalugodaarachchi[1]*, D.S. Kekulandara[2] and D.R. Gimhani[1]

[1]*Department of Biotechnology, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP) 60170, Sri Lanka*
[2] *Plant Genetic Resources Centre, Gannoruwa, Peradeniya 20400, Sri Lanka*
*vidyamali1994@gmail.com

Dahanala is a traditional rice variety which exhibits the thrips resistance. This study was mainly focused on phenotypic and genetic diversity assessment in *Dahanala* accessions for systematic conservation and effective utilization of germplasm, required for future breeding purposes. Twenty-six *Dahanala* accessions conserved in the Gene Bank of Plant Genetic Resources Center, Gannoruwa and six accessions from Rice Research and Development Institute, Batalagoda were analyzed morphologically and genetically. Phenotypic characterization was carried out using MINITAB 15 software, evaluating seeds of each *Dahanala* accession with seven qualitative and quantitative parameters; seed shape, color and pubescence of lemma and palea, seed coat color, sterile lemma color, grain length and grain width based on the descriptors of rice issued by International Plant Genetic Resources Institute (IPGRI). The molecular evaluation was done using 31 Simple Sequence Repeat (SSR) primers. Analysis of genetic variation and construction of phylogenetic tree were done by POWER MARKER V3.25 and MEGA 7 software, respectively. According to the results of both morphological and molecular analysis, the accession numbers: 003924/003327 and 0010160/006165 were identified as two pairs of duplicates while accession numbers; 003971, 002049, 002050 and 014122 were characterized distantly from the rest of the accessions. According to the genetic analysis Polymorphic Information Content (PIC) of primers were varied between 0 (RM 255) and 0.697 (RM 412). Genetic distance ranged within 0.0 and 0.94 revealing a considerable genetic variance among 32 accessions. Closely related 16 accessions namely 003924, 003327, 006376, 010160, 006165, 006378, 004968, 003304, 006739, 005386, 004507, 003149, 003131 627, 626 and 629 were selected as representative set of *Dahanala*.

Keywords: Rice, *Dahanala*, Molecular characterization, Morphological characterization

Deep Learning for Tomato Disease Classification Using Leaf Images

L.A.K.S. Chathuranga[1], D. Athauda[1] and D. Herath[2]*

*[1]Department of Manufacturing and Industrial Engineering, Faculty of Engineering,
University of Peradeniya, Peradeniya 20400, Sri Lanka
[2]Department of Computer Engineering, Faculty of Engineering,
University of Peradeniya, Peradeniya 20400, Sri Lanka
damayanthiherath@eng.pdn.ac.lk

Sri Lanka has exported 20.19 % of agricultural products out of the total exports in 2018. This indicates the significant role of agriculture in the Sri Lankan economy. However, an annual loss of 25 - 30 % is expected due to insect pests, diseases, and weeds. A more effective method of reducing the loss due to crop diseases is to identify the disease at an early stage. However, it is hard for the farmers in Sri Lanka to achieve this due to the scarcity of technology and expertise. Automated crop disease identification can help the farmers and agricultural officers to quickly remedy the disease spread leading to higher yields. Image processing coupled with deep learning can be used to develop such solutions. The objective of this study was to identify the most appropriate deep neural network architecture for tomato disease classification using leaf images. Accordingly, five convolutional neural network (CNN) architectures were evaluated for their classification accuracy on a real dataset. The tomato disease types considered are Bacterial Spot, Late Blight, Septoria Leaf Spot, and Yellow Leaf Curl Virus. The highest training accuracy of 98.53% was obtained by adopting VGG16 CNN with a validation accuracy of 97.93%. The training time of the model was 43.7 minutes when tested in a Google Colaboratory framework (hardware accelerator: GPU) and implemented in the Keras-TensorFlow backend. The prediction time was 0.786 seconds. It can be concluded that the proposed system incorporating VGG16 CNN can be used to identify the considered tomato diseases with high accuracy within a short time. The developed method can be adopted to identify diseases in other types of crops in Sri Lanka. Thereby, it can be integrated into a user-friendly mobile-based application so that farmers can use it to identify diseases in their crops automatically.

Keywords: Tomato disease identification, Image processing, Deep learning, Machine learning

Photosynthesis-Irradiance Response Curves as Affected by Mutual Shading in Batch Cultures of *Euglena gracilis* Klebs

V.N. Kodithuwakkuge[1]*, S.M.P. Seneviratne[1], M.L.D.I Madhuwanthi[1],
M.H.S.M. Hettiarachchi[1], R.P.W.A. Dilrukshi[1], D.M.N.S. Dissanayaka[1],
K. Goto[2] and C.K. Beneragama[1]

[1]*Department of Crop Science, Faculty of Agriculture, University of Peradeniya,
Peradeniya 20400, Sri Lanka*
[2]*Laboratory of Biological Rhythms, Obihiro University of Agriculture and Veterinary
Medicine, Obihiro, Japan*
*virashmikodithuwakku@gmail.com

Because of the nutraceutical value, the algal flagellate *Euglena gracilis* Klebs is becoming increasingly popular. However, the optimum culture conditions for bioreactors to harvest the photosynthesis-derived bioproducts have not been elucidated to date. As an initiative, in the present study, the photosynthesis-irradiance response curves of *E. gracilis* Klebs were determined under exponential, transitional and stationary phases. The alga was cultured at three different light intensities 30, 90 and 210 µmol m^{-2}s^{-1} photoautotrophically and axenically in modified Cramer-Meyer medium at 25˚C as batch cultures. The results show that, the values of dark-respiration rate (DRR), light-compensation point (LCP) and light-saturation point (LSP) were significantly lower in lower-light cultures during the exponential growth phase. These differences across cultures were however not maintained until stationary phases, because actual photon flux density (PFD) became unparallel to incident PFD due largely to mutual shading. Thus, in the transitional growth phase, the lowest LCP was achieved in the alga cultured at the higher-light, whereas the values of both the DRR and the LSP still followed the same as in the exponential cultures. When they reach the stationary growth phases, all the cultures may have encountered deep shade below a critical level making DRR, LCP and LSP indistinguishable from each other cultures. Despite these complexities, it is obvious that the DRR, LCP and LSP are lower in lower PFD cultures and decreased with increasing cell titers, and thus decreasing actual PFD, within each culture. Results suggest that the typical shade tolerance in *E. gracilis* while making the irradiance a crucial factor for photosynthesis-based physiological activities. These results will help deciding industrial-level culture conditions for the cultivation of *E. gracilis* Klebs targeting harvesting of nutraceutical bioproducts.

Keywords: *Euglena gracilis* Klebs*, Photosynthesis-irradiance, PFD, Nutraceutical, Bioproducts

Acclimatization of *In Vitro* Derived Dendrobiums

P.D.D.M. Panapitiya*, V.L.P. Amarasinghe,
N.D.C.S. Leelarathne and A.I.S. Priyadharshan

*Floriculture Research Centre, Department of Plant and Molecular Biology,
Faculty of Science, University of Kelaniya, Kelaniya 11300, Sri Lanka
frc@kln.ac.lk

Dendrobium is one of the most important ornamental plants in the floriculture industry with a high commercial and medicinal value. Micropropagation is used widely for the rapid multiplication of Dendrobiums. However, a high percentage (around 50-60 %) of plants either die or get damaged when transferring from *in vitro* to *ex vitro*. In the present study, an attempt has been made to acclimatize *in vitro*-derived Dendrobiums by standardizing potting media that can be used in an alternative, small-scale greenhouse condition. Sterilized coconut husk, brick pieces, charcoal, sand and leaf mold compost were used as potting substrates and chopped into 1.0 – 2.0 cm sized pieces when necessary. *Dendrobium* plantlets with 5.0 cm average height, containing 06 average leaves and 12 average roots were transplanted in six different substrate compositions plastic pots (15.0 cm in diameter). Potting medium containing coconut husk alone was used as the control treatment. The experiment was completely randomized with three replicates and three plantlets per replicate. Potted plantlets were maintained in an alternative greenhouse condition, which was prepared using a glass aquarium (64″×32″×32″) covered up with a polythene sheet. A layer of bricks and water was used to maintain the humidity within the glass box. The humidity was brought down in a phased manner to the ambient conditions by removing the polythene sheet with duration lengthening over time. After 12 weeks of acclimatization in this condition, plantlets on potting medium containing brick pieces, charcoal and leaf mold compost (1:1:1) proved the best composition for higher survival percentage (77.8%). However, significant plant growth was not observed during this period in any media composition. According to the results, the potting medium containing brick pieces, charcoal and leaf mold compost (1:1:1) is suitable to acclimatize *in vitro* grown Dendrobiums in the alternative, small-scale greenhouse condition. However, further research is essential to optimize a successful protocol to grow these acclimatized plantlets in the field.

Keywords: Acclimatization, Dendrobiums, Potting substrates, Greenhouse

An Efficient Protocol for *In Vitro* Regeneration of *Aloe Vera*

N.D.C.S. Leelarathne, P.D.D.M. Panapitiya*,
V.L.P. Amarasinghe and A.I.S. Priyadharshan

*Floriculture Research Centre, Department of Plant and Molecular Biology,
Faculty of Science, University of Kelaniya, Kelaniya 11300, Sri Lanka
frc@kln.ac.lk

Aloe vera belongs to the family Asphodelaceae (Liliaceae) and has a high medicinal value resulting in wide usage in the cosmetic and pharmaceutical industry. However, slow propagation rate of axillary shoots and male sterility holds back its efficient propagation. Therefore, scientists focus on developing *in vitro* micropropagation methods to fulfill the demand for aloe plants. Hence, this study aimed to optimize *in vitro* propagation conditions by identifying the best plant hormone concentration for the efficient regeneration of *Aloe vera*. Surface sterilized shoot tips of aloe were cultured in full strength Murashige and Skoog (MS) media supplemented with Activated Charcoal (500.00 mg/L), Polyvinylpyrrolidone (PVP) (50.00 mg/L), Citric Acid (50.00 mg/L), Ascorbic Acid (100.00 mg/L) and different plant hormone compositions. The experiment was completely randomized with ten treatments of five different concentrations of Kinetin and 6-Benzylaminopurine (BAP) (0.10, 0.25, 0.50, 0.75, 1.00 mg/L) in combination with 2,4-dichlorophenoxyacetic acid (2,4-D) (0.10, 0.25, 0.50, 0.75, 1.00 mg/L), besides the control with no hormones and five replications per treatment. The results showed that the treatment containing 2,4-D (0.10 mg/L) and BAP (0.10 mg/L) was found to be the best composition for direct shoot regeneration from shoot tip explants. On this medium, 100% of cultures responded with an average number of 1.40±0.55 shoots per explant, which had an average height of 1.40±1.47 cm after 20 days. Therefore, the present protocol with the use of MS media supplemented with 2,4-D (0.10 mg/L) and BAP (0.10 mg/L) is efficient for the regeneration of *Aloe vera*. Further, the research is being continued to introduce a rapid *in vitro* multiplication protocol for *Aloe vera*.

Keywords: Aloe Vera, Kinetin, 2,4-D, BAP, Regeneration

Evaluation of Effectiveness of "Touch DNA" Evidence in Criminal Investigations in Sri Lanka

B.D. De Silva and R.J. Illeperuma[*]

Department of Molecular Forensics, Genetech, Colombo 00800, Sri Lanka
*ruwanille@gmail.com

DNA evidence has been used in Sri Lanka during the past two decades. Among various types of DNA evidence used, "Touch DNA" evidence defines DNA deposited onto surfaces by physical contact. The amount deposited is often extremely small and can vary significantly between individuals, contact surfaces and environmental conditions making such evidence challenging to be tested. "Touch DNA" samples (n=100) from crime scenes of varying nature were subjected to DNA extractions using a column-based method (Qiagen, Germany). The amount of DNA recovered and purity (A260/280 ratio) were measured by a NanoDrop spectrophotometer (Thermo Fisher Scientific, USA) followed by PCR (AmpFℓSTR Identifiler, USA). Each sample was genotyped by an automated genetic analyzer (Applied Biosystems, USA). The success of obtaining the unique allele combination; the DNA profile of each sample was evaluated.The average amount of DNA recovered was 11.35± 9.11 ng/μl with an average purity of 3.55± 2.55, of which only 4/100 (4%) samples generated partial DNA profiles while 8/100 (8%) generated full profiles; yielding an overall success rate of 12%. Mixed profiles (multiple alleles per locus in a DNA profile) were observed in 9/12 (75%) samples; which included 5/8 (62.5%) full profiles and 4/4 (100%) partial profiles, with two profiles successfully matched with that of suspects.A majority of crimes committed were attributed to theft (77.19%), followed by murder (15.79%), property damage and arson (3.51%), sexual abuse and assault (1.75%). A wide array of items was tested, most as entire items (86%) with the rest being swabbed samples from the "touched surface" (14%).The success rate of generating DNA profiles from "Touch DNA" is modest. This can be attributed to multiple factors such as limited DNA amounts, degradation, coupled with difficulties in interpreting profiles containing DNA mixtures. Despite this, "Touch DNA" evidence proves the identity of a criminal.

Keywords: Crime, Forensics, Touch DNA, DNA profile

A Study on Queuing System Performance of a Public Hospital Pharmacy

R.D.S.S. Rambandara*, E.A.S.K. Ekanayake, H.M.I. Lakmali,
A.G.D. Rasangi and W.A. Thilini

*Department of Industrial Management, Faculty of Applied Sciences,
Wayamba University of Sri Lanka, Kuliyapitiya 60200, Sri Lanka
rdssrambandara@gmail.com

Pharmacies in public hospitals play a vital role in the Sri Lankan healthcare sector. The study focused on analyzing the queuing system of the pharmacy specified for heart, kidney, diabetes and nerve disease patients in a public hospital. The objective was to propose proper means of reducing patient waiting times in pharmacy queues. Therefore, authors observed the two queues independently served by two pharmacists from 8.00 am to 10.00 am on Tuesdays and Wednesdays in three successive weeks. They recorded patient arrival times to the queues, counters and departures from the counters in seconds using stopwatches. The sample consisted of 406 patients. The system was modelled as a multi-server queuing system using Rockwell ARENA 16. The input analyzer exhibited Beta distributions for inter arrivals and service times of counter one and a Weibull distribution for service times of counter two. The model ran for a replication length of eight hours permitting 137 patients into the system and 52 of them were served. Results presented that the average waiting times of patients near counter one and counter two were 43.60 and 34.28 minutes respectively. Moreover, the corresponding numbers of patients waiting in counter one and counter two were 26 and 22. The study assumed the patient arrivals to be random and independent while the service was continuous. Therefore, two alternatives namely, adding an extra counter and occupying more pharmacists were tested to reduce the waiting time and the number of patients waiting in queues. Observations revealed that adding pharmacists for both counters could increase the performance of queuing system by reducing the waiting times at counters to 16.40 and 16.58 minutes respectively. Accordingly, only ten and nine patients were waiting near the two counters. Thus, the simulation concluded that proper resource utilization increases the performance of the pharmacy.

Keywords: Multi-server, Pharmacy, Queuing system, Rockwell ARENA, Simulation

In-Vitro Anticandida Activity of *Panchawalkala* Decoction and *Rathmal Panchanga* Decoction against *Candida Albicans*

K.C.M. Gamage[1]*, D.N. Wanigasekara[2] and H.P. Wakkumbura[3]

[1]*Gampaha Wickramarachchi Ayurveda Institute, University of Kelaniya, Yakkala 11870, Sri Lanka*
[2]*Department of Biochemistry, Faculty of Medicine, University of Ruhuna, Galle 80000, Sri Lanka*
[3]*Department of Kaumarabruthya and Stree Roga, Gampaha Wickramarachchi Ayurveda Institute, University of Kelaniya, Yakkala 11870, Sri Lanka*
*kalanagamage91@gmail.com

Candidiasis is a yeast infection commonly called as thrush. Although there are numerous treatment strategies available for treatment of candidiasis, there is a tendency to choose Ayurveda treatments in the community for curing candida infections. *Rathmal* (*Ixora coccinea*) *panchanga* (whole plant) decoction and *Panchawalkala* (combination of five barks namely *Ficus benghalensis, Ficus glomerata, Ficus religiosa, Thespesia populnea* and *Ficus lacor*) decoction have been used to treat such infections in Ayurveda medicinal system for years. This study was conducted to investigate the in-vitro efficacy of these two formulations against *Candida albicans*. The antifungal activity was evaluated using agar well diffusion method. Fluconazole (2.5 mg/mL) was used as the positive control while sterile distilled water served as the negative control. 100 µL of overnight culture of *C. albicans* (McFarland 0.5) was pipetted out onto Mueller Hinton Agar plate and spread to a uniform lawn. 50 µL of each *Rathmal panchanga* decoction, *Panchawalkala* decoction, positive control and negative control was added to wells. After 24-hour incubation at 37ºC for 24 hours, inhibition zone diameters were measured in millimeters. The test was triplicated. Mean inhibitory zone diameter obtained for *Rathmal panchanga* decoction was 11.33±0.58 mm and no inhibition was reported for *Panchawalkala* decoction. Negative control exhibited no inhibition and positive control showed an inhibition zone diameter of 22.33±0.57 mm. These preliminary observations of the study suggest that *Rathmal panchanga* decoction has the potential to be further developed to enhance its anti-candida activity as an herbal pharmaceutical.

Keywords: Antifungal*, Candida albicans, Ixora coccinea,* Panchawalkala

Analyzing Queuing Performance of a State Pharmacy by Simulation: A Case Study of Sri Lanka

H.P.N.I. Kumarasinghe*, W.M.T.H. Wijesundara, G.J. Bulegodaarachchi,
W.K.A.H. Weerasinghe, M.G.N.C. Dharmawansha and H.P.I.M. Fernando

*Department of Industrial Management, Faculty of Applied Sciences,
Wayamba University of Sri Lanka, Kuliyapitiya 60200, Sri Lanka
hpni.kumarasinghe@gmail.com

State pharmacies contribute significantly to providing medicine even outside the hospitals. Therefore, the customer queues are vital in-state pharmacies. This would decrease the quality and the reputation of their services. Accordingly, this study aimed to analyze the queuing performance of a selected state pharmacy and to present the relative measures and recommendations for its further improvements. The sample size was 300. The observations were done on three consecutive weekdays from 9.30 a.m. to -11.30 a.m. at two service counters. Inter arrival times and the service times of the customers were collected. Then, data were analyzed using Rockwell ARENA 16. The model was run for a replication length of 10 hours to find the performance of the existing system. The probability distributions of inter-arrival times and the service times were obtained through the Arena Input Analyzer. The percentage of customers served was recorded as 96.28%. The study revealed the average waiting time of customers at counter one and counter two to be12.09 and 10.18 minutes respectively. Therefore, assuming random counter selections, independent arrivals, customers taking the service only at once, service discipline in the First-In-First-Out basis and infinite queue discipline, the authors recommended employing another person for each counter as the best solution. Thus, the resources used in the existing model were doubled and the model was run for the same replication length. Then, the proposed system served customers with98.87%, hence; the waiting time could be reduced. Those average waiting times at counters one and two were 0.71 and 0.39 minutes respectively. Therefore, the proposed system increased the queuing performance of the pharmacy through proper utilization of resources.

Keywords: ARENA 16, Simulation, State pharmacies, Queuing performance

iPURSE 2021 – 403   *Science, Technology and Industry*

Women's Sexual Health Mobile Partner: What Do Women Expect from the App?

E.D. Uthpala* and R.M.M. Pradeep

*Information Technology Department, Faculty of Computing,
General Sir John Kotelawala Defense University, Ratmalana 10390, Sri Lanka
danushielgiriyage97@gmail.com

Women who are busily dealing with their parents and children as first-line helpers in any family lead a more complex mental life than men. Simultaneously, prioritizing these tasks reduces the focus on the menstrual cycle, the biological clock on which their behavior and activities depend, as well as sexual health. According to World Health Organization (2020) and the United Nations report (2020), more than 65% of women are unaware of menstrual cycle/dates, contraception, prenatal, and postnatal care. Due to this ignorance, more than 80% have anemia, face difficulties in pregnancy, and suffer diseases after menopause. All these are related to the menstrual cycle, and mindfulness on the cycle is important for early detection of any sexual health problem. There are more than 125 mobile apps available to track menstrual cycle, but no mobile app is popular. Therefore, this study was carried out to find gaps in the women's requirements and facilities provided by the available mobile applications. For that, the investigators interviewed 12 women to find what they needed from an app. Then, 50 mobile apps were evaluated over the requirements identified through the interview to find the gaps in the present apps. Next, it conceptualized the new functional requirements and tested these preferences through a survey. There were 40 women participants and 98% confirmed the conceptualized functionalities. The study found that women mainly need accurate predictions of the menstrual cycle and nutritious eating patterns according to their menstrual cycle. In addition, they need customized birth control and psychological relief methods, which are based on the individual menstrual cycle. Hence, the future mobile apps should be loving companions that provides accurate predictions, correct nutritional patterns, sex education, and psychological relief based on an individual menstrual cycle.

Keywords: Women's sexual health, Mobile application, Menstrual date, Fertility period, Pregnancy, Awareness

Science, Technology and Industry

Assessment of Ultrasound-Based Radiomics as A Marker of Chronic Kidney Disease

M.S. Bandara[1]*, C. Jayathilake[2], A. Pallewatte[2] and J. Wansapura[3]

[1]Department of Physics, Faculty of Science, University of Colombo, Colombo 00300, Sri Lanka
[2]Department of Neuroradiology, National Hospital of Sri Lanka, Colombo 00010, Sri Lanka
[3]Advanced Imaging Research Center, UT Southwestern Medical Center, Dallas, Texas 75390, USA
*muditha@sci.cmb.ac.lk

Radiomics is a technique used to extract a large number of texture features from medical images to support diagnostic decisions using mathematical algorithms. Chronic Kidney Disease (CKD) is one of the major global health challenges. Ultrasound B-mode imaging is considered a first-line diagnostic method in CKD, based on visual features. Renal biopsy remains the golden marker for CKD detection. We recently showed that CKD can be detected using Radiomics features. Wavelet decomposed (Low-High) Gray Level Run Length based Normalized Run Length Non-Uniformity (WT(LH)GRLN) was identified as one of the best Radiomics feature to differentiate CKD and healthy kidneys. In the current study, we assessed the ability of WT(LH)GRLN to detect CKD grades on biopsy-proven CKD kidneys. CKD patients who were diagnosed based on biopsies (n = 65) and age-matched (p>0.05) volunteers (n = 68) without any clinical history of renal diseases were recruited with their consent. The study was approved by the institutional ethical committee. The Patient group was subdivided based on their biopsy reports. Minimal and mild fibrosis to patient group 1 and moderate and severe fibrosis to patient group 2. All groups underwent B-mode Ultrasound (Mindray, DC-80 Exp Insight) scans. Collected DICOM images were trend corrected and rotated, such that pole to pole axis was perpendicular to the vertical axis of the image. WT(LH)GRLN feature was calculated using a Python library (PyRadiomics). The mean value of WT(LH)GRLN in CKD kidneys (0.21 ± 0.02) was significantly less (T-test, two-tailed, p<0.05) than that of healthy kidneys (0.32 ± 0.02). No significant difference (T-test, two-tailed, p>0.05) in WT(LH)GRLN was found between the patient group 1 (0.21 ± 0.01) and the patient group 2 (0.20 ± 0.02). This study further confirms WT(LH)GRLN is a robust marker of CKD, although it is not able to differentiate CKD grades based on biopsies.

Keywords: Normalized run length non-uniformity, Radiomics, CKD

Investigating *In Vitro* Anti-Cancer Potency of *Osbeckia octandra L.* (Heen bovitiya) on YD 38 Oral Carcinoma Cells with Prognostic Genetic Markers

Y.G.M. Prasadani[1,2], R.P. Illeperuma[2], D.V. Jayathilaka[3] and S.P. Kodithuwakku[2,4]*

[1]Postgraduate Institute of Agriculture
[2]Centre for Research in Oral Cancer, Faculty of Dental Sciences
[3]Department of Agricultural Biology, Faculty of Agriculture
[4]Department of Animal Science, Faculty of Agriculture
University of Peradeniya, Peradeniya 20400, Sri Lanka
*surangap@agri.pdn.ac.lk

Oral cancer is a malignant neoplasm in the lip or oral cavity, which is identified as an oral squamous cell carcinoma (OSCC). The *in vitro* anti-cancer potency of *Osbeckia octandra* water-based leaf extract (OWLE) was previously investigated using an *in vitro* YD 38 cell line. The current study was carried out to analyze the effect of OWLE on the expression of three cancer related genes. YD-38 oral carcinoma cells were cultured under standard cell culture conditions and were treated with three different OWLE concentrations (0.3 µg/mL, 3 µg/mL and 30 µg/mL) and Doxorubicin with the concentration of 5 µM as the positive control. Total RNA was extracted from the treated cells and were reverse transcribed to synthesize cDNA. The relative mRNA expression levels of *B-cell Lymphoma-2* (*BCL2*), *BCL2–antagonist of cell death* (*BAD)*, and *B Cell Lymphoma-2-Associated-x protein* (*BAX)* genes were evaluated using semi-quantitative RT-PCR. Housekeeping gene β-*Actin* was used to normalize the expression data. The results revealed that the expression of *BAX* gene expression was not significantly different ($p < 0.05$) among the treatment groups. However, the expression of anti-apoptotic gene *BCL-2* was significantly lower ($p < 0.05$) at both 3 µg/mL and 30 µg/mL OWEL treatments. Moreover, the *BAD* gene expression was significantly ($p < 0.05$) upregulated at the 30 µg/mL OWEL treatment and hence, would be a promising target gene to study further, given its association with cell apoptosis. Overall, the present data reiterate our previous findings on anti-cancer properties of OWEL warranting further in-depth investigations.

Keywords: *Osbeckia octandra*, oral squamous cell carcinoma (OSCC), BAD, BAX, BCL2

ICT Usage and Impact on Undergraduates' Psychological Well-Being

D.M.J. Wickramasinghe

Faculty of Graduate Studies, University of Colombo,
Colombo 00700, Sri Lanka
mihirijanitha@gmail.com

Globalisation has changed human lives in the era of ICT. ICT has become an important source of innovation across the globe. Though there are positive social and educational benefits of ICT use, scholarly attention is now on identifying whether ICT usage is harmful since it is related to psychological aspects. On the other hand, ICT usage is comparatively and significantly higher among university students. Therefore, identifying the impact of ICT usage on the psychological well-being of students is crucial for the higher education sector. This study mainly focused on examining how factors like smartphone usage, social media usage, internet usage, device usage, video gaming and television viewing affect undergraduates' psychological well-being. To achieve the proposed research objectives, the quantitative research method was adopted, and data was gathered in the form of primary data through self-administered structured questionnaires. 383 undergraduates from the state universities of Sri Lanka participated in the study and the stratified sampling technique was employed. Collected data was analysed using the SPSS package and basic descriptive statistics, correlation analysis, and stepwise regression tests were run in order to examine ICT usage and its impact on the psychological well-being of undergraduates. Consequently, the findings revealed that social media usage, internet usage, and television viewing have significant positive impacts, while video gaming has a significant negative impact on the psychological well-being of undergraduates. Meanwhile, smartphone usage and device usage have no significant impact on psychological well-being. Further, internet usage is the most influential factor of ICT usage, which has the strongest predicting power on psychological well-being. The findings of the study would be beneficial to university students, parents, academic and non-academic staff, social media developers, etc. for further improvements.

Keywords*:* ICT usage, Psychological well-being, Undergraduates, Internet usage

Identifying Adoption Level of Blended and E-Learning Approaches in Sri Lankan Higher Education Sector: A Case Study Based on Science Stream Students during Covid 19 Pandemic

W.M.C.J.T. Kithulwatta[1]* and W.A.W.U. Wickramaarachchi[2,3]

[1]Faculty of Graduate Studies, Sabaragamuwa University of Sri Lanka, Belihuloya 70140, Sri Lanka
[2]Department of Computing, Faculty of Applied Sciences, Rajarata University of Sri Lanka, Mihintale 50300, Sri Lanka
[3]School of Computer Science and Technology, Wuhan University of Technology, China
*chiranthajtk@gmail.com

E-learning is a novel experience for the Sri Lankan education system. With the COVID-19 pandemic, the Sri Lankan education sector shifted to using E-learning approaches heavily. Blended learning gives a mixed and interactive approach to hold educational activities. For a digitalized blended learning approach, various platforms were used such as Learning Management Systems (LMS), online communication tools and document sharing platforms etc. Currently, Sri Lankan higher education communities are looking to deploy blended learning with E-learning in a wider approach. But there is no strongly identified adoption level for electronic based blended learning protocols. The study was designed to identify the adoption level of blended learning approaches to make future directions with E-learning. For the study, data were collected by sharing a structured online questionnaire among 511 undergraduates of the Faculty of Applied Sciences, Rajarata University of Sri Lanka. The simple random sampling technique was applied by considering all four levels of the undergraduates. Exploratory data analysis techniques were used with Microsoft Excel for data analysis. The major problems of undergraduates for remote E-learning which were identified are internet coverage issues and the cost incurred. To continue blended learning approaches in the long term, the strengths which are provided by the government, internet service providers' and donors of smart devices have been beneficial. 93% of the respondents had expressed that they wish to continue the LMS session for future educational activities. 54.4% undergraduates indicated that WhatsApp communication application was easy and beneficial to make group discussions and lecturer-student collaborations. 63.4% respondents had expressed that internet charges are affordable when using WhatsApp or other communication modes. Finally, the study identified that a sustainable development of blended learning can be achieved with support in various electronic based protocols.

Keywords: Blended education, E-learning, Learning Management System, Online education, Science stream

Heavy Mineral Industry of Sri Lanka and Its Impact on Global Market

H.C.S. Subasinghe* and A.S. Ratnayake

Department of Applied Earth Sciences, Faculty of Applied Sciences,
Uva Wellassa University, Badulla 90000, Sri Lanka
*chandimasubasinghe00@gmail.com

Sri Lanka is globally famed for the heavy minerals industry, and it brings considerable compensation to the economy of the country. The main objectives of the current study are to (i) examine annual global production and unit price variations of ilmenite, rutile, and zircon, (ii) forecast global variations for 15 years, and (iii) investigate price and production variations of heavy minerals in Sri Lanka. The global production and unit price variation of ilmenite (FeOTiO$_2$), rutile (TiO$_2$), and zircon (ZrSiO$_4$) were analysed using the data obtained from the Mineral Year Books of the United States Geological Survey (USGS) over 65 years from 1950 to 2015. After that, the global production and unit price of the three prominent heavy minerals were forecasted for 15 years over the period from 2015 to 2030 using Minitab 17 statistical software. Thereafter, the local production and total sales were analysed using the data provided by Lanka Mineral Sands Limited (LMSL). Time series decomposition analysis was carried out to determine any seasonal production and price variations of ilmenite, rutile, and zircon. Results show healthy growth rates of global production and unit price of the three selected heavy mineral commodities. Moreover, the global production and price of ilmenite, rutile, and zircon are expected to experience higher growth rates from 2015 to 2030. However, the production and sales values of ilmenite, rutile, and zircon in Sri Lanka are generally observed to fluctuate in the period from 2010 to 2020. Despite the continuous production and supply of the three commodities to the global market, Sri Lanka cannot make any considerable impact on the global heavy minerals industry since the contribution has always been less than 1%. Consequently, it is recommended to add value to the local raw material heavy minerals rather than exporting the bulk just after separation. In this regard, ilmenite can be upgraded to synthetic rutile or titanium slag, and zircon can be utilised to produce zircon flour.

Keywords: heavy minerals industry, Sri Lanka, production and price, sustainability, global market

GIS Technology for Vehicle Routing and Scheduling in Solid Waste Collection System: Case Study of Galle Municipal Council Area

H.K.N.A. De Silva* and K.U.J. Sandamali

Department of Spatial Sciences, Faculty of Built Environment and Spatial Sciences, General Sir John Kotelawala Defense University, Southern Campus, Sooriyawewa 82010, Sri Lanka
*987nipuanjana@gmail.com

The accelerated movement of persons towards cities and urban areas has increased significantly in recent decades. Most of the commercial places are located around the urban areas targeting the urban population. The increase in the population of cities has a significant impact on the volume of household waste produced, which needs to be collected and recycled in a timely manner. Household waste collection has a wide range of challenges, particularly in downtown areas: the collection system must be reliable, flexible, cost-efficient, and environmentally friendly. Recent improvements in Geographic Information Sciences (GIS) enable solving of various engineering and management problems. Under this investigation, a methodology based on GIS technology for optimizing waste collection and transportation systems was developed. The major criteria that supported optimum route selection were applied, such as population, traffic condition, and travel time. Population and the road network data were obtained from the respective departments, and travel time and traffic data were collected from the relevant Google Map for each date of the week. All the data were corrected prior to the network analysis by using a topological editing tool. Through the proposal of new vehicle routing and new vehicle time, a Network Analysis was performed in Arc Map 10.3 environment. The Galle Municipal Council area was used to promote the productivity of the waste collection process and its transportation. As the final outcome of the study, the proposed solid waste collection routes optimized the previous system while decreasing the travel time, fuel consumption, number of vehicles uses, and the distance of travel. In conclusion, these outcomes show that the proposed system improves the overall effectiveness significantly.

Keywords: GIS, Municipal solid waste collection, Network analysis, Optimal routing**,** Urban

Consumer Perceptions and Preference for Traditional Rice Varieties in Sri Lanka: A Case Study Based in Colombo District

J.K.W.N. Subashini[1]*, M.A.D. Danushika[2], I.V. Kuruppu[2],
N.W.B.A.L. Udayanga[3] and H.M.L.K. Herath[2]

[1]*Department of Horticulture and Landscape Gardening*
[2]*Department of Agribusiness Management*
[3]*Department of Bio-Systems Engineering*
Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka,
Makandura, Gonawila (NWP) 60170, Sri Lanka
*Subashini@wyb.ac.lk

Rice varieties inherited from previous generations are known as Traditional Rice Varieties (TRV), which have been nurtured and preserved by Sri Lankan farmers for over 3000 years. The unique characteristics of TRV, including rich nutritional values and health beneficial qualities, have created an increasing demand for consumption of TRV, leading to a surge in consumer popularity in the domestic market. However, consumer preference and their market choice of rice depend on different attributes and the market potential of TRV remains limitedly studied in Sri Lanka. Therefore, this study was conducted to assess the consumers' Willingness to Pay (WTP) for TRVs over non-traditional rice in Sri Lanka, while evaluating the factors affecting these purchasing decisions. A questionnaire-based survey was carried out with 300 randomly selected consumers in the Colombo district, followed by a Choice Experiment (CE). Aroma, medicinal value, nutritional value, nature of production (Organic or not), presence of a brand & certification, and price (Rs.) of rice were considered as attributes in CE. The data gathered from the choice experiment were analyzed using a Conditional Logit Model. The study revealed that around 70% of the respondents were willing to consume TRV, and 'Suwandel' remained the most preferred TRV. Poor awareness on TRV (31%) and low preference by family members (20%) were identified as the reasons for being unwilling to purchase TRV. On the other hand, medicinal properties (75.8%) and nutritional value (75.6%) were recognized as the main factors behind the high preference for TRV. Product attributes such as aroma, taste and storage quality were recognized as the greatest influence factors considered during purchasing of TRV. The highest Marginal Willingness-To-Pay (MWTP) was recorded for medicinal value (Rs. 753.11), followed by nutritional value (Rs. 580.02). Based on the findings, TR market represents a notable potential to be expanded in Sri Lanka.

Keywords: Choice experiment, Consumer perception, Traditional rice, Willingness to pay

Stock-Price Prediction Using Regression Analysis – Colombo Stock Exchange, Sri Lanka

A.W.V.M. Amunugama[1]* and U.N.B. Dissanayaka[2]

*[1]Faculty of Arts and Sciences, Sri Lanka Technological Campus,
Meepe, Padukka 10500, Sri Lanka
[2]Department of Mathematics, Faculty of Science, University of Peradeniya,
Peradeniya 20400, Sri Lanka
vichithraa@sltc.ac.lk

The stock market is one of the vital areas in the global economy because it provides investors the opportunity to buy shares of ownership in companies with access to capital. The research was motivated by the fact that investors are interested to know whether past stock prices have a propensity to forecast future stock prices. The objective of the study was to uncover patterns and examine the relationship between price-earnings ratio and stock price for companies listed at the CSE. Data were obtained from the daily reports of the stock exchange published by the CSE. The period covered by this research is from January 2015 to June 2018 and twenty companies were selected based on the eminent S&P rating method. In the literature, researchers demonstrate considerable interest in modelling stock price behavior and in testing existing models. Traditional Auto Regressive Integrated Moving Average (ARIMA) method was used to predict future stock prices in numerous studies in the past. The moving average method which was used in this study is a better method for reducing fluctuations and obtaining trend values with a fair degree of accuracy compared to ARIMA. The moving average method was used to get the corresponding value of predictor using 3-monthly moving average period. The study shows that stock price shifts follow some patterns and that historical price changes can be used to predict future price movements, which is further supported by a 80% value of coefficient of determination. This empirical study also illustrates that regression analysis is a valuable tool in stock price prediction for the companies listed in the Colombo Stock Exchange (CSE). Moreover, findings demonstrate the capacity of regression analysis with the moving average method to recognize trends and to predict the future stock prices.

Keywords: Regression analysis, Stock price, ARIMA, Moving average

Factors Affecting Labor Turnover Intentions in Sri Lankan Apparel Industry: A Case Study

K.A.N. Rasanjana* and M.G.S. Dilanthi

Department of Industrial Management, Faculty of Applied Sciences,
Wayamba University of Sri Lanka, Kuliyapitiya 60200, Sri Lanka
*nethmikulasinghe@gmail.com

The apparel industry is a major contributor to the economy of Sri Lanka. Though employees are the key players of this industry, recent studies have identified a rapid increase in the labor turnover. Therefore, labor turnover has become a significant issue in the Sri Lankan apparel industry. Accordingly, this study aimed to identify the factors affecting labor turnover intentions and their respective impacts. The study randomly selected 200 employees representing a 382 total population in a selected apparel company. The substantive literature review found seven factors affecting labor turnover intentions as the independent variables. The primary data were collected through a questionnaire. Further, managerial comments and documentaries were used to collect secondary data. Then, they were analyzed using the Minitab software. The correlation analysis showed that only job satisfaction, salary structure, leave policy and disciplinary actions were correlated with labor turnover intentions. The regression analysis revealed their impact on the labor turnover intentions. In addition, leave policy and salary structure highly impacted leave turnover compared to job satisfaction and disciplinary actions. The study was also continued with root cause analysis to suggest possible alternatives to minimize the labor turnover intentions. They were reducing assigned night shifts, providing balanced work schedules, organizing event handling, awareness programs and campaigns for all employees, and improving their wellbeing, satisfaction and motivation. Moreover, this research provided insights to further comprehensively analyze shift patterns in work assignment, the impact of demographic factors and other direct and indirect factors affecting labor turnover intentions. Also, the study provided insights to use data obtained through effective performance evaluation criteria for feedback systems.

Keywords: Labor turnover, Labor turnover intention, Sri Lankan apparel industry

Status of Computer Literacy in Sri Lanka

S. Sirikanth

The Open University of Sri Lanka – Hatton Study Center, Hatton 22000, Sri Lanka
Sivakumaransri.c@gmail.com

Information and Communications Technology is dominating in all aspects of Political, Socio-Economic life in the world which is not an exception in Sri Lanka. Against this backdrop, the purpose of this study is to identify the status of computer literacy and the factors that influence computer literacy in Sri Lanka. This study adopts a mixed research approach (Qualitative and Quantitative). For analysis, secondary source information was derived from the Department of Census and Statistics reports of computer literacy from 2006/07 to 2019 and various other sources. According to this study, the computer literacy rate in Sri Lanka is at a low level of only 30.8%, the household rate owning computers was 22.0% and the digital literacy rate accounts for 46% as per the 2019 data published by the Census and Statistics Department of Sri Lanka. Further, high rate of computer literacy is found in the urban sectors (43.6%) in the age group 15-24 years (61.85%). GCE A/L and above have 72.6% of literacy, and those who have English language proficiency have 71.5%. The finding shows that there are more opportunities to improve computer skills in urban areas as compared with other sectors, that English plays an important role in learning computer, that the younger generation is speedily moving towards technology than the elderly population and that schools and universities remain key avenues to improve computer literacy while the contribution of government training institutes remains very low. The following are the main factors influencing the declining trend of computer literacy. This includes poor ICT infrastructure in plantations and rural areas, lack of opportunity and resources for self-learning, high cost for computer technology devices, poverty of livelihoods and poor English language proficiency. Effective policy and institutional measures are vitally important to address these shortcomings and move towards the sustainable development of Sri Lanka.

Keywords: Computer literacy, Digital literacy, Computer, ICT, Sri Lanka

Recent Advances in Augmented Reality Technology in Education

T.A. Pindeniya* and H.N. Amaratunge

*Department of Information Technology, Faculty of Computing,
General Sir John Kotelawala Defence University, Rathmalana 10390, Sri Lanka
tharuama37@gmail.com

Augmented reality is an emerging technology with tremendous opportunity for the world. This futuristic technology has the facility to combine the real world with the digital world. Education is the most important aspect for every human being in the world. Learning Mathematics is referred to as the practice of teaching and learning of mathematics in a way of solving arithmetic problems. Dyscalculia is a condition that affects the ability to acquire numerical and arithmetical skills and it can hardly be cured as a result of neurological defects. Several studies indicate that up to 12% of the world population suffers from Dyscalculia, and in Asia it is estimated that about 15% of children suffer from a learning disability. Out of these children, around 50%-60% suffer from Dyscalculia. The main problem is the lack of knowledge among teachers and parents about this disability. Nevertheless, with early detection of this disease and by using effective technological approaches, dyscalculia can be improved. This paper presents an augmented reality base mobile solution for numerical and arithmetical deficits of primary school children in Sri Lanka. The application provides children to learn numbers interactively, pronunciation and the usage of numbers in real world scenarios. Therefore, this application mainly focuses on children who are suffering from dyscalculia. The main intention is to provide a unique and interactive learning experience for its users. It's time to adopt this interactive learning system, so that they can expand their learning, understanding, and memorizing competence. It is essential to create a high quality and realistic learning environment for learning disabilities. The Augmented reality approach has greatly promoted a child's ability in the acquisition of knowledge and skills. This interactive augmented reality-based solution would be an appropriate method especially for the children with dyscalculia.

Keywords: Dyscalculia, Augmented reality, Character segmentation, Image processing, Mobile solution

Google Earth Engine (GEE) to Monitor Historical and Near-Real-Time Agricultural Droughts in Sri Lanka

N. Alahacoon[1,2]* and C.M. Edirisinghe[1]

[1]Department of Physics, Faculty of Science, University of Colombo, Colombo 00300, Sri Lanka
[2]International Water Management Institute (IWMI), Colombo 10120, Sri Lanka
*n.alahacoon@cgiar.org

Drought, which can be introduced as a decrease in water supply to all sectors relative to the normal natural conditions of the environment, has a severe impact on agriculture, the environment and socio-economic activities. Although the onset of an agricultural drought is very slow, its impact is gradually increased. Droughts affect different geographical areas with varying intensities. Thus, it is of timely importance to systematically and expeditiously investigate the drought progression and distribution with high spatial and temporal resolution covering the whole of Sri Lanka. The most suitable and effective method which can be applied to agricultural drought monitoring is the use of remote sensing data and indices. However, continuous and systematic drought monitoring using traditional satellite data analysis methods is a complex and time consuming process. This study reports the usefulness of Google Earth Engine (GEE) to map the spatial occurrences of drought over Sri Lanka between 2001 and 2020 using various remote sensing drought indices. Normalized Difference Vegetation Index (NDVI), Normalized Difference Water Index (NDWI) and Normalized Multiband Drought Index (NMDI) are used to map the spatial distribution of drought at country level every 16 days. In order to generate these drought indices, Moderate Resolution Imaging Spectroradiometer (MODIS) satellite data was used from the Google Earth Engine (GEE) platform. Furthermore, an interactive dashboard has been developed using GEE to provide near-real-time drought monitoring capabilities. Significantly, the results of the study suggest that GEE is an effective platform for monitoring long-term drought occurrence at the national level at 250m spatial and temporal (16 days) resolution. The specialty of GEE-based dashboard is that it allows the users to efficiently calculate and visualize the drought indices which were used to map drought over the past 20 years at a given time.

Keywords: Agricultural drought, Drought monitoring, NDVI, NDWI, Google Earth engine

Role of Smart Classroom System in Reducing Digital Divide among Schools in Jaffna District, Sri Lanka

R. Kalaichelvan

District Secretariat, Jaffna 40000, Sri Lanka
narakaselvan@gmail.com

A smart classroom is considered to be one of the essential modes of teaching that can transform the traditional education system into a modern one. This system has been popularized recently. Schools in the district have got smart classroom facilities from various funding sources, including the Government, but the impact of this system on student performance remains unassessed. Thus, the present study was designed to evaluate the role of the smart classroom system in reducing the digital divide among rural and urban schools in the district. The study used a mixed method to analyze both primary and secondary data. Primary data were collected through semi-structured questionnaires. Three subject areas such as availability of digital infrastructure, teachers' integration and student performance were considered. The questionnaires were distributed to all 455 active schools in the district. Data analysis was based on questionnaires received (223) which were from urban (32) and rural schools (191). The study revealed that 69% of schools have digital infrastructure facilities to promote smart classrooms. The impact of the system on students' performance has increased by 15.86%; this impact has increased more among rural students (15.42%) compared to urban students (6.12%). The impact on teachers' integration has increased by 8.75%, reflecting a higher increase among urban teachers (10.05%) than rural ones (9.66%). Finally, this system has contributed to increasing the interest in ICT knowledge among rural students over urban students, and it has increased teacher integration in urban schools. Therefore, the smart classroom system has contributed to reducing the digital divide as one factor among others. Hence, it is recommended that the Government should take necessary steps to develop digital infrastructural facilities uniformly in all areas for successful implementation of the digital learning system.

Keywords: Digital divide, Smart classroom, Urban, Rural area, School

In-Vitro Antimicrobial Activity of Selected Commercially Available Herbal Toothpastes

A.D.H. Sudesh[1]*, D.N. Wanigasekara[2], E.D.C. Karunarathne[1],
D.M.S.K. Dissanayake[3] and P.D.U. Pavithra[2]

*[1]Central Laboratory, Gampaha Wickramarachchi Ayurveda Institute,
University of Kelaniya, Yakkala 11870, Sri Lanka
[2]Department of Biochemistry, Faculty of Medicine, University of Ruhuna,
Galle 80000, Sri Lanka
[3]Department of Microbiology, Faculty of Science, University of Kelaniya,
Kelaniya 11300, Sri Lanka
sudeshvamp@gmail.com

Toothpastes are formulated gel dentifrices or pastes for regular use with a toothbrush for maintaining the oral hygiene and aesthetics of teeth. Many commercially available herbal toothpastes claim to have antimicrobial properties and potential to eliminate oral pathogens. The present study was undertaken to investigate the different levels of *in-vitro* antimicrobial activities in some commercially available herbal toothpastes. Eight commercially available herbal toothpastes named as toothpaste 1, 2, 3, 4, 5, 6, 7 and 8 were tested against two clinically isolated oral pathogens namely, *Streptococcus sanguinis* and *Candida albicans*. The level of antimicrobial activity of herbal toothpastes was evaluated using agar well diffusion method. Amoxicillin was used as the positive control for *S. sanguinis* and fluconazole was used as the standard antibiotic for *C. albicans*. Each test was triplicated. The inhibition zone diameters obtained from each test was measured in millimeters (mm).The mean inhibition zone diameters obtained for *S. sanguinis* were 13.00 mm, 13.67 mm, 14.33 mm, 17.00 mm, 16.33 mm, 17.00 mm, 10.67mm and 12.33 mm whereas 22.00 mm inhibition zone was obtained for the standard. 27.33 mm, 28.00 mm, 24.33 mm, 24.67 mm, 23.67 mm, 26.67 mm, 24.33 mm and 23.33 mm were the values reported for *C. albicans* while fluconazole exhibited a zone diameter of 35.00 mm. The study revealed that tested toothpastes possess different levels of antimicrobial activity against tested pathogens.

Keywords: Antimicrobial effect, Herbal toothpaste, Oral pathogens

Characterization of Effluent Water from Small Scale Vehicle Service Stations for Implementing a Cost-Effective Filtration System to Improve Effluent Water Quality

K.H.I. Gamage* and S.R. Wickramasinghe

Faculty of Graduate Studies, University of Kelaniya, Kelaniya 11600, Sri Lanka
*kharshana572@gamail.com

Vehicle service stations are considerable effluent water generators which are now increasing rapidly in number all around the world. As population is growing rapidly, the use of vehicles and the amount of wastewater produced by vehicles washes are increasing respectively. Small scale service stations have inefficient treatment methods and they face difficulties with related to high amount of maintainers, and investment cost. During vehicle repair and maintenance activities vehicle fluids may drip or spill and enter floor drains. These fluids may contain various pollutants such as engine oil, transmission fluid, power steering fluid, brake fluid, hydraulic fluid, cleaning solvents and degreasers. A study was carried out to introduce a cost effective simple treatment method to the effluent of small scale service stations. The collected effluent water samples from small scale vehicle service stations analyzed for physical and chemical parameters such as pH, Turbidity,Oil and grease, Conductivity, Chemical Oxygen Demand (COD),Biological Oxygen Demand (BOD), dissolved Oxygen (DO), Heavy Metals. The collected effluent water samples passed through implemented media filter which is constructed by using sand, burnet brick clay & partially burnt rice husk. Then filtered samples were analyzed for the physical and chemical parameters. Filtration process reduce the percentages of COD,BOD, Oil & Grease, Turbidityare 54 %, 57.8% ,67% ,76% respectively. Results indicate that flow rateis an important factor for the treatment process and optimized flow is 0.8 ml/min.

Keywords: Biological oxygen demand, Chemical oxygen demand, Media filter, Flow rate

Isometric Mapping for Pixel Classification in Hyperspectral Images

E.M.M.B. Ekanayake[1]*, G.M.R.I. Godaliyadda[2],
H.M.V.R. Herath[2] and M.P.B. Ekanayake[2]

*[1]Office of Research and Innovation Services, Sri Lanka Technological Campus,
Padukka 10500, Sri Lanka*
*[2]Department of Electrical and Electronic Engineering, University of Peradeniya,
Peradeniya 20400, Sri Lanka*
**mevane@sltc.ac.lk*

Isometric Mapping (Isomap) is a widely utilized dimensionality reduction technique (DRT) in many Signal Processing and Machine Learning applications. Isomap extends the Multidimensional Scaling (MDS) algorithm to preserve the distance between data points in the original data space by incorporating a geodesic distance-based framework. Pixel classification in Hyperspectral Image (HSI) datasets has been studied frequently over the past years by the HSI community while incorporating linear DRTs in the classification pipeline. Standard HSI datasets such as the Salinas dataset showcase a highly nonlinear data structure due to the presence of varieties of the same ground truth class (e.g. Lettuce Week 4,5,6, and 7). Hence, the utilization of a geodesic distance-based nonlinear DRT seems to be convenient for the said task. Thus, we implemented Isomap for dimensionality reduction in HSIs. After determining the k-nearest neighbors for each data point in the original higher-dimensional HSI data space, a neighborhood graph is constructed utilizing the shortest path algorithm in order to compute the inter-pixel geodesic distances. Finally, MDS is utilized with Eigenvalue decomposition to compute the lower dimensional embedding of the data. For the comparative evaluation of the algorithm, we have implemented several other linear and nonlinear DRTs such as Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), and Locally Linear Embedding (LLE). We have tested these methods on standard HSI datasets such as the Salinas dataset, Pavia University dataset, and Indian Pines dataset utilizing the mathematical and statistical toolboxes available in MATLAB® 2020b. For the final stage of pixel classification in the reduced dimensional space, K-means Clustering is utilized, and the performance in terms of Root Mean Square Error (RMSE) show improvements of 2.54%, 1.23%, and 0.98% for the Salinas dataset, Pavia University dataset, and Indian Pines dataset respectively. These quantitative results validate the superiority of Isometric Mapping over the other DRTs considered. The contribution of our work is generalizing the suitability of Isomap as a DRT in the pixel classification pipeline of HSIs.

Keywords: Nonlinear dimensionality reduction, Geodesic distance, Eigenvalue decomposition, Multidimensional scaling, Isometric mapping

A Feasibility Evaluation of Plausibility of Using Recycled Concrete Waste in Construction Projects in Sri Lanka: A Case Study Approach

S.G.S. Karunanayake

Department of Civil Engineering, Faculty of Engineering (Off-Campus Division), University of Bolton (Academic Centre in Sri Lanka), Nugegoda 10250, Sri Lanka
sithum@swehg.com

Construction waste is currently a major problem for the sustainability parameters of the Sri Lankan construction industry. A very less amount of Construction and Demolition (C&D) waste has been recycled in order to reuse while most of it has been ended up as a landfill. Although most of the countries in the Asian region have already applied these practices, and however in Sri Lanka the application has been limited due to the uncertainty of the final outcome. The overall quality, environmental impact and cost impact of the project were analyzed to assess the performance impact of the project using the recycled material. For quality assessment, tests were performed on selected case studies, and according to the final results, the effect of the use of recycled concrete material was found to be positive compared to the use of virgin material. Moreover, considering the environmental impact, the major sustainability requirements have been identified and the environmental impact has been predicted using the recycled concrete material as per the final results of the assessment. A Whole Life Cost assessment and a Cost-Benefit assessment of the selected product were performed to analyze the cost-effectiveness and identify the results of the assessment, which has a positive impact on both Whole Life Cycle (WLC) and the benefit-cost. The purpose of this assessment was to identify the long-term benefits and indirect benefits of this application. Lack of knowledge and resource availability for limited application has been identified throughout the study and resources should be improved to increase the suitability of recycled concrete materials for projects. To enhance the procedure, regulations should be encouraged by the government and other relevant authorities to increase the practical application of the technology by professionals. As further assessments, structural applications of C&D waste recycled materials and performance of other materials (fly ash, etc.) should be evaluated along with overall project performance.

Keywords: Concrete waste, Cost, Quality, Sustainability, Performance

Application of Multiple Correspondence Analysis on Road Traffic Accidents in Jaffna Division

M.A. Akbar* and N. Satkunanathan

*Department of Mathematics and Statistics, Faculty of Science,
University of Jaffna, Jaffna 40000, Sri Lanka
ashwak072@gmail.com

Road traffic accidents are one of the major causes for death, injuries and property damage all over the world. In particular road traffic accidents claim a lot of valuable lives in Sri Lanka. In addition, the government has provided free treatment and immediate medical care for road traffic accident victims. As a consequence, it makes a considerable impact on socio-economic costs in Sri Lanka. On the other hand, in Jaffna, during the post-war period, a sudden huge increment was observed in the number of new registrations of motor vehicles as well as the number of causalities due to road traffic accidents. The problem of increasing road traffic accidents motivated us to identify the most contributing factors for road traffic accidents in the Jaffna division. The data for the 422 accident cases were collected from the records of the Jaffna police traffic division for the period from July 2018 to June 2019. Twelve influencing factors, Time of the day, Area, Days of week, Road Surface Condition, Weather, Light Condition, Type of Location, Vehicle Type, Age, Gender, Accident Cause and License Validation, were treated as variables for this study. Multiple Correspondence Analysis (MCA) was used as an exploratory data analysis technique to identify the most contributing factors to road traffic accidents since it is appropriate for categorical data. Based on the computation of the coefficient of determination, it was noted that the variables Light condition and Time of the day contributed each more than 70% on the first dimension and the variables Road Surface condition and Weather each contributed more than 50% on the second dimension. Hence, these four variables were closely associated with road traffic accidents in the Jaffna division. The results of this study shall be used to develop good new strategies to reduce the frequency of accidents in the future.

Keywords: Road traffic accidents, Multiple correspondence analysis, Exploratory data analysis, Categorical data

A Study on the Impact of Tsunami Bore Driven Objects on Coastal Structures Using Computational Fluid Dynamics

H.D.A. Thilina[1]*, K.A.D.Y. Panduka[2], D.D. Dias[3] and H.A.D.S. Buddhika[4]

Department of Civil Engineering, Faculty of Engineering, University of Peradeniya, Peradeniya 20400, Sri Lanka
*e15365@eng.pdn.ac.lk

A Tsunami bore is a steep, turbulent, rapidly moving Tsunami wave front that forces objects such as shipping containers, boats, and shipwrecks which propagate towards ashore with a tremendous power. Once such an object collides with a near shore structure, a massive impact force is triggered due to the energy transfer. Although the literature reveals previous attempts on modelling the interaction between Tsunami bore driven objects and nearshore structures, a study to evaluate the sensitivity of the impact force and parameters governing it (hydrodynamic parameters, bathymetric parameters and Tsunami bore driven object related parameters) has not been reported up to date. Therefore, a Computational Fluid Dynamics (CFD) based approach with ANSYS-Aqwa software has been devised to study the sensitivity of governing parameters with the impact force. A model object accelerated by a scaled Tsunami bore was directed to collide on a selected structural configuration and the resulting impact force was determined. The model calibration and validation was performed utilizing data reported in the literature. The tuned model was applied under different combinations of hydrodynamic, object related parameters and the obtained results showed an increasing trend of the impact force with the object's mass, density, acceleration and the wave height. When the object mass and impact force variation was graphed under different wave spectrums, a slight variation among the impact forces was observed up to 15 kg of object masses. When the object masses varied from 15 kg to 25 kg, graphs showed a convergence to a same impact force irrespective of the spectrum used. This study will be instrumental in understanding the sensitivity of the parameters that govern the force triggered on a coastal structure by a Tsunami bore driven objects and the experience gained by this study can be used in upgrading of near shore design guidelines against the impacts from Tsunami.

Keywords: CFD, ANSYS AQWA, Tsunami Bore

Support Vector Machines-Based Traffic Sign Detection System for Autonomous Driving

G.A.N.S. Gunasekara[1]*, D.A. Gunarathna[1], M.B. Dissanayake[1] and S. Aramvith[2]

[1]Department of Electrical and Electronic Engineering, Faculty of Engineering, University of Peradeniya, Peradeniya 20400, Sri Lanka
[2]Department of Electrical Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
*e15112@eng.pdn.ac.lk

Autonomous driver assistance systems (ADAS) are becoming popular by the day in modern traffic systems. In ADAS, traffic sign recognition is an essential feature. In this study, we investigate traffic sign recognition using Support Vector Machines (SVM) algorithm. SVM is popular in image classification applications and is best suited for handling tasks with fewer amounts of data. The data set used to train the model consists of traffic sign images from Sri Lankan traffic systems, representing custom-selected signs from Danger warning signs and Regulatory signs. The database is built using dash camera images captured within city-limits and consists of 250 RGB images per class before data augmentation. At the input stage, the algorithm resizes the input images into 50×50 resolution. A real-time traffic sign recognition system demands for high detection accuracy under relatively low decision time delay. Hence, we have chosen SVM with simple pre-processing, in contrast to heavy image processing or deep learning based models in literature. Also, it is important to find the best fitting algorithm in terms of accuracy, efficiency and processing time. This was achieved by optimising hyperparameters, namely; regularization parameter, kernel, and kernel parameter in the SVM and obtained a maximum accuracy at 75:25; training:testing data split. The accuracy was further improved by, preprocessing techniques; upsampling, smoothing and sharpening filters, and a feature extraction method; Histogram of Oriented Gradients (HOG). The model obtained a 5-fold cross validated average accuracy of 85.21% with hyperparameter optimization, and an accuracy of 91.54% after utilizing preprocessing and feature extraction. With the implementation of automated traffic sign capturing with live video feeds, this model can be used in a local setting for traffic sign recognition.

Keywords: Machine learning, SVM, Pre-processing, Feature extraction

A Simulation on Service Performance Improvement:
A Case Study from Fast Food Industry

H.A.S. Fernando*, Y.B. Herath, E.T. Dhananjana,
K.L.T. Perera and I.D.W. Samarawickrama

*Department of Industrial Management, Faculty of Applied Sciences,
Wayamba University of Sri Lanka, Kuliyapitiya 60200, Sri Lanka
anuferh@gmail.com*

The fast food industry is associated with the rapid delivery and customer satisfaction is contingent with the rapidity in service provision. Thus, waiting time and queues tarnish the reputation. This study attempted to use a quantitative approach in assessing the service performance of a fast food restaurant in a hustling suburb of a commercial city in Sri Lanka. The purpose was to increase the effectiveness in queue management. Observations identified Monday 1 p.m. – 2 p.m. to be the most demanding hour at this two server restaurant. The study used a primary data sample of 386 customers through purposive sampling. Data on times of customer arrival, placement of the order to delivery were recorded on three consecutive Mondays. The study used Rockwell ARENA version 2019 to simulate the existing state. Queue one and queue two had average waiting times of 16.8 and 11.4 minutes respectively, indicating different serving capacities. The analysis identified that the existing system served only 35.65 percent of customers at the busiest hours. The study simulated the development possibilities of improving the efficiency of the servers and including an additional server. The decisive selection of an equally anticipated server among the three was an efficient result among the two alternatives. On an average, the additional server increased the serving times of the restaurant by 52.73 percent given consideration to the different service capabilities shown by the servers. The maximum service capacity at the premise would increase up to 72.88 percent at the busiest hour. The study identified service improvement opportunities in staff efficiency development and in addition to resources for peak-hour congestions in competing in the immensely competitive fast food industry. The study can be developed to reflect on the waiting average performance of the system, leading to strategies in optimizing the use of resources during non-peak times.

Keywords: ARENA simulation, Fast-food industry, Service improvement, Waiting time

Finite Element Approach to Evaluate Strength and Ductility of Steel Box Column with Corner Stiffener

M. Jenothan*, T. Thevega, J.A.S.C. Jayasinghe and C.S. Bandara

Department of Civil Engineering, Faculty of Engineering, University of Peradeniya, Peradeniya 20400, Sri Lanka
*makeswaranjenothan@eng.pdn.ac.lk

Most of the developing countries are upgrading their highways with grade-separated lanes which include flyovers and bridges. Steel bridge piers with hollow box sections are recently becoming more popular in highway bridge constructions due to their lesser construction time over concrete. Unlike columns in buildings, these steel piers are designed with a high width to depth ratio which makes them susceptible to damage with local or global buckling in severe earthquakes. Strength and ductility are the most important parameters for bridge pier structures to survive in severe earthquakes. There are many retrofitting methods introduced by the researchers to improve the seismic performance of steel columns by improving their strength and ductility. In this study, the seismic performance of steel columns with different stiffener arrangements (longitudinal stiffeners and corner stiffeners) inside the column are numerically analyzed under constant axial and varying lateral cyclic loadings. The advanced finite element simulation package, *ABAQUS* is used for this numerical study which includes both material and geometrical non-linearity where the column undergoes large inelastic cyclic deformation due to the cyclic loadings. The numerical simulation is conducted with the combined hardening material model and comparisons are carried out between three different groups of stiffener arrangements such as only corner stiffeners, corner stiffeners with two longitudinal stiffeners and corner stiffener with four longitudinal stiffeners. The results clearly show that the longitudinal stiffeners are important to enhance the strength, but corner stiffeners significantly increase the ductility compared to the column which has longitudinal stiffeners only. Although the corner stiffeners increase the ductility of the column, proper size, arrangement and length of the corner stiffeners play a major role in achieving the highest efficiency.

Keywords: Bridge piers, Cyclic loading, Ductility, Nonlinear FE simulation, Stiffened steel column, Strength

A Predictive Virtual Keyboard for Brain-Computer Interfacing

K.P.P.S. Pathirana

Department of Computer Science and Informatics, Faculty of Applied Sciences,
Uva Wellassa University, Badulla 90000, Sri Lanka
suneth@uwu.ac.lk

Brain-Computer Interfacing (BCI) is an impressive technology which enables individuals to operate a computer while being unable to be manipulated manually. The intentions of the user are recognized by analyzing the sensitive variations of the electrical potentials found on the scalp, as a result of the brain's (regional) neural activity and Electroencephalographic (EEG) electrodes. It is a challenging task to classify the EEG signals in real-time, or map the recognized patterns to corresponding user intentions. An intention is then converted into a simulated functionality of an input device such as a mouse. In most BCI systems, an on-screen (virtual) keyboard is used to get the user's input. A comprehensive study related to the process of designing and optimization of virtual keyboards, specialized in BCI was conducted. In addition to a critical analysis of existing layouts, an absolutely innovative and simplified keyboard is introduced. The principal strategy of the modernized keyboard is to update the caption of the keys (only 8 keys are available on the interface) dynamically with the predicted characters of the word which the user attempts to type. The unique eye-shaped layout is to further minimize the 'mental effort' where the eight dynamic keys are arranged in a manner, which can be reached easily (with minimal movements). The implementation was tested with a five (5) channel EEG device called Emotiv's "Insight". An important observation made was the overall performance which depends upon the performance of BCI (EEG device). A Multi-Agent System (MAS) was employed as the EEG data classification algorithm. The implementation has been evaluated with four (4) BCI users. Compared to the standard (QWERTY) layout, users could enhance the typing speed up to 26% approximately with the new optimized design. The study is planned to be improved, with better (accurate, faster/with minimal response delays) EEG devices and to be tested with more subjects.

Keywords: Brain-computer interfacing, Electroencephalography, Virtual keyboard

Impact of Ergonomics on Employee Performance of Sri Lankan Apparel Industry: A Case Study

R.V.M. Maduwanthi* and M.G.S. Dilanthi

Department of Industrial Management, Faculty of Applied Sciences, Wayamba University of Sri Lanka, Kuliyapitiya 60200, Sri Lanka
*mmaduwanthi272@gmail.com

The Sri Lankan apparel industry is highly labor intensive, hence; its overall productivity depends on employee performance. Thus, ensuring their health and safety is a necessity. Accordingly, adopting proper ergonomic practices affect both employee performance and the overall productivity of any organization. However, this study identified improper adaptation of ergonomic practices in the Sri Lankan apparel industry. Therefore, this research attempted to find the ergonomic factors and their impact on employee performance in sewing, cutting and warehousing sections in a selected apparel manufacturer. The substantive literature review identified the working environment, body postures, working hours, and repetitive motions as the mostly affected ergonomic factors hence; selected them to be the independent variables of this study. Then, it was conducted as a quantitative survey based research. Among the total population of 257, a sample of 201 employees was selected randomly. Accordingly, the primary data were collected through a common questionnaire with five point Likert scale for all three sections. They were analyzed using R software. Thereby, correlations between the identified ergonomic factors and the employee performance were checked. Furthermore, the regression analysis was also done. The results revealed that the sewing section was significantly affected by the working environment, body postures, and repetitive motions. The cutting section was significantly affected by body postures and repetitive motions. Moreover, the working environment and working hours significantly affected the warehousing section. The study was further continued with cause and effect analysis to investigate the impact of the ergonomic factors on the three selected sections. Accordingly, alternative solutions were suggested to improve employees' performance based on the findings. This study also provided insights to expand the ergonomic evaluations for the remaining sections in the industry and to investigate the impact of demographic factors on ergonomics using other methods except questionnaires.

Keywords: Employee performance, Ergonomics, Ergonomic factors, Sri Lankan apparel industry

Traditional vs. Deep Learning: A Comparative Study for Credit Card Fraud Detection

R.C. Nissanka[1]* and C.K. Walgampaya[2]

[1]*CareSystems Inc, 12 S Summit Avenue, Suite 325, Gaithersburg, MD 20877, USA*
[2]*Department of Engineering Mathematics, Faculty of Engineering,*
University of Peradeniya, Peradeniya 20400, Sri Lanka
*rchirath@caresystemsinc.com

This paper compares machine learning algorithms, namely deep neural networks, support vector machines (SVM), decision trees, logistic regression, and random forests, to predict fraud in the dataset. We implemented a deep neural network with four input layers, 12 neurons in the first hidden layer and eight neurons in the second, third, and fourth hidden layers, with two neurons in the output layer. In between the layers, a dropout function of probability 0.7 is applied to prevent overfitting. Further, we conducted a differentiation of the accomplished supervised machine learning and deep learning techniques. Our analysis aims to propose a comprehensive guide to choose the best technique for credit card fraud detection. The dataset used for training had 1000 instances of fraud transactions and 2128 instances of valid transactions. There were 53 attributes for each transaction. The attributes we used for classification were the longitude and the latitude of the client's internet protocol (IP) address and the timestamp attribute of each instance. Since the dataset is subjected to high-class imbalance, we have used synthetic sampling methods such as Synthetic Minority Oversampling Technique (SMOTE), Borderline-SMOTE (BSMOTE), and Adaptive Synthetic Sampling Method (ADASYN) to balance the dataset. The principal component analysis (PCA) was used as a pre-processing technique. We found out that when the input data is encoded with PCA, the deep neural network and the traditional classification approaches tend to perform better than when trained with the original data. All approaches that we evaluated in this paper scored an accuracy of above 90%.

Key words: Credit card fraud detection, Deep neural networks, SMOTE, BSMOTE, ADASYN

Vision-Based Road Distance Modeling for Inter-Vehicle Distance Estimation

I.U. Perera[1]*, K.M.S.K. Senavirathna[1], K.B.A.C. Jayarathne[1], G.M.R.I. Godaliyadda[1],
M.P.B. Ekanayake[1], J.V. Wijayakulasooriya[1], V.R. Herath[1] and I.M.S. Sathyaprasad[2]

[1]Department of Electrical and Electronic Engineering
[2]Department of Civil Engineering
Faculty of Engineering, University of Peradeniya, Peradeniya 20400, Sri Lanka
*imaliep101@gmail.com

Inter vehicle distance estimation plays a pivotal role in motion pattern analysis for intelligent traffic management systems. Estimation of the real distance between two points using the corresponding distance in video frames is an integral part of vision based inter-vehicle distance estimation. The basic geometric approach followed in mapping a distance in an image to its actual distance is based on coordinate transformations performed using intrinsic and extrinsic parameters of the camera. This study exploits a simple yet highly effective method of road distance modeling using video footage obtained from a pole mounted monocular camera by the method of regression analysis. The objective of this study is to estimate the real-world distance between two known points on a road surface using the pixel coordinates on an image. Data collection for the study was done by laying a printed grid on a suburban road and collecting a set of images of the road surface from a pole mounted camera. Linear step-wise regression was performed on the collected dataset with the pixel coordinates as the dependent variables and the measured distance between grid points as the predictor variable to identify the best subset of the predictor variables to be used. In addition, a neural network was also built using *Keras* and was trained on the same dataset to perform nonlinear regression. The validity and accuracy of the proposed methods were assessed using a validation dataset. By comparison of the mean square errors (mse) of the validation results, it is evident that the neural network regression model estimates the road distances with a higher level of accuracy (mse~0.0081m^2) and therefore this method of estimation can be utilized in inter-vehicle distance estimation.

Keywords: Distance estimation, Inter-vehicle distance, Regression, Neural network

Prioritization of Expected Employability Skills of Fresh Civil Engineering Graduates

M.M.G.V. Shyamalee[1]* and K.S. Walgama[2]

[1]Industrial Training and Career Guidance Unit
[2]Department of Engineering Mathematics, Faculty of Engineering,
University of Peradeniya, Peradeniya 20400, Sri Lanka
*shyamalee@eng.pdn.ac.lk

Prior awareness on the industry expectations of the employability skills of fresh engineering graduates is a very important aspect for deciding their career path. In this context, this study presents a methodology that can be applied to prioritize expected employability skills by considering the parameters which reflect the employer expectations. In a previous study by authors, eleven employability skills were identified as expected skills of fresh civil engineering graduates through a comprehensive data analysis performed using Factor Analysis. Data were collected from 110 employers based on the twenty-eight attributes identified to be important for engineering graduates. In the present analyses, the Multi-Attribute Value Technique (MAVT) which is used in decision making analysis was employed to prioritize the employability skills and the respective attributes. MAVT uses a linear additive model that explains the parameters related to employer expectation in terms of expected level of the skills and attributes, relative weights of the attributes, expected scores of the skills, and ranking indices of the skills and the attributes. The validation of the prioritized skills was done using a separate set of data collected from the employers on the expected skills of engineering undergraduates during their industrial training period. Quadrant Analysis which is used as a tool for strategic decision making was employed to compare the levels of required employability skills and to eliminate those with low priority. The results revealed that the employers consider Engineering Fundamentals and Application, Communication skills, Working Attitudes, Personal Attitudes, Computer Science and Technology, Engineering Practice, Standards of Engineering Practice and Design skills as the order of highly expected employability skills from fresh civil engineering graduates. The achievement of fresh civil engineering graduates in terms of these employability skills can be assessed using the proposed methodology in order to select their career prospects.

Keywords: Employability skills, Attributes, Engineering graduates, Multi-attribute value technique, Quadrant analysis

Effect of Under Sleeper Pad on Shear and Degradation Behaviour of Railway Ballast

H.G.S. Mayuranga*, S.K. Navaratnarajah, C.S. Bandara and J.A.S.C. Jayasinghe

*Department of Civil Engineering, Faculty of Engineering,
University of Peradeniya, Peradeniya 20400, Sri Lanka
sushanm@eng.pdn.ac.lk

Railway transportation provides a cost-effective and efficient transportation experience to passengers worldwide. Because of the numerous advantages, the ballasted railway track is the most prevalent track system in many countries including Sri Lanka. The ballast layer acts as the major load-bearing component in a ballasted track and that provides diverse advantages. However, during the track operation, the degradation of ballast aggregates due to the repetitive moving loads is significant and that results in excessive track settlement and damages to track elements. This increases the number of maintenance operations and thereby the life cycle cost of the railway track. This situation becomes severe with the presence of faster and heavier trains on existing ballasted tracks. To overcome these drawbacks, the attachment of Under Sleeper Pads (USP) to the bottom of the sleeper at the sleeper-ballast interface has become an established practice in most countries. USP with a softer surface improves the contact area at the sleeper-ballast interface and thereby reduces the ballast layer stresses by distributing the train load over a larger area. This significantly reduces the ballast degradation and improves the performance of the railway track. However, only limited studies have been conducted on the shear and degradation behaviour of ballast when these USPs are adopted. Therefore, this study focused on evaluating the shear and degradation behaviour of ballast with and without the inclusion of USPs by using the large-scale direct shear apparatus under 30, 60, and 90 kPa normal stresses. The results exhibited that the adoption of USP has reduced the ballast degradation by more than 75% for the three normal stresses examined. However, there was about a 40% reduction in friction angle of fresh ballast when USPs are adopted to the ballast layer.

Keywords: Ballast, Large-scale direct shear test, Railway track, Under sleeper pad

Science, Technology and Industry

Development of Train Track Models with Continuum Superstructure and Simplified Substructures

R.M.D.L. Rathnayake*, S.K. Navaratnarajah, J.A.S.C. Jayasinghe and C.S. Bandara

Department of Civil Engineering, Faculty of Engineering, University of Peradeniya, Peradeniya 20400, Sri Lanka
*dimalir@eng.pdn.ac.lk

The ballasted railway track is the most economical, and widely used conventional transportation mode in many countries. Many kinds of research associated with railway tracks are being conducted to contribute to the development of the railway network to cater future demands. A typical railway track of ballast consists of the superstructure and the substructure. The superstructure is composed of the rails, the fastening systems, and the sleepers, whereas the substructure is composed of the ballast, the sub-ballast, and the subgrade. The behavior of the superstructure and substructure below is always interdependent. Ballast and sub-ballast layers transfer the dynamic forces generated due to train movement to the underlying subgrade. Therefore, it is important to consider the response of the substructure when implementing a model of the superstructure of a railway track. Although software with advanced soil models is often used to represent the complex soil characteristics, merging such a model with the superstructure modeled in detail will demand an unrealistic large computational cost. Adopting a low fidelity model which can represent the railway substructure with sufficient accuracy can reduce the computational cost significantly. This study focuses on coupling simplified substructure models with high fidelity finite element superstructure model with acceptable accuracy. Various substructure models are developed referring to Winkler foundation model and its extensions using spring and connecter elements in ABAQUS software and coupled with continuum superstructure to analyze the dynamic behavior. A 3D Finite element model with continuum substructure and continuum superstructure developed using ABAQUS software and validated using field data documented in literature is used as a reference model to do a comparative study between the simplified substructure models. A parametric study is done by changing train speed and substructure conditions and the best simplified models to be coupled with continuum superstructure is recommended.

Keywords: Ballast, Superstructure, Substructure, Low fidelity, Continuum

Solving Capacitated Vehicle Routing Problem with Ant Colony Optimization-Based Clustering

R.C. Nissanka[1]* and C.K. Walgampaya[2]

[1]*CareSystems Inc, 12 S Summit Avenue, Suite 325, Gaithersburg, MD 20877, USA*
[2]*Department of Engineering Mathematics, Faculty of Engineering,
University of Peradeniya, Peradeniya 20400, Sri Lanka*
**rchirath@caresystemsinc.com*

Transportation is an essential aspect of the existence of society. In the modern era, the transportation of goods and passengers is one of the basic requirements for society's sustainability. Therefore, a requirement arises to make transportation as efficient as possible by minimizing fuel consumption, distance traveled, and the time taken to deliver goods to various locations. Vehicle Routing Problem (VRP) is often studied to make transportation as efficient as possible. Capacitated Vehicle Routing Problem (CVRP) is the simplest form of VRP. Two approaches to solving the CVRP are evaluated in this paper. Clustering the locations into several cluster sets and then, for each cluster, solving the traveling salesman problem (TSP) is the standard methodology of solving the CVRP. Solving the TSP across all locations and then clustering the locations by demand and vehicle carrying capacity is an alternative approach in solving the CVRP. Ant colony optimization, simulated annealing, and dynamic programming were utilized to solve the TSP. The time it took to find an optimal route and the total distance traversed for each approach was evaluated. Google's distance API was used to find the cost of traversing from one location to the next, which was then used to evaluate the total distance traversed on each optimal route. A supplier company based in Sri Lanka has 82 locations and mini trucks of 3500kg carrying capacity, which was used as the case study to evaluate our approaches. The TSP approach of ant colony optimization and then clustering based on demand and vehicle carrying capacity constraint approach performed the best with 20 trucks utilized and a total distance traversed of 9,720 km, which had a running time of 3.19 seconds.

Keywords: Capacitated vehicle routing problem, Travelling salesman problem, Ant colony optimization

Insertion of Geogrid to Ballast Layer to Improve Rail Track Performance

S. Venuja*, S.K. Navaratnarajah, C.S. Bandara and J.A.S.C. Jayasinghe

Department of Civil Engineering, Faculty of Engineering, University of Peradeniya, Peradeniya 20400, Sri Lanka
*venujas@eng.pdn.ac.lk

Rail transport provides assured services to commuters and freights more economically. In conventional rail tracks, rails are rested on sleepers on top of the layered substructure. The ballast layer is the prominent load-bearing layer in the substructure. It facilitates quick drainage through its interconnected larger voids. Ballast is a highly angular coarse granular material that is obtained from blasting rocks and has high shear strength. Ballast particle breakage with time is the main crisis that affects the functionality and service life of tracks. It blocks the drainage as the broken particles clog the voids in the ballast layer. It also increases the frequency of monitoring and the maintenance cost. This ballast degradation depends on load cycles, aggregate gradation, the angularity of particles, and track confining pressure. One of the popular methods to decrease ballast deformation and degradation is the adaption of geogrid into the substructure. Polymeric geogrids with different shaped apertures are used in rail track applications. Geogrid has high tensile strength and high adaptability. Geogrids provide reinforcement and confinement to the ballast aggregates through the excellent mechanical interlocking of granular aggregates into the apertures. This study analyzed the effect of geogrid insertion into the ballast layer to understand the shear behavior of ballast by conducting large-scale direct shear tests on ballast with and without geogrid. There was a significant improvement in the shear resistance of ballast with the geogrid insertion due to the particle interlocking into the geogrid apertures. Moreover, numerical modeling was carried out using the discrete element method which confirmed the experimental findings. It is concluded that geogrids provide beneficial performance improvement to the ballasted tracks as it reduces the frequency of maintenance, provides lateral confinement to the ballast layer and improves load transmission.

Keywords: Ballast, Breakage, Gradation, Geogrid, Confinement

Large-Scale Testing Facilities to Study Stress-Strain, Degradation and Drainage Behaviour of Railway Ballast

S.K. Navaratnarajah*, H.G.S. Mayurang and S. Venuja

Department of Civil Engineering, Faculty of Engineering,
University of Peradeniya, Peradeniya 20400, Sri Lanka
*navask@eng.pdn.ac.lk

The demand for quicker and safer transport and solutions for congestion in main highways during peak hours has made the railways the most favourable means of public transportation in many countries. Besides, the demand for increased axle loads of heavy-haul trains for industrial needs is inevitable to provide a cost-effective and efficient transportation system. However, when subjected to heavy axle and faster wheel loading, ballast aggregates rapidly degrade, compromising the particle shear resistance and associated substructure's load-bearing capacity. The conventional geotechnical testing facilities such as direct shear, triaxial and permeability apparatus are the most versatile laboratory methods for obtaining the strength, deformation and drainage properties of fine-grained materials to small size granular rock specimens. The sizes of ballast particles used in rail tracks ranges from 20 mm to about 65 mm. Therefore, the load-bearing capacity of ballast and its deformation, degradation and drainage characteristics can only be studied using large-scale testing equipment, because the conventional geotechnical equipment cannot accommodate relatively large size aggregates. Nevertheless, the difference between the actual particle sizes used in rail tracks and the significantly reduced particle sizes used in aforesaid conventional laboratory equipment contribute to imprecise deformation, degradation and drainage behaviour and failure modes. This is because of the inevitable size-dependent dilation and different mechanisms of particle crushing that occur in real-sized particles. To overcome these size-dependent problems, large-scale direct shear, triaxial, and permeability test facilities for testing ballast have been designed and built in-house at the Department of Civil Engineering of the University of Peradeniya. These test apparatus provide more realistic information on stress, strain, degradation and drainage characteristics of ballast particles used in actual rail tracks. This study elucidates the results of this major testing program conducted at the Department of Civil Engineering where static, dynamic and drainage testing of ballast are being conducted. The Sri Lankan railway ballast materials tested by this large-scale testing shows that the friction angle of the fresh ballast is 69° and the permeability is 0.43 m/s which are generally within the accepted limits for railway ballast materials.

Keywords: Ballast, Deformation, Degradation, Direct shear, Triaxial, Permeability

Effect of Enterprise Social Networking Adoption Practices on Knowledge Management in Sri Lankan Software Companies

H. Asela

Department of Electrical and Information Engineering, Faculty of Engineering, University of Ruhuna, Galle 80000, Sri Lanka
asela.h@eie.ruh.ac.lk

Enterprise social networking (ESN) tools provide a platform for businesses to work collaboratively on group activities and tasks. These tools are rapidly expanding in business environments replacing traditional methodologies for employee collaboration and project management. Many Sri Lankan software firms are adopting these tools to support virtual operations but the adoption practices play a significant role in achieving desired benefits. Knowledge management (KM) is identified as one of the essential requirements for software firms as it is knowledge-driven. Some of the previous researches indicate that the ESN tools implementation positively impact knowledge management in organizations but there are limited research done to identify the relationship between these two variables in the Sri Lankan software industry. Therefore, investigating on the relationship between ESN tool adoption practices and knowledge management in Sri Lankan software companies is essential. This research study aims to analyze the effect of ESN tool adoption practices on knowledge management in Sri Lankan software companies. The research instrument for this study is an electronic questionnaire. The target population had IT professionals with different job roles employed in small to large scale software firms. 95.6% of them had experience in using ESN tools in their organizations and 78.8% of them are using these tools daily. The study followed a convenient sampling technique with a sample size of 205. The relevant indicators for the dependent and independent variables were derived from previous literature. Statistically significant person correlation value of 0.423 and standardized beta coefficient value of 0.258 proved the moderately positive relationship between ESN tool adoption practices and knowledge management in Sri Lankan software companies. Therefore, it is significant to consider ESN tool adoption practices to improve knowledge management in Sri Lankan software companies.

Keywords: Enterprise social networking tools, Adoption practices, Knowledge management, Sri Lankan software companies

Science, Technology and Industry

Damping Change-Based Damage Detection of Post-Tensioned Concrete Girder Bridges

A.J. Dammika

Department of Civil Engineering, Faculty of Engineering, University of Peradeniya, Peradeniya 20400, Sri Lanka
dammikaaj@pdn.ac.lk

Structural health monitoring (SHM) techniques are used all over the world to detect the damages in infrastructures to assure the safety of the public and the property. The most common practice of SHM in the world is the period visual inspections. However, the visual inspection method has many drawbacks such as difficulty of detecting invisible damages, accessibility issues and person dependent judgements etc. Therefore, complementary tools like vibration-based structural health monitoring techniques (V-SHM) are investigated worldwide to assist the periodic visual inspection judgments. This research was focused on the damage detection of a few selected post-tensioned concrete (PC) girder bridges of different ages using V-SHM techniques as it is a one of the most common type of bridges in Sri Lankan context. Among V-SHM techniques, modal damping change-based techniques can be identified as one of the most sensitive damage indicators, especially due to its capability of detecting nonlinear dissipative characteristics produced by cracks like internal defects. The research was conducted by basically experimental modal identification of the selected bridges and their numerical modal identifications using finite element method. In the experimental model identification, span wise field vibration time histories recorded by the wired sensors were analyzed by using the natural excitation technique with Eigensystem realization algorithm (NExT - ERA). Vibration mode shapes and their natural frequencies of the bridges were verified by simply comparing the results obtained from both approaches. Then experimentally identified modal damping ratios were studied to reveal the status of the health condition of the bridges. No abnormal behavior of modal damping ratios were detected in similar spans of the same bridge, as well as between bridges having similar span length of different ages. Therefore, no significant amount of accumulated damages in the studied PC bridges and identified modal parameters can be used as a set of baseline data for SHM activities the bridges in future.

Keywords: Post tensioned concrete girder bridges, Vibration-based health monitoring, Modal damping ratio

Optimization of Coagulation and Flocculation Process in Kandana Water Treatment Plant

N.S. Jayasinghe[1], M. Makehelwala[1], W.B.M.L.I. Weerasekara[2] and S.K.Weragoda[1]*

[1]*China Sri Lanka Joint Research and Demonstration Center for Water Technology, Kandy 20000, Sri Lanka*
[2]*National Water Supply and Drainage Board, Kurunagala 60000, Sri Lanka*
*Skwera7@gmail.com

There are several treatment unit processes in conventional water treatment plants (WTP). The turbidity of raw water (RW) is eliminated by the coagulation and flocculation processes (CFP). The overdosing and under dosing of coagulant in CFP has become critical in the water treatment process since it affects on the public health and treatment efficiency. In order to assess the optimal coagulant dose, most WTPs in Sri Lanka conduct the jar test, taking into account only the RW pH and turbidity. Moreover, when performing the jar test, there is no concern about the velocity gradient (G) value in the WTP architecture. This case study was conducted to compare the optimum coagulant doses obtained for the same RW sample from the general jar test method (M1) and the WTP design G value considered method (M2). Three trials were conducted for each method. Rapid mixing, slow mixing rates, and settling time of M1 were; 1 min at 180 rpm, 4 min at 120 rpm, 6 min at 40 rpm and 30 min respectively. Rapid mixing, slow mixing rates, and settling time of M2 were; 1 min at 155 rpm, 22 min at 20 rpm, and 30 min respectively. Jar tests were performed using Alum as the coagulant. The average optimal coagulant dose obtained for M1 was 11.87 mg /L and for M2 was 10.27 mg/L. The optimal coagulant dose of M1 is therefore higher than that of M2. It is therefore advised to consider the design G value of the WTP design manual to achieve a more precise optimum coagulant dose. However, further modifications of the jar test procedure should be done considering the other effecting factors.

Keywords: Coagulation, Flocculation, Velocity gradient, Rapid mixing, Slow mixing, Optimum coagulant dose

Usability of Waste Glass Wool in Concrete to Improve Compressive Capacity: An Analysis

K.M.J.R. Gajadheera

Department of Civil Engineering, Faculty of Engineering and Technology,
CINEC Campus (University of Wolverhampton, UK), Malabe 10115, Sri Lanka
randhulagajadheera@gmail.com

Currently, Waste Glass Wool (GW) is dumped on construction sites or used as backfill, both which are not environmentally friendly. Hence, more research is required on effectively reusing glass wool. Past research show that Glass fibres (GF) are known to increase the tensile and flexural strengths of concrete while increasing or maintaining the compressive strength. However, glass fibres are not commonly used around the world due to the high cost of manufacture. The Glass wool (GW) is a much finer version of glass fibres which are bonded into blankets or sheets and is more cost effective –the waste is essentially free. Although flexural and tensile strengths have been shown to increase, the compressive strengths were not satisfying by using glass wool in the past. Hence, this research is focussed on analysing the effective reuse of waste glass wool fibres in concrete mixes, along with an admixture, to increase the compressive strength of concrete. Cube tests were performed to determine the characteristic compressive strength of the concrete mixes with 0%, 5% and 10% GW by volume, along with a slump test for each mix to determine the workability. A superplasticiser was used to obtain a reasonable workability for the fibre mixes. A cost comparison of previous studies on Glass Fibre Reinforced Concrete (GFRC) was done to clarify the economic benefits of replacing glass fibres with glass wool. The workability of the GW concrete decreased until the superplasticiser was incorporated, after which a workability of 71mm was attained with 5% GW, whilst 10% provided a similar workability to the control mix (65mm). The density of the concrete decreased with the addition of GW, i.e., 2.512% decrease with 5% glass wool and 6.455% decrease with 10% glass wool. The compressive strength showed the greatest increase of 22% with 5% glass wool.

Keywords: GFRC (Glass fibre reinforced concrete), Glass wool reinforced concrete, Superplasticiser, Compressive strength, Density

Sustainable Solutions for Manufacturing of Automotive Panels

M.L.R. Meragalge[1,2]* and P. Gamage[2]

[1]*Department of Mechanical and Manufacturing Technology, Faculty of Technology, Wayamba University of Sri Lanka, Kuliyapitiya 60200, Sri Lanka*
[2]*Department of Manufacturing and Industrial Engineering, Faculty of Engineering, University of Peradeniya, Peradeniya 20400, Sri Lanka*
*lakshitham@wyb.ac.lk

Sustainable, eco-friendly manufacturing has become a key area in the modern manufacturing industry. Hence, sustainable solutions for automotive parts manufacturing have become a leading research area. Enhancing the fuel efficiency of automobiles is one of the main topic concerns today. Therefore, application of light weight metals for automotive body parts has been identified as a successful sustainable solution, although those materials have a low formability compare with generally used materials. Lubrication is another key point in the sheet metal forming process where the body panels are formed. This research is focused on enhancing the formability of light weight metals which can be used in automotive body panels as a sustainable solution and also sustainable metal forming approach with sustainable lubricants. In this study, formability of AA 2014 T6 Aluminum material was tested using Forming Limit Diagrams (FLD) which were developed using Nakajima test method at elevated temperatures with different lubricants. In the first phase of the study, FLDs were developed at three elevated temperature conditions (200^0C, 250^0C and 300^0C) with three types of lubricants (Spray type - MoS_2, Paste Type – Chisel Paste and Liquid Type – ST FORGE STAR E). The highest formability of AA 2014 T6 material was observed at 300^0C with MoS_2. In the second phase of the study, sustainable lubricants were tested to replace the MoS_2 synthetic lubricant. Soapnut solution and Canola oil with boric acid powder mixture were identified as two types of green lubricants which can be used as alternatives for MoS_2. There was a significant improvement in the formability of AA 2014 T6 material at high temperatures with the two green lubricants. Therefore, AA 2014 T6 Aluminum material can be recommended to be used in automotive body panels as a sustainable light weight material.

Keywords: Automotive body panels, Sustainable manufacturing, Lubricants, Temperature, Formability

FFBPNN Approach to Smartphone-Based Indoor Positioning Technique

L.C.D. Wickramasinghe[1]* and M.B. Dissanayake[2]

[1]Department of Electronics, Faculty of Applied Sciences, Wayamba University of Sri Lanka, Kuliyapitiya, 60200, Sri Lanka
[2]Department of Electrical and Electronic Engineering, Faculty of Engineering, University of Peradeniya, Peradeniya, 20400, Sri Lanka
**lasini2013@gmail.com*

There exist many Indoor Localization (IL) techniques like radio-frequency identification, Wi-Fi, iBeacon, vision based surveillance. However, most of them, except Wi-Fi, require additional hardware. Traditional Received Signal Strength Indicator (RSSI) based IL, uses trilateration technique. The specific attribute of the Machine-Learning (ML) models is the ability to learn complex relationships that map inputs to the outputs while identifying patterns. In literature, researchers have used ML such as recurrent neural network, artificial neural network, k-nearest neighbor, support vector machine for IL, but very few have adopted back propagation. In our system, a smartphone with WiFi Analyzer software, in home Wi-Fi network, collects RSSI data from three Wi-Fi access points. This process was repeated for morning, noon and night to revoke the errors in the dataset by calculating the average. These RSSI data along with measured 2D coordinates of the smartphone location are used to train a Feed Forward Backpropagation Neural Network (FFBPNN) which is capable of fine tuning the weights of the network based on the feedback channel. The proposed FFBPNN employs, training function; Levenberg-Marquardt, the fastest backpropagation algorithm, adaptation learning function; gradient descent for momentum weight and bias updating, performance function; mean squared error, the default performance function for feedforward networks, and transfer function; Tan-Sigmoid. Mean Absolute Error (MAE) and Mean Absolute Percentage Error (MAPE), where MAPE indicates the distance error percentage per meter, are used for performance evaluation. The proposed FFBPNN reached a test accuracy of 73.4% (MAE = 0.82, MAPE=26. 6%) in the tested home environment. According to the MAPE, every 1m distance is associated with a 26.6 cm error. The significance of this error depends on the size of the indoor environment and the application scenario. In future, the model could be generalized for any indoor environment by expanding the variability of the dataset.

Keywords: Received signal strength, FFBPNN, Smartphone, Trilateration

Generating Efficient Delivery Routes Utilizing a Heterogeneous Fleet of Vehicles

P. Hettiarachchi*, S. Dharmapriya and A.K. Kulatunga

*Department Manufacturing and Industrial Engineering, Faculty of Engineering,
University of Peradeniya, Peradeniya 20400, Sri Lanka
hpunsarahettiarachchi@gmail.com

This study considered a distribution network of a brewery manufacturer delivering products to retail outlets in different geographical locations with distinct demand and operating time windows. The company possesses a heterogeneous fixed fleet of trucks in four different capacities. An increased distribution cost and the underutilization of resources are major issues of the company due to its inefficient distribution planning method. This study aims to generate efficient delivery routes with minimum traveling distance assigning a set of outlets to utilize more than 80% of the truck capacity. This problem was formulated as a vehicle routing problem with the heterogeneous fleet, which is an integer programming problem belonging to the combinatorial optimization category. The model was solved using the Simulated Annealing algorithm, a metaheuristic used to solve NP-hard type industry applications. Initially, the optimal sequence of all outlets in terms of distance was generated using Simulated Annealing with and without mutation local operator. Trucks were then assigned to the best set of outlets achieving the required capacity utilization levels given the minimum travel distance achieved. Control parameters including starting temperature, ending temperature and cooling rate of Simulated Annealing were set according to the convergence of Simulated Annealing. The mean and standard deviation of the results from both methods were compared, and the analysis revealed that Simulated Annealing with mutation gave the best results. The total travel distance was reduced by 15% compared to the existing value and average vehicle utilization was 90%.

Keywords: Vehicle routing problem, Logistics, Heterogeneous Fleet, Combinatorial optimisation, NP-hard

Bearing Enhancement of Pad Foundation on Geomat Reinforced Soft Soil: A Numerical Study

M. Nithurshan*, E.G.T.D. Edirisinghe and H.M.P. Sandaruwan

Department of Engineering Technology, Faculty of Technology, University of Jaffna, Ariviyal Nagar, Kilinochchi 44000, Sri Lanka
*nithurshan@univ.jfn.ac.lk

A foundation is a substructure that transmits the load coming from the superstructure to underlying soil or rock. When designing a shallow foundation, special consideration should be paid to critical parameters such as bearing capacity and settlement. Increasing population growth and the demand for the land, force the constructions on soft soil, where the bearing capacity of the soil needs to be improved. Reinforcing the soil with environmentally friendly material made from coconut fiber, known as coir geomats, is one of the sustainable and cost-effective methods used to improve the bearing capacity of such soils. Many studies have been carried out related to improvement in the bearing capacity of sand soil using reinforcing material. However, there have been only few studies focusing on the improvement of very soft soil using geomats. Thus, the aim of the study was set to investigate the bearing capacity of peat by varying the number of geomats at different depths. Coir geomat is to be coated with polythene to improve the durability in the peat. Analytical methods such as Terzaghi's theory and Eurocode7 provisions, were used to estimate the unreinforced bearing capacity and settlements of a pad footing in a specific configuration. Then, a numerical model was developed in the finite element software, *PLAXIS*, to predict the load-settlement behavior. Fine mesh analysis was used for numerical analysis to confirm the convergence of results. The analytical estimates were compared with results from numerical analysis. Furthermore, the numerical analyses were extended to investigate the effect of various parameters: depth to first reinforcement (u)/ Footing width (B), spacing between reinforcement layers (h)/B, and length of the reinforcement layer (L)/ B. The results showed that the reinforcement configuration has a very significant effect on the behavior of reinforced peat soil foundation. For effective utilization of coir geomat reinforcement, the optimum depth to first reinforcement should be 0.2B, the vertical spacing between reinforcement layers should be 0.2B, the length of the reinforcement layer should be 3B and the number of reinforcement layers should be at least three.

Keywords: Bearing capacity, Coir geomat, Peat soil, Settlement, Shallow foundation

Sentiment Analysis in User Reviews: A Study of Incompatibility in Hotel Reviews in City of Anuradhapura, Sri Lanka

H.P.P.M. Abeysinghe[1]* and C.K. Walgampaya [2]

[1] *Department of Civil Engineering* [2]*Department of Engineering Mathematics*
Faculty of Engineering, University of Peradeniya, Peradeniya, 20400, Sri Lanka
**prarthanamabeysinghe@gmail.com*

Along with technological advancements, travelers often use social media platforms such as TripAdvisor to share their opinions, attitudes, and feelings using few lines of text also known as user reviews. Sentiment analysis or opinion mining aims to detect subjective information in such user reviews. In TripAdvisor, travelers not only can submit written reviews but also can rate hotels or attractions based on their overall experience on a numerical scale, which is known as the bubble rating. Choosing such a single score which matches the review could be subjective. For example, despite the excellent service facilities of a particular hotel, the condition of the road to the hotel may be poor. The users' bubble rating may be influenced by such secondary data. The objective was to find such similar instances where the bubble rating does not reflect users' genuine opinions expressed in their comments or reviews. In this research, approximately 7,000 hotel reviews in TripAdvisor were taken for popular hotels located in the city of Anuradhapura, Sri Lanka. The data were collected for 10 years from 2010 to 2020 using an algorithm which was developed to automate the data extraction task. An automatic sentiment detection algorithm was developed to study the compatibility between users' bubble ratings and reviews. As the dataset is unlabeled, Vader and TextBlob unsupervised lexicon-based sentiment analysis approaches were used to assign sentiment scores to each word. According to the confusion matrices obtained from both approaches, it was concluded that users may write negative sentences in positive reviews and vice versa; therefore, the bubble rating on TripAdvisor is not a satisfactory indicator for gathering users' experience on hotels in the city of Anuradhapura and will be a cause for missing a lot of crucial information provided by customers on the quality of service in the hotel industry.

Keywords: Sentiment analysis, Social media, TripAdvisor, VADER sentiment, TextBlob

Estimating the Degree of Market Power of Rice Milling Industry in Sri Lanka

M.M. Mufeeth[1]*, S.A.Weerasooriya[2] and J. Weerahewa[3]

[1]Postgraduate Institute of Agriculture [2]Department of Agricultural Economics and Business Management, Faculty of Agriculture
University of Peradeniya, Peradeniya 20400, Sri Lanka
*mufeethsnis@gmail.com

The rice milling industry in Sri Lanka serves as an integral industry in supplying rice to the nation in terms of quantity and quality. Many argue that the rice milling industry's market structure is non-competitive. In this setting, the present study investigated the degree of market power of the rice milling industry and the impact of Government Ceiling Price (GCP) on it. The study used the Conjectural Variation (CV) elasticity model of the New Empirical Industrial Organization (NEIO) approach. The data on wholesale rice price, milling input prices, demand for domestically produced rice and demand shifters such as per capita gross national income, the wholesale price of wheat and imported rice were collected from the Department of Census and Statistics, Central Bank of Sri Lanka, and Hector Kobbekaduwa Agrarian Research and Training Institute spanning from 1982 to 2019. The system of equations such as; (1) rice miller's pricing equation and (2) demand equation for domestically produced rice was estimated via a non-linear seemingly unrelated regression. The empirical results show that the value of CV elasticity was statistically different from zero (p<0.05) thus, the industry was in a non-competitive condition during the study period. Further, the Sri Lankan rice milling industry operated in an oligopoly market structure for each year of the period 1982 to 2019. An insignificant (p>0.05) declined was observed in CV elasticity once the GCP was introduced. The price of rice set by the rice miller was positively affected by the farm gate price of paddy, wage rate and industrial electricity charge (at p<0.05). Further, the estimated own-price elasticity produced rice was -0.50 (p<0.05). Thus, the own-price elasticity of demand for locally milled rice was inelastic for the period.

Keywords: Conjectural variation, Market power, NEIO approach, Rice-milling industry

Significance of Employee Motivation in Insurance Industry in Sri Lankan Context

A.H.N. De Zoysa

Department of Philosophy, Faculty of Social Sciences, University of Kelaniya, Kelaniya 11600, Sri Lanka
harini.navo33@gmail.com

Employee motivation which has long been a hotly debated topic is an essential component of any organization's performance at present. Motivation inspires employees to work together toward a single goal, allowing a company to achieve its goals more rapidly. Many organizations, however, are having problems keeping employees due to high-pressure conditions, rigorous deadlines, massive work volumes, and lengthy work hours. Thus, this study attempted to investigate the importance of employee motivation in the Sri Lankan insurance sector. The objectives of the study were to (1) identify the factors that are necessary for successful motivation, and (2) find techniques for increasing employee motivation and efficiency in the workplace. The study was conducted through quantitative research utilizing a random sampling method to choose 150 employees from three insurance companies. Both primary and secondary data were used in this study. Questionnaires prepared based on the Likert scale were used to collect primary data, and magazines, books, and web sites were used to collect secondary data. The descriptive statistics, reliability analysis, and factor analysis tests were all performed using SPSS. The findings of the research identified several motivating factors: promotions, salary, appreciation, relationships with management, rewards, good working conditions and training and development, etc. According to employees, salary, rewards and good working conditions are the three most important factors for successful job motivation. Further findings suggest that, in order to minimize employee demotivation, management should use strategic techniques to promote employee motivation and get them to interact effectively and efficiently. They create an evaluation system, promote frequent staff conversations, and praise them for work completion and accomplishments, and improve communication. This study therefore concluded that employee motivation is crucial for enhancing productivity and, eventually, assures the company's success and it is based on a number of factors that motivate employees to work efficiently in order to attain high levels of performance.

Keywords: Employee motivation, Insurance industry, Organization's performance, Motivating factors, High levels of performance

Forecasting Share Price Index of Health Sector in Sri Lanka

R.P.S. Lankadari* and N. Satkunanathan

*Department of Mathematics and Statistics, Faculty of Science,
University of Jaffna, Jaffna 40000, Sri Lanka
shashikalarajapaksha1996@gmail.com

Share market investment has become one of the most popular modes of investment in Sri Lanka. However, due to the uncertainty of the share prices, forecasting share price indices is one of the essential tools that would support the potential investors. Among several sectors whose shares are circulating in the share market, Health sector shares have a stable price with no high fluctuations. The objective of this study is to develop a suitable Autoregressive Integrated Moving Average (ARIMA) time series model for the monthly share price indices of the health sector based on data received from the Colombo Stock Exchange to   that cover the period from March 2002 to September 2019 as in-sample data and from October 2019 to March 2020 as out-of-sample data. Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test and Box-Pierce (Ljung-Box) test were used to check the stationary and white noise of the series respectively. Further, The Maximum Likelihood method was applied to estimate the model parameters. In addition, forecasting accuracy measures Mean Absolute Percentage Error (MAPE), Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC) were considered for the model selection based on in-sample data. Root Mean Square Error (RMSE) and Mean Absolute Error (MAE) were considered to identify the best model based on out-of-sample data. Second-order differencing of log transformed series was clearly stationary. Then, by considering the minimum value of MAPE, AIC and BIC, ARIMA(0,2,1)(0,0,0)[12], ARIMA(0,2,1)(1,0,0)[12] and ARIMA(2,2,3)(0,0,0)[12] were selected as best fitted models. Finally, ARIMA(0,2,1)(1,0,0)[12] was chosen as the best-fitted model since it has the smallest RMSE and MAE values of out-of-sample forecasting. Further, the forecasted value of share price indices revealed that share price indices will generally fluctuate for the following 10 months. Hence, the health sector would provide better opportunities for investors during the forthcoming period.

Keywords: Share price indices, ARIMA, Box-pierce (ljung-box) test, KPSS test, Forecasting

Influence of Visual Merchandising on Consumer Purchasing Habits in Bandarawela Area, Sri Lanka

F.A. Nisthamin and H.M. Rathnayake*

Department of Agribusiness Management, Faculty of Agricultural Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya 70140, Sri Lanka
*maheshika@agri.sab.ac.lk

Retail industry is an industry with a high level of competition. Therefore, they should mainly focus on the store atmospheric variables to achieve competitive advantage over the other retail businesses. As there are several studies, which are related to the impact of visual merchandising on consumer buying patterns in Sri Lanka, it is essential to identify the impact of store management systems to create a superior customer experience. The main objective of this study is to identify the impact of the store management system on the consumer buying behavior in two supermarket outlets in Bandarawela area. Descriptive and inferential research approaches were used to evaluate the research hypothesis. Two regional divisions were selected out of ten divisions in the Bandarawela regional divisions and a multi-stage random sampling method was employed. Responses were collected from 170 respondents, 85 from each outlet. The research was conducted using a questionnaire survey and evaluated using factor analysis, correlation analysis and regression analysis. The research process started with building a theoretical framework of independent variables; cleanliness, lighting, display, layout, scent, color and the dependent variable; consumer buying behavior. According to the research findings, store display and store layout have a significant relationship with consumer's buying behavior while cleanliness, lighting, and scent have an insignificant relationship with consumer's buying behavior. Based on the research findings, color is the major determinant factor in the grocery store. Thus, the retailers should focus more on the determinants in the retail store as store layout, store display, scent, lighting, and cleanliness respectively. Due to the limitations of finance, it was unable to conduct this research in all cities choosing a large sample size. This research has important implications for marketing practitioners in the context of retail store management systems as it provides a clear direction for managing customer based store environments.

Keywords: Consumer purchasing habits, Retail buyability, Store atmosphere, Store environment, Store layout

Strategic Impact of Utilizing *YouTube* Influencers in Digital Marketing on a Brand: From a Sri Lankan Consumer Perspective

R.D. Pathiraja[1]* and P.M.P.C. Gunathilake[2]

[1]*School of Computing and Information Systems, Kingston University, London, KT2 7LB, United Kingdom*
[2]*Department of Statistics and Computer Science, Faculty of Science, University of Peradeniya, Peradeniya 20400, Sri Lanka*
*rameshdilshan.srilanka@gmail.com

YouTube has become a splendid tool in social media product marketing to target and influence especially the generations of millennials and centennials through digital content management. The authors attempt to discover the truth behind the dilemma: whether the natural endowment of a *YouTube* influencer has the power to provoke centennials in the digital customer journey experience. The research is based on a scope of centennials accommodating among the three most populated cities in Sri Lanka: Colombo, Kandy, and Kurunegala, with an increase in internet penetration. A cross-sectional study was designed and exploratory data analysis was carried out to derive results for the set objectives. Screen-time in *YouTube* was matched with the alternate visual entertaining mediums to proceed in understanding the cause of deterioration of interest in the traditional television and the acceleration of interest in *YouTube* with the technique of random sampling. The centennial age group was targeted using social media and tuition classes and 313 respondents participated in the survey with individual consent. The study derives that when authentic channels promote products, the viewers are automatically provoked to buy them because of the credibility they have entrusted to the influencers. This research would help the reader to comprehend the value of *YouTube* influencer marketing, which is valuable, accessible, and ultimately, a splendid tool for marketing in the long run. Outcomes of the research can be taken as facts by marketers to make effective decisions by anticipating the *YouTube* audience behavior. The recommendations of *YouTube* influencers and product purchasing were highly correlated (more than 0.8). To conclude, *YouTube* influencers will not only endorse the awareness but also will garland the brand with trust and acceptance if invested in the right *YouTuber* and the content.

Keywords: Centennials, YouTube marketing, Brand awareness, Product marketing, Influencer marketing

Impact of Team Leader-Group Leader Structure on Manufacturing Flexibility in Apparel Industry

M.L.W.T. Karunaratne[1]*, M.L.W.O.M. Karunaratne[2] and W.M.M.T. Wijekoon[3]

[1]Department of English Language Teaching, University of Peradeniya, Peradeniya 20400, Sri Lanka
[2] Human Resources (Academic) Division, Uva Wellassa University, Badulla 90000, Sri Lanka
[3]MAS Intimates, Pallekele, Kandy 20000, Sri Lanka
*thilini@mgt.pdn.ac.lk

In a fast paced world where the society is moving towards a rapid consumption culture, the fashion industry is at a peak in vibrancy and speed and the taste of consumers' changes quickly. Thus, apparel manufacturing entities need to deliver their products within a short lead time with no margin for error. Lack of sufficient staff for training, very short lead times for trainings and requirement for rapid response to the manufacturing support structure are seen as key issues prevailing in the existing manufacturing unit. Also, the apparel industry faces many difficulties in meeting the demand for flexible manufacturing capacity. This study focuses on a selected apparel company which has implemented the Team Leader-Group Leader structure to resolve these issues with its application of the unique support structure. Primary data is collected from hundred respondents (Non-pilot area & Pilot area) through open ended and semi-structured questionnaires which are distributed among all the Team Leaders, Job Trainers and Management of the plant. The questionnaire contains open ended questions and semi-structured questions which have qualitative options. This research, which is a case study with an intensive data analysis within the said company, intends to measure the impact of the TL-GL structure on manufacturing flexibility. This study uses a combination of qualitative and quantitative data through multiple data sources in the process of measuring the impact. The study shows that majority of the pilot area are capable of effectively using problem solving tools and complete the problem solving within the day compared to the non-pilot area. It is recommended that the elements should be improved for the success of the TL-GL structure as the essence of the concept is building a robust problem solving culture at each level and across the organization.

Keywords: Apparel industry, Short lead time, TL-GL structure, Manufacturing flexibility

Development of a Tour Planning Model for Varied Tourist Needs

T.P.R.P.K. Dayawansha*, S.A.R.K. Samarathunga, S. Dharmapriya and A.K. Kulatunga

*Department Manufacturing and Industrial Engineering, Faculty of Engineering,
University of Peradeniya, Peradeniya 20400, Sri Lanka
ranga.dayawansha@gmail.com

There are some common problems encountered by tourists in the tourism industry when visiting a country for the first time. An average person takes more than 10 hours to prepare a tour plan using online sources, and it is a tedious job as it requires comparing alternative plans given the individual capacity limits. Hence, necessary initiatives are required to use information technology effectively to support tour planning decisions. However, it is rare to find comprehensive and efficient information and communication technology platforms developed with up to date information, including all that individual tourists wanted to know, such as logistics, accommodation, and tourist attractions. Hence, there has been a growing interest in developing tools with robust mathematical models to support decision-making. An integer programming model was developed to generate tour plans for the varied needs of tourists in terms of special places to visit, budget and time while maximizing tourists' satisfaction. The solution methodology has been inspired by the well-known KNAPSACK problem, which is a problem in combinatorial optimization. It has been used in many industrial applications to find the best set of discrete items maximizing the desired attributes. When generating the tour packages, tourists' special requests have been given the first priority, and then certain other places have been proposed by the model based on the rating of those places within their budget and time. The model has been tested with different tourist requirements and tour packages have been generated accordingly. Promising results were generated in each case by utilizing more than 90% of the resources.

Keywords: Tourism, satisfaction, Tour planning, KANPSACK, Combinatorial optimization

Utilizing Augmented Reality as a B2C Marketing Tool in E-Commerce Industry in Sri Lanka

A.A.L.N. Adikari* and P. Neelawala

School of Business, ESOFT Metro Campus, Kandy 20000, Sri Lanka
*lochithaadikari@gmail.com

According to industry experts, Sri Lanka's annual domestic e-commerce sales value including services is around an estimated US $40 million, and by 2022, Sri Lanka's e-commerce business sector is projected to hit US $400 million. Given the records, the country requires formulating an e-commerce framework that would safeguard the country's digital transactions locally and abroad. In this context, Augmented Reality technology plays an important role. This technology is used to enhance the customer experience in the e-commerce platform. On the contrary, the Sri Lankan e-commerce industry is reluctant to adopt such technology due to difficulties, challenges occurring and its novelty. This study focuses on the field of business-to-consumer marketing in Sri Lanka with the purpose of discovering solutions for e-commerce companies yet to utilize Augmented Reality as a marketing tool alongside the issues faced in the process implementation of Augmented Reality. This study will be highly beneficial to much Augment Reality and Virtual Reality solution providers in the information technology industry. The e-Delphi methodology with two rounds of questionnaires along with an expert panel of twenty members from Sri Lanka is used to conduct the study. Twelve themes: Staff with IT and Marketing competencies, Financial and technical capability to maintain the differentiated e-commerce platform, Awareness of new technological trends in Sri Lanka, Awareness regarding customer requirements, Long term financial plans, Awareness of the challenges when adopting technology, Top management's support for innovative employees, Financial and technical capability to integrate the technology into the e-commerce platform, Inducing market penetration by using the technology for value addition and product positioning, Relative advantage over global and local companies, Consumer readiness with Digital literacy, Device compatibility with the technology, are found during data analysis. Three models are created using Grounded theory corresponding to small, medium, and large e-commerce firms.

Keywords: Augmented reality, Virtual reality, E-commerce industry Sri Lanka, B2C marketing, AR solutions providers

Determination of Tolerance Limits of Dimethyl Sulfoxide (DMSO) on Selected *Candida* Strains for *Candida* Sensitivity Assays

D.N. Wanigasekara[1]*, M. Napagoda[1],
S.S. Wickramasinghe[2] and W.M.D.G.B. Wijayaratne[2]

[1]Department of Biochemistry [2]Department of Microbiology
Faculty of Medicine, University of Ruhuna, Galle 80000, Sri Lanka
*dharaninirasha@gmail.com

Dimethyl sulfoxide (DMSO) is a commonly used solvent to dissolve test compounds of antimicrobial assays. Due to its less toxicity and polar, aprotic nature; DMSO serves as a universal solvent in different fields of science. However, certain high concentrations of DMSO can interfere with test results of antimicrobial assays by inhibiting the growth of test microorganisms. The recommended DMSO concentration in most protocols to dissolve plant-based components is 5%. But in practical situations, it is not sufficient to obtain homogenized test solutions. Thus, the present study was conducted to determine the maximum DMSO concentration which can be used to dissolve test compounds used for *Candida* sensitivity assays without any inhibitory interference to the test *Candida* strains. A series of concentrations of DMSO (10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% and 100%) were tested for inhibition against *Candida albicans* (ATCC 10232), *Candida krusei* (ATCC 200917) and *Candida parapsilosis* (ATCC 22019) by agar well diffusion method. Turbidity adjusted to McFarland 0.5, overnight cultures of all tested strains were used and 100 μL of candida cultures were inoculated on Mueller Hinton Agar plates as uniform lawns. Fifty microliters of each DMSO solution were added to the wells. Plates were incubated at 37ºC for 24 hours. The test was triplicated. According to the results, *C. albicans* (ATCC 10232) and *C. parapsilosis* (ATCC 22019) tolerated 100% DMSO without any inhibition while *C. krusei* (ATCC 200917) was inhibited by 100% DMSO. The latter was able to retain its viability up to 90% DMSO which is also a greater concentration than the conventionally used DMSO concentration. Therefore, it can be concluded that DMSO solvent concentration used to dissolve test compounds can be increased accordingly in *Candida* sensitivity assays.

Keywords: Antifungal assay*, Candida,* DMSO solvent*,* Plant extracts, Tolerance limit

Feasibility of Sound Touch Elastography Technique to Detect Fibrosis in Chronic Kidney Disease

M.S. Bandara[1]*, C. Jayathilake[2], A. Pallewatte[2] and J. Wansapura[3]

[1]*Department of Physics, Faculty of Science, University of Colombo, Colombo 00700, Sri Lanka*
[2]*Department of Neuroradiology, National Hospital of Sri Lanka, Colombo, 00700, Sri Lanka*
[3]*Advanced Imaging Research Center, UT Southwestern Medical Center, 5323, Dallas, Texas, TX 75390, USA*
*muditha@sci.cmb.ac.lk

Ultrasound (US) Elastography is a technique that uses low-frequency vibrations to measure the stiffness of the tissues. Liver elastography has shown the appropriability of detecting liver fibrosis which is considered to be the first stage of many liver diseases including cirrhosis. Chronic Kidney Disease (CKD) is known as one of the highly prevalent non-communicable diseases in most of the world including Sri Lanka. Fibrosis in the kidney is the common pathway in CKD progression. Currently, the diagnosis of CKD is mainly carried out by blood tests and biopsies. We have assessed the feasibility of detecting renal fibrosis using the clinically available Sound Touch Elastography (STE) technique. STE has been used to diagnose liver diseases in past studies. CKD (n=65) patients who visited the routine clinic and who had undergone renal biopsies were recruited to the study with their consent and institutional ethical clearance. An age-matched (p>0.05, mean age 42 years) group of volunteers (n=68) with no history of renal diseases also participated in the study. Both groups underwent STE scans (Mindray, DC-80 Exp Insight) conducted by an experienced radiologist. The elastic modulus of each patient and volunteer was recorded. The renal fibrosis content of the patients' kidneys was verified using renal biopsy reports. After assessing the normality, student t-test was used to compare the means of the two groups. The mean value and standard deviation of elastic modulus of the fibrotic kidneys were 24 ± 8 Pa and that of the healthy kidney was 22 ± 5 Pa. There was no significant difference (p>0.05) between the fibrotic and healthy groups. Although the STE technique is capable of detecting liver fibrosis, our study shows no difference between fibrotic kidneys and healthy kidneys. The reason might be the vascular complexity of the kidneys.

Keywords: Sound touch elastography, Renal fibrosis, Chronic kidney disease

Native Bees of Sri Lanka Enhancing Pollination of Sesame, *Sesamum indicum* L.

E.M.D. Ekanayake and W.A.I.P. Karunaratne*

*Department of Zoology, Faculty of Science, University of Peradeniya,
Peradeniya 20400, Sri Lanka*
*inokap@pdn.ac.lk

Bee pollinator decline cause insufficient pollination reducing quality and quantity of crop yield. As comprehensive studies are lacking in Sri Lanka, the present study investigated the native bee requirement to pollinate sesame, *Sesamum indicum* L. The study was conducted at Meewatura Farm, Peradeniya where a field was established for three pollination treatments. Stigma receptivity period and pollen availability were recorded in five flowers per day for five days per treatment. For each treatment, 100 flower buds were randomly selected and tagged. One set was covered with fine mesh bags to prevent bee visits, another set was kept open to enable bee visits while the third set was hand pollinated and kept covered using fine mesh bags. Bee visits were monitored from 6.30-11.00 a.m. for 14 days. Mature pods of each treatment were separately harvested and seeds were counted and germinated. Six bee species; *Systropha tropicalis*, *Gnathonomia nasicana*, *Lasioglossum serenum* (F: Halictidae), *Apis cerana*, *Amegilla comberi* and *Ceratina binghami* (F: Apidae) visited sesame flowers. Period of stigma receptivity (7.00-11.00 a.m.) and pollen availability (6.40-11.00 a.m.) coincided with the period of highest bee activity (8.30-10.30 a.m.). Two-sample t-test between treatments showed significant differences (p<0.05) among seed number, seed weight and seed germinability. Open flowers had significantly higher seed number (4981) and seed germinability (50%) compared to covered flowers 4482 and 27%, respectively. Hand pollinated flowers also produced a significantly higher number of seeds (3627) with higher germinability (36%) compared to the other two treatments. Although there was no significant difference in seed weight between seeds collected from open flowers (0.12427±0.03936 g) and covered flowers (0.11220±0.09669 g), seed weight of hand pollinated flowers (0.07958±0.05619 g) was significantly higher. This pioneering study highlights the importance of the native bees of Sri Lanka to enhance seed number, seed weight and seed germinability in *S. indicum*. Similar studies to cover major agro-ecological regions of the country would shed more light on this finding.

Keywords: *Sesamum indicum*, Native bees, Hand pollination, Seed germinability, Seed set

Halloysite Nanotubes and ZnO Nanoparticles Reinforced Carboxymethyl Cellulose Nanocomposite for Food Packaging Applications

S.N. Wijesooriya* and N. Adassooriya

Department of Food Science and Technology, Faculty of Livestock, Fisheries and Nutrition, Wayamba University of Sri Lanka, Gonawila (NWP) 60170, Sri Lanka
*nsenari@gmail.com

Nanotechnology has the potential to generate novel food packaging materials with enhanced performance. Employing nanomaterial can improve the properties such as mechanical strength and barrier properties, reduce weight, and increase heat resistance. In this research, novel carboxymethyl cellulose (CMC)-based nanocomposite films containing halloysite nanotubes (HNT) (5% and 10%wt) and zinc oxide (ZnO) (5% wt) nanoparticles (NPs) were fabricated via casting method as a potential biodegradable packaging material. The prepared nanocomposite packaging materials was analyzed for moisture content, moisture uptake, water solubility, water vapor barrier properties, opacity, mechanical properties and antimicrobial properties. In addition, the prepared nanocomposite was characterized using FT-IR, XRD and SEM techniques. To improve the stability of the nanocomposite polymer films in terms of moisture uptake, polymer films were thermally annealed to improve the crystalline structure. Incorporation of 5% wt HNT into the film reduced the moisture uptake remarkably (by ~108%). However, the addition of ZnO NPs increased the moisture uptake. Nevertheless, findings revealed that the increment in the content of ZnO nanoparticles resulted in a significant decline in the moisture content by ~10% compared to the neat CMC film. Water vapor permeability was drastically decreased in the HNT added nanocomposite films at three different conditions (freezing, refrigeration, ambient). Furthermore, the addition of nanofillers into the polymer matrix significantly improved the tensile strength. The addition of ZnO NPs also induced the property of UV blocking to the film, which can prevent photo catalytic reaction of foods. The growth inhibition of bacteria was influenced by ZnO NPs while HNTs showed a very low cytotoxic effect. However, ZnO and HNTs showed a synergistic effect in bacterial growth inhibition. These findings revealed that prepared CMC/HNT/ZnO nanocomposite films can be a potential food packaging material.

Keywords: HNT, ZnO NPs, Barrier properties, Antimicrobial property

Ginger (*Zingiber officinale*) Bioactive Compounds – Montmorillonite Nanocomposite as a Sustained Release Nutraceutical Formulation

H.A.S.D. Darshani* and N. Adassooriya

Department of Food Science and Technology, Faculty of Livestock, Fisheries and Nutrition, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP) 60170, Sri Lanka
*sandaruwanideepika95@gmail.com

Ginger (*Zingiber officinale*) is a tropical plant, having green-purple flowers and fragrant rhizome which are widely consumed for flavor or fragrance. Whole plant of ginger (flowers, leaves, rhizomes, roots, stem) is a collection of different bioactive compounds including phenolics and terpenes. Gingerol, shogaols and paradols are the principle bioactive compounds that provide the unique flavor of ginger in addition to medicinal properties such as antimicrobial, anti-inflammatory, blood pressure-lowering, cholesterol-lowering, antiplatelet aggregation, antioxidant, and hypoglycemic activity. However, these bioactive compounds are relatively less stable and possess poor bioavailability and low water solubility. During this study, ginger oleoresin was extracted (in 96% ethanol) from ginger rhizome followed by encapsulation of ginger extract into montmorillonite (MMT) nanoclay. The prepared MMT-ginger nanocomposite was oven dried at 60℃ overnight and the resulting powder was palletized. Using ginger extract, total phenolic content (13.925 ± 0.361 mg/g), total antioxidant activity ($91.680 \pm 1.817\%$) and maximum antioxidant capacity/IC_{50} (98.70 µg/mL) were determined. In addition, Gas Chromatography Mass Spectroscopy (GC-MS) was carried out to identify bioactive compounds present in the extract. Furthermore, prepared nanocomposite was characterized using powder X-ray diffraction (PXRD), scanning electron microscopy (SEM) and Fourier transform infrared spectroscopy (FTIR). The release study results showed that 80% of active compounds (phenolics) were released from the composite within 2 h and 30 min in distilled water at pH 5.4. The MMT-ginger nanocomposite showed antibacterial activity against *Escherichia coli* (9 CFU). In summary, the prepared MMT-ginger nanocomposite is a potential candidate to be used as a nutraceutical with sustained release properties and improved bioavailability.

Keywords: Ginger bioactive Compounds, Nutraceutical, Nanocomposite, Montmorillonite, Characterization

Nanocomposite Coating Based on Carboxymethyl Cellulose and Nano-TiO$_2$ for Shelf-Life Extension of Fresh "*Ambul*" Banana (*Musa acuminata*)

M.S.S. Fernando[1]*, W.A.H. Champa[2] and N.M. Adassooriya[1]

[1]Department of Food Science and Technology
[2]Bio-statistics Unit
Faculty of Livestock, Fisheries and Nutrition, Wayamba University of Sri Lanka,
Makandura, Gonawila (NWP) 60170, Sri Lanka
*sonali.sewwandika@gmail.com

Ambul banana which is the most widely cultivated and consumed banana type in Sri Lanka, becomes unmarketable after 5-6 days from harvesting at mature green stage. The postharvest losses of banana in Sri Lanka account for about 30% among all the fruits. The present study was conducted to evaluate the effectiveness of CMC/TiO$_2$ nanocomposite coating to extend the shelf-life of banana under ambient conditions (31±1 °C and 70±1% RH). CMC/TiO$_2$ nanocomposite (TiO$_2$ was 5 % w/w of CMC) solution was prepared by adding sonicated TiO$_2$ (E171) (25 nm) into CMC (2% w/v) solution and stirring for 1 hour. Glycerol (25% w/w of CMC) was used as the plasticizer. Three treatments (uncoated, CMC coated and CMC/TiO$_2$ coated) were prepared using 60 bananas per each treatment (20 per replicate) by dipping in respective solutions for 1 min. The shelf life of banana was analyzed using peel colour changes, firmness, starch content, total soluble solids (TSS), titratable acidity (TA), ripening index (RI – the ratio of TSS/TA), pH, weight loss (%), moisture content (%) and disease incidence. In addition, the prepared nanocomposite films were characterized using powder X-ray diffraction, fourier transform infrared spectroscopy and scanning electron microscopy techniques. Bananas coated with CMC/TiO$_2$ exhibited the highest shelf life of 19 days (yellow but no brown freckles) whereas uncoated and CMC coated banana displayed a shelf-life of 6 and 10 days (yellow with brown freckles), respectively. In 6 days, RI of uncoated banana, banana coated with CMC and banana coated with CMC/TiO$_2$ nanocomposite increased from 9.0 to 27.6, 23.1 and 18.3, respectively. A similar pattern was observed for the other quality attributes examined. In conclusion, CMC/TiO$_2$ nanocomposite coating significantly reduced the rate of ripening of *Ambul* banana extending the shelf-life up to 19 days under ambient conditions.

Keywords: Fruit, Postharvest losses, Quality, Ripening, X-ray diffraction

Development of a Regression Model to Investigate Correlation of Selected Input Parameters to Thread Consumption of "Over-Lock Stitch 514"

T.S. Niroshan

Department of Engineering Technology, Faculty of Technology, University of Jaffna, Jaffna 40000, Sri Lanka
samt@tech.jfn.ac.lk

The cost of manufacturing and distribution of apparel products are highly depended on the sewing thread consumption. Thus, the calculation of sewing thread consumption has to be done accurately using effective methods. Due to the inefficiency of the existing formulae, the predictions of thread requirement have become inaccurate. It is obvious that the precise estimation of required sewing thread will reduce the unused stocks in the industry. The consumption calculations exhibit significant error percentages due to the ignoring of important parameters which affect thread consumption. This study investigates the correlation of parameters grams per square meter (GSM), seam width, Stitches per inch (SPI) frequency, thickness of fabric and yarn count to thread consumption of over-lock stitch 514 which is an over-edge stitch for seaming with wide bite and greater stretch for knitted fabrics. The existing thread consumption formulae are optimized by considering new parameters, using regression analysis and geometrical modelling techniques. For the over-lock stitch 514, results indicate that the above parameters significantly affect in determination of the thread consumption. This particular method addresses the following issues: inaccurate consumption calculation, excess seam length or inaccurate seam length, the use of predefined thread consumption factors and the calculation of thread consumption only considering the machine type. This particular study establishes a correlation among the selected parameters through the regression model. An error analysis of proposed formulae was performed to indicate that the proposed formulae was more accurate compared to the current method of predicting sewing thread consumption. The results were validated against samples obtained from a manufacturing plant. The results show that the estimation using this technique has an 80% accuracy against actual consumption. Therefore, the proposed formulae are expected to be a better approach to calculate thread consumption of over-lock stitch 514.

Keywords: GSM, Over-lock stitch, Thread consumption, Seam length, Regression model

Statistical Analysis on Factors Influencing Child Injuries in Colombo, Sri Lanka

N. Varathan* and S.N.D.H. Subasinghe

Department of Mathematics and Statistics, Faculty of Science, University of Jaffna, Jaffna 40000, Sri Lanka
*varathan@univ.jfn.ac.lk

At present, 90% of the injuries which occur are unintentional and many of the injured children are left with long-or short-term disabilities and on occasions lead even to death. This study was conducted to identify the factors influencing child injuries in Sri Lanka. Data was collected from Lady Ridgeway Children's hospital (LRH), Borella from January-June, 2018. All patients aged between 0-15 years, who were admitted due to unintentional injuries were considered. Most of the patients admitted to LRH are from Colombo but a few patients are from outside Colombo, patients in critical condition transferred from other hospitals. Poisson regression analysis was used to model the relationship between number of injured children and the explanatory variables; age, gender, nationality, injury type and place of occurrence. Out of 9581 cases, majority (39%) of injured children were between 1 -5 years of age. 67% were males, 59% were Sinhalese. Around 55% injuries were caused by falls and 96% of the injuries had occurred at home. Poisson model showed that all the explanatory variables significantly related to the number of injured children. The dispersion parameter was 26.3033, which showed an over dispersed data. For over-dispersed data Quasi-Poisson and Negative binomial models were used. After implementing the Negative Binomial model it showed that all the explanatory variables were significant to the model. The results revealed that while holding the other explanatory variables constant, the expected number of injured children, decreased by 0.5331 for females compared to males; increased by 3.4998 among road traffic injuries traffic injuries when compared to fall injury; increased by 8.1368 among the children aged 1-5 years when compared to children aged less than 1 year. Moreover, Chi-squared test was carried out to check the dependence among injury type and other four explanatory variables. It showed that there is a significant relationship among injury type and other explanatory variables.

Keywords: Child injury, Chi-Squared test, Poisson regression model, Over-dispersion

Statistical Analysis of the Impact of Macro-Economic Variables on Gross Domestic Production in Sri Lanka

N. Varathan* and K.B.W.P. Balasooriya

Department of Mathematics and Statistics, Faculty of Science, University of Jaffna, Jaffna 40000, Sri Lanka
*varathan@univ.jfn.ac.lk

Gross domestic production (GDP) is one of the determinants of the country's economic growth. This study intends to analyse the impact of various macro-economic variables on GDP in Sri Lanka. Agriculture, Industry and Services are the main contributors to the total GDP. Many studies were carried out to find which macro-economic variables mainly impact the GDP and its sectors. It is still problematic to choose the relevant macro-economic variables due to the unavailability of data, different characteristics of countries, and different time periods. In the Sri Lankan context, the impact of macro-economic variables on GDP and its sectors are not deeply discussed with a critical analysis. This research mainly focuses on identifying macro-economic variables that may affect the total GDP of the country. The data was obtained from the World Bank national accounts and Organization of Economic Co-operation and Development (OECD) national accounts for the period from 1970 to 2017. The multiple linear regression approach was used to model this problem. Further, GDPwas considered as a response variable and the macro-economic variables such as import, export, foreign direct investment, inflation rate, consumption, investment and life expectancy were considered as the explanatory variables. A stepwise regression technique was applied to find out the best fitting regression model. Furthermore, diagnostic checking of the residuals of the fitted regression models were carried out to check the adequacy of the fitted model. Results from this research concluded that import and life expectancy are the most influential variables on the total GDP and sector-wise GDP. Moreover, it was noted that among all the macro-economic variables, import has a positive impact on total GDP and sector-wise GDP.

Keywords: Gross domestic production, Macro-economic variables, Multiple linear regression

Studying Synthesis of a Novel Cardanol-Based Monoglyceride Using Cashew Nut Shell Liquid

A.H.F. Nimra*, M.A.B. Prashantha and P.I. Godakumbura

Department of Chemistry, Faculty of Applied Sciences,
University of Sri Jayewardenepura, Nugegoda 10250, Sri Lanka
*fathimanim12@gmail.com

Following greener synthetic pathways and employing renewable organic resources has become a major concern in modern research. Phenol being a non-renewable petrochemical resource, substituting it with renewable resources is vital. Therefore this research work was carried out in order to synthesize a novel Monoglyceride (MG) utilizing cardanol as a starting material, which is a promising eco-friendly phenolic substituent. Cardanol is a major component present in raw cashew nut shell liquid (CNSL) with significant properties such as high thermal and mechanical stabilities and drying properties. Cardanol percentage in raw CNSL was increased by decarboxylation of anacardic-acid in raw CNSL into cardanol at 140 °C, which was reported to be the optimum temperature for this reaction. A kinetic study performed at 140 °C for this reaction, using isothermal Thermo Gravimetric Analysis (TGA) showed that it followed first order kinetics up to sixty five minutes. Cardanol was isolated from decarboxylated CNSL using a solvent extraction method with a yield of 82.37%. In the synthetic pathway followed in this study, cardanol was reacted with maleic anhydride to synthesize a mono-phenyl maleate (MPM) derivative using a conventional reflux method. Based on the variation of the acid value of this product from the theoretical acid value, the MPM composition was obtained as 65.5%. This crude product was subjected to a direct-esterification with glycerol to obtain the novel MG. The percentage composition of the MG was determined by Per-iodic oxidation method and it was obtained as 70.1%. MG structure was elucidated using the FT-IR spectroscopy. This novel product showed high thermal stability up to about 250 °C without undergoing any thermal decomposition. The decomposition was prominent at 284 °C. This MG is a di-functional compound with the potential of behaving as a novel monomer and can be used to synthesize a novel alkyd resin with enhanced properties in the future.

Keywords: Monoglyceride, Cashew nut shell liquid, Cardanol, Decarboxylation, Phenolic substituent, Novel

iPURSE 2021 – 463   *Science, Technology and Industry*

Characterization of Petroleum Oil-Degrading Indigenous Bacteria Isolated from Petroleum Waste Contaminated Garage Soil in Kandy, Sri Lanka

T. Balendran and P. Samaraweera*

Department of Molecular Biology and Biotechnology, Faculty of Science, University of Peradeniya, Peradeniya 20400, Sri Lanka
*psam@pdn.ac.lk

Increased use and transport of petroleum oil causes persistent and continuous spills that contaminate the soil with mixtures of hydrocarbons that affect agriculture and the local systems in Sri Lanka. Indigenous bacteria that have the potential to bioremediate oil through complete biodegradation can be used for bioremediation purposes. Therefore, this present study mainly focuses on the characterization of effective indigenous oil degraders isolated from petroleum waste contaminated soil. Bacteria were isolated through selective enrichment in Bushnell and Haas medium supplemented with engine oil as their sole carbon source. Triton X-100, which does not serve as a competitive carbon source was selected as the surfactant. Isolated bacteria were subjected to primary screening by the hole-plate diffusion method. Bacteria that showed the highest growth (>1.00 cm) were subjected to turbidity assay and 2,6-Dichlorophenol indophenol (2,6-DCPIP) assay at 600 nm to quantify their growth pattern and duration of effective degradation. Bacteria that showed higher degradation were used to design bacterial consortia. The Genus level of the isolates was characterized by gram staining and biochemical tests. Turbidimetry showed degradation of 0.260 for *Staphylococcus*, 0.176 for *Escherichia*, 0.135 for *Bacillus*, 0.123 for *Micrococcus*, and 0.059 for *Klebsiella*. Results obtained by turbidity assay were validated by the 2,6-DCPIP assay. *Staphylococcus* showed the highest color change percentage of 77.9% for the 2,6-DCPIP assay. Among the tested consortia, the consortium consists of *Staphylococcus* and *Micrococcus* showed the highest degradation (turbidity assay = 0.312, 2,6-DCPIP assay = 61.8%). In conclusion, *Staphylococcus* and the consortium that includes *Staphylococcus* and *Micrococcus* can be suggested for contaminated soil oil-degradation in Sri Lanka. Also, 2,6-DCPIP assay can be used to support the results obtained from turbidity assay. These findings are beneficial for practical bioaugmentation applications. Further studies should include molecular characterization of efficient bacterial degraders.

Keywords: Degradation profile, Turbidity assay, 2,6-dichlorophenol indophenol assay, *Staphylococcus, Micrococcus*

An Algorithm to Compute Minimal Solution of Continuous Algebraic Riccati Equation

R. Prasanthan

Department of Mathematics and Statistics, Faculty of Science, University of Jaffna, Thirunelvely 40000, Sri Lanka
prasanthanr@univ.jfn.ac.lk

In this note, I propose an algorithm that determines the minimal solution of the continues algebraic Riccati equation written in the form

$$A^T X + XA - XBB^T X = -Q,$$

where $A, Q \in \mathbb{R}^{n \times n}$, with Q being symmetric positive semidefinite, $B \in \mathbb{R}^{n \times m}$ and $X \in \mathbb{R}^{n \times n}$ is the symmetric positive semidefinite solution of the continuous algebraic Riccati equation. The continuous algebraic Riccati equation possesses multiple positive semindefinite solutions when the controllability conditions are not fully satisfied. In such less restrictive control theory problems, the minimal solution is often used for further analysis. Therefore, computation of minimal solution is important and the following algorithm is proposed to the minimal solution. The existing algorithms such as Newton's Procedure and Lyapunov Algorithm determines only the maximal stabilizing solution. However, our proposed algorithm determines the minimal solution for specific initial values. We define the algorithm as follows:

Let $X_0 \in \mathbb{R}^{n \times n}$. For $i = 0, 1, \cdots$, a sequence of matrices $\{X_i\}_{i=0}^{\infty}$ is determined by solving

$$(A - \gamma I)^T X_{i+1} + X_{i+1}(A - \gamma I) - X_{i+1} BB^T X_{i+1} = -(Q + 2\gamma X_i), \ \forall \, i = 0, 1, \cdots.$$

Here the positive constant γ is chosen such that $(A - \gamma I, B)$ is stabilizable and $(A - \gamma I, Q)$ is detectable. Moreover, for an initial value $X_0 \leqslant X$, where X is the minimal solution, the algorithm determines a monotonically increasing sequence that is bounded above the minimal solution of the continuous algebraic Riccati equation. In particular, the sequence converges to the minimal positive semidefinite solution of continues algebraic Riccati equation. In view of numerical examples, a zero matrix $X_0 = 0$ serves as a convenient choice for the initial value.

Keywords: Continuous algebraic Riccati equation, Iterative algorithm, Minimal solution, Monotone convergence, Positive semidefinite,

Designing and Improving Performance of Cobalt Titanate/Lithium Polysulfide/Graphite Li-ion Cell

S.T.N. Yasaswin[1]*, L. Palliyaguru[1], P.M. Jayaweera[1] and P.V.V. Jayaweera[2]

[1]*Department of Chemistry, Faculty of Applied Sciences,*
University of Sri Jayewardenepura, Nugegoda 10250, Sri Lanka
[2]*SPD Laboratory, Inc., Hamamtsu, 432-8011, Japan*
*nyasaswin20@gmail.lk

Lithium-ion (Li-ion) battery research area has been experiencing a drastic development in the past decade. Today, it has the potential to become the premier electrical energy storage device mainly for portable electronic devices. However, to achieve higher efficient battery performance, some hazardous electrode materials and electrolytes are commercially used despite safety and environmental issues. In this study, two Li-ion cells were invented under normal laboratory conditions using lithium polysulfide electrolytes, prepared in aqueous and ethylene glycol mediums while using graphite as the cathode material and laboratory synthesized ilmenite type cobalt titanate as the anode material. Lithium polysulfide electrolytes in both aqueous and ethylene glycol media were studied by using the UV/Visible analysis and the characteristic maximum absorption was recorded at the wavelength of 300 nm. And, their second peak values were recorded at the wavelengths of 370 nm and 390 nm, respectively. Electrochemical analysis for two cells which were designed with (i) aqueous electrolyte $(Al_{(s)}|CoTiO_{3(s)}|Li_2S_{n(aq)}|C_{graphite}|Cu_{(s)})$ and (ii) electrolyte in ethylene glycol medium $(Al_{(s)}|CoTiO_{3(s)}|Li_2S_{n(eg)}|C_{graphite}|Cu_{(s)})$ was done by using charge-discharge curves and cyclic voltammograms. Accordingly, the observed specific capacities were about 0.8 mAh / g and 0.7 mAh / g and short-circuit current densities were about 16.3 mA / g and 12.8 mA / g with open-circuit voltages of about 2.0 V and 1.9 V, respectively. The cell with aqueous electrolyte has shown faster discharge for a short period than the cell with electrolyte in ethylene glycol medium. According to the results, higher current density and capacity were observed in the cell with an aqueous electrolyte compared to the other, and both cells were observed as highly rechargeable. The mechanism of the designed cells was proposed as the combined effect of reversible lithium intercalation-deintercalation and lithium polysulfide oxidation-reduction processes.

Keywords: Lithium-ion battery, Lithium polysulfide, Cobalt titanate, Charge-discharge curves, Ethylene glycol

Forecasting CO_2 Emissions in Sri Lanka Using ARIMA Approach

N.M.I.M. Rathnayake and A. Laheetharan*

Department of Mathematics and Statistics, Faculty of Science, University of Jaffna, Jaffna 40000, Sri Lanka
*kalahee@yahoo.com

The global warming and natural greenhouse effect have increased since the beginning of the 21st century in comparison to three previous decades. One of the main causes is the continuous rise of carbon dioxide (CO_2) emissions from major countries such as China, the United States, India and the other emerging economies. Many studies have reported that the impact of CO_2 emissions is a key element in the rising threat of climate-related natural disasters. Sri Lanka is also identified as one of the substantial CO_2 emitting countries during the last decade. Therefore, developing a time series model to forecast CO_2 emissions in Sri Lanka is an important tool for government policymakers and other environmentalists. The objective of this study was to identify the best fit autoregressive integrated moving average (ARIMA) model and consequently, to project the annual CO_2 emission values for the next ten years. The annual data was collected from World Bank open data source for a period of 55 years (1960-2015). The model parameters were estimated by the maximum likelihood method. Moreover, forecasting accuracy measures, Root Mean Square Error (RMSE), Mean Absolute Error (MAE), Mean Absolute Percentage Error (MAPE) and Akaike information criterion (AIC) were used to identify the best forecasting model based on the lowest measure of accuracy. Initially, many significant ARIMA models were identified and finally, ARIMA (2,2,3) was selected as the best model to forecast the CO_2 emissions in Sri Lanka. The forecasted figures showed that the future CO_2 emission will gradually increase and MAPE is 13.8765 for the period from 2016 to 2019 and will be 31280.52 kilo tones in 2025. This is 55.52% higher than in 2015. Hence, it is time to initiate the necessary policy actions around the world for a sustainable future and to prevent the hazards of nature.

Keywords: ARIMA model, CO_2 emission, Accuracy measures, Forecasting

On Number of 1-Factors in a 1-Factorization of Complete Multipartite Graph of Form $K_{m,m,m,\ldots,m}$ with an Even Number of n-partite Sets

M.D.M.C.P. Weerarathna*, P.G.R.S. Ranasinghe and A.A.I. Perera

*Department of Mathematics, Faculty of Science, University of Peradeniya,
Peradeniya 20400, Sri Lanka
chinthakaweerarathna@gmail.com

Graph Theory is an important branch in mathematics with many applications. One of the key areas in graph theory is factorization of graphs. A factor of a graph G is a spanning subgraph of G which is not totally disconnected and factorization of a graph G is a set of spanning subgraphs of G that are pairwise edge-disjoint and whose union is G. Most of the research work on factorization of graphs is on complete bipartite graphs. Our work focuses on complete multipartite graphs of the form $K_{m,m,m,\ldots,m}$ with an even number of n-partite sets. In one of our previous work, 2-factors of 2-factorization of the complete multipartite graphs $K_{2,2,2,\cdots,2}$, $K_{2^r,2^r,2^r,\cdots,2^r}$ and 1-factors of 1-factorization of the complete multipartite graph $K_{3,3,3,\ldots,3}$ have been constructed using degree factors. In the present study, by considering degree factorization, we have established a result to obtain 1-factors of 1-factorization, for different values of m and n, of the complete multipartite graph of the form $K_{m,m,m,\ldots,m}$ with an even number of n-partite sets. We show that a complete multipartite graph with $n = 2l, l \in \mathbb{Z}^+$ partite sets of the form $K_{m,m,m,\ldots,m}$ has

$$\frac{{}^{mn}C_2 - \sum_{k=0}^{m-1} kn}{mn/2} \quad (m, n \in \mathbb{Z}^+)$$

number of 1-factors for a 1-factorization for an even number of n partite sets. Here $\mathbb{Z}^+$ denotes the set of positive integers. We used a combinatorial argument with the multidimensional induction to prove this result. The multidimensional induction involves three steps; the base case, induction over m, and induction over l. In future, we try to generalize this work to obtain the number of n-factors for a complete multipartite graph $K_{m,m,m,\cdots,m}$ with n partite sets.

Keywords: Graph factors and factorization, Multidimensional mathematical induction, Multipartite graph

Distinguishing Local Minimizers and a Global Minimizer for Nonlinear Minimization Problems with Mixed Variables

S. Selvarajan*, B. Muraleetharan and S. Srisatkunarajah

Department of Mathematics and Statistics, Faculty of Science, University of Jaffna, Jaffna 40000, Sri Lanka
*selvarajan09@gmail.com

In nature, almost all the optimization problems are nonlinear functions of several variables. The development of global optimality conditions for non-convex programs has long been an important idea and it has played a major role in global optimization. Gradual progress has been made by deriving global optimality conditions for different classes of optimization problem. The development and application of classical calculus theory leads to find the optimal solution for the nonlinear mathematical programming problems with several variables. That is the Lagrangian multipliers and developed Kuhn-Tucker conditions identify the global minimizer for nonlinear programming problem with equality and inequality constraints. In particular, identification of a minimizer is well known for convex function with bonds on the variables, where a local minimizer is global. There is a question that when is a local minimizer of a non-convex function of severable variables with bounds on the mixed variables both discrete and continuous variables, a global minimum? The enlargement of mathematical criteria which distinguish the global minimizer is the answer for the above question. We provide suitable necessary and sufficient conditions for a local minimizer to be a global minimizer for nonlinear minimization problems with mixed variables.

Keywords: Mixed variables, Nonlinear minimization, Optimality conditions

An Alternative Method of Construction of Anti-Magic Labeling of Complete Bipartite Graphs $K_{n,n}$

W.V. Nishadi* and A.A.I. Perera

*Department of Mathematics, Faculty of Science, University of Peradeniya,
Peradeniya 20400, Sri Lanka
vindinisha@hotmail.com

Labeling of graphs using integers is being investigated over the years due to its diverse range of applications in various branches of engineering such as civil, electrical, software, and telecommunication etc. Especially, both anti-magic and magic graphs provide models for security systems in urban planning. Edge labeling of a graph G with m edges is a bijection from set of edges $E(G)$ to set $\{1,2,\ldots,m\}$ such that the vertex sum at a vertex v is the sum of the labels on edges incident to v. A labeling is anti-magic if the vertex sums are pairwise distinct. The graph which admits anti-magic labelling is called an anti-magic graph. We have used the properties of magic squares in our work by arranging a square of order n with integers $\{1,2,\ldots,n^2\}$ such that the row sum and the column sum are different. We have proved that the anti-magic labeling of $K_{n,n}$ can be formulated by satisfying the requirement $a_{ij} = (i-1)n + j$ for $1 \leq i,j \leq n$ when n is even with the condition $\frac{(n^2-1)}{2} + j \equiv 0 \ (mod \ n)$, where a_{ij} stands for the value at ij^{th} position of the $n \times n$ square. This result has been illustrated by giving an example. In addition, when n is odd, (say) $n = 3$ and $n = 5$, anti-magic labeling of $K_{3,3}$ and $K_{5,5}$ is established and a general form is given by the following conjecture: The complete graph $K_{n,n}$, when n is odd, has anti-magic labeling if the ij^{th} position of the corresponding $n \times n$ square is defined as:

$$b_{i,j} = \begin{cases} a_{i+j-1} - (p-1)a_1 & if \ \ 1 \leq i \leq n-j+1 ; \\ n^2 + (j-n)a_1 - a_{2n-i-j} & if \ \ n-j+2 \leq i \leq n \end{cases}$$

where $b_{i,1} = a_i = \frac{i(i+1)}{2}$.

Keywords: Anti-magic labeling, Complete bipartite graphs, Magic squares

Science, Technology and Industry

Comparative Study of MM-PBSA and LIE Binding Free Energy on Selected HDLP-Inhibitor Complexes

R. Dushanan[1], M.S.S. Weerasinghe[2], D.P. Dissanayake[2] and R. Senthilnithy[1]*

[1]Department of Chemistry, The Open University of Sri Lanka, Faculty of Natural Sciences, Nugegoda 10250, Sri Lanka
[2]Department of Chemistry, Faculty of Science, University of Colombo, Colombo 00300, Sri Lanka
*rsent@ou.ac.lk

Calculation of binding free energies (ΔG_{bind}) between an inhibitor and its target protein is important in drug development. It can be used to prescreen the compounds to be examined experimentally for their affinity to target proteins. The linear-interaction energy (LIE) method and the Molecular Mechanics-Poisson-Boltzmann surface area (MM-PBSA) are the fastest and accurate end-point techniques used to estimate the G_{bind} values. In order to calculate the G_{bind}, the LIE model requires both free-state and the bound-state systems, whereas MM-PBSA requires only the bound-state system. In this article, the trends of results of these two end-point methods were analyzed and correlated with the experimental results. This preliminary binding energy analysis could predict HDAC inhibitors' efficacy, which minimizes the time and investment required in cancer research. The chosen HDAC inhibitors for this study are trichostatin-A, dacinostat, resminostat, and entinostat. The HDLP crystal structure was downloaded from the Protein Data Bank, and the inhibitor structures were configured using the G09W package. Auto Dock Vina was used to conduct blind docking, and the resulting complex was used to initiate the molecular dynamics (MD) simulation. For the trajectory analysis, the final configuration of the HDLP-inhibitor complex from the 100 ns of MD simulation was extracted. The experimental half-maximal inhibitory concentrations of trichostatin-A (1.8 nM), dacinostat (32 nM), resminostat (42.5 nM), and entinostat (1.5 μM) are correlated with both the LIE ΔG_{bind} values (-581.2±12.5, -283.4±0.5, -199.7±0.5, and -43.2±0.2 kJ/mol, respectively), and MM-PBSA ΔG_{bind} values (-368.1±12.4, -312.7±8.0, -245.3±9.0, and -152.5±7.2 kJ/mol, respectively). It can be observed that the experimental and theoretical results reveal that trichostatin-A has a high potential to inhibit HDLP. Furthermore, we find that the van der Waals and polar interactions contributed negatively to the binding energy. However, the electrostatic interactions contributed positively to the binding energy.

Keywords: MM-PBSA, LIE, HDAC inhibitors, HDLP enzyme, MD simulation

Multiple Linear Regression Approach for Determining Relationship between Serum Biomarkers and Estimated Glomerular Filtration Rate of Chronic Kidney Disease

R.A.S. Rajapaksha[1]*, Y.R.D. Yapa[1] and N. Nanayakkara[2]

[1]*Department of Statistics and Computer Science, Faculty of Science, University of Peradeniya, Peradeniya 20400, Sri Lanka*
[2]*Department of Nephrology, Teaching Hospital, Kandy 20000, Sri Lanka*
*achinisulakkanarajapaksha@gmail.com

Chronic kidney disease is a major public health problem around the world. It affects millions of people each year. Chronic kidney disease describes the progressive decline of kidney function. Diabetes, high blood pressure, from genes or being 60 years old can directly cause chronic kidney disease. Socio-economic problems and lack of access to proper medicine increase the risk of deaths in chronic kidney disease. Serum creatinine is the most common test used to identify chronic kidney disease. Biomarkers have become main section in chronic kidney disease. The aim of this study is to identify relationship between novel biomarkers (serum biomarkers) and estimated Glomerular Filtration Rate (eGFR), as it helps to determine whether kidney damage or the presence of cancer.70 Sri Lankan patients (age between 19 to 69) with chronic kidney disease were used for this study. The analysis was done using R statistical software version 3.5.0. Correlation analysis, regression analysis and factor analysis was used to identify relationships between age, serum creatinine, biomarkers and eGFR. Four factors were selected as the optimal number of factors and used in a multiple linear regression model for the given data. All four factors explained 50% of the variability in the data. eGFR was used as the dependent variable while biomarkers and Serum Creatinine were used as independent variables. The best model was generated using backward selection method. Next, lower Akaike information criteria (AIC), Bayesian information criteria (BIC), higher adjusted R^2, lower mean absolute error (MAE) and lower Root Mean Square Error (RMSE) values of the selected models were used to check the model performance. The results were validated using cross validation method. eGFR showed a significant relationship with age, serum creatinine and the biomarkers (*S.COLLAGEN IV, S.TIMP1, S.Cystatin C, S.OPG, S.b-2-Microglobulin, S.TGFbeta1, S.Pentaxin 3 and S.NGAL*). The best model showed lower RMSE (15.5) and 74.5% of the variability in *eGFR* is accounted for by the regression on the above variables.

Keywords: eGFR, RMSE, Biomarkers, MAE, Multiple linear regression

Investigation of Materials Suitable for Supercapacitor Applications

P.W.S.K. Bandaranayake[1]* and M. Rabindran[2]

[1]Department of Physics, Faculty of Science,
[2]Postgraduate Institute of Science
University of Peradeniya, Peradeniya 20400, Sri Lanka
*kumarab@pdn.ac.lk

Supercapacitors have gained attraction as high power density energy storage devices. This study is focused on supercapacitors assembled as electrochemical double layer capacitors (EDLCs) with two carbon based electrodes with high surface area. The experiment undergoes with three types of electrolytes and electrodes. In EDLCs, the capacitance arises due to the ionic charges of the electrolyte at the electrode-electrolyte interface. LiCl (1M) solution was used as an aqueous electrolyte, whereas $LiClO_4$ salt incorporated with ethylene carbonate (EC), propylene carbonate (PC) dissolved in tetrahydrofuran were taken as organic electrolyte. Lithium perchlorate salt with polyethylene oxide and tetrahydrofuran was incorporated to have a conducting polymer electrolyte. Graphene from Hummers method, natural vein graphite from Kahatagaha mines and activated carbon were chosen as the electrode material. Electrodes were prepared by adding 80 wt% carbon material, 15 wt% polyvinylidenefluoride and 5 wt% carbon black together and stirred until having homogeneous slurry, which was doctor bladed on aluminum foil current collectors. The complex impedance taken from a Solatron SI-1260 impedance analyzer shows a single conductivity mechanism which is verified from the smooth semicircular section of impedance plot and the straight line of the plot confirmed the non-reacting nature of materials at the interface. The cyclic voltammetry measurements show the chemical stability of the sample at the voltage range of ±1.0 V for the LiCl solution and ±2.0 V for the organic and gel polymer electrolytes. Aqueous LiCl which showed ionic conductivity of 0.22 S cm^{-1} incorporated with the graphene electrode showed the highest capacitance of 0.45 F for the voltage between ±1.0 V, and also 0.25 F for the voltage between ±2.0 V for the non-aqueous electrolyte incorporated with $LiClO_4$ salt with EC and PC. Therefore, it can be concluded that the carbon based electrodes with higher surface area are more suitable for making supercapacitors.

Keywords: Carbon based electrode, Electrochemical double layer capacitor, Polymer electrolyte, Supercapacitor

Attaining an Initial Feasible Solution to Hitchcock Transportation Problem

A.P. Batuwita[1]* and Z.A.M.S. Juman[2]

[1]Postgraduate Institute of Science
[2]Department of Mathematics, Faculty of Science
University of Peradeniya, Peradeniya 20400, Sri Lanka
[*]anushabatuwita@gmail.com

Transportation problems are special type of linear programming problems (LPP). Transportation problems are formulated to minimize the total cost of transportation of products between supplier and receiver. Sometimes it is called as Hitchcock Transportation problem (HTP). Because of its complexity, the usual solving methods such as simplex method cannot be used to solve HTP. In the literature, different transportation algorithms exist in a variety of forms and everyone is keen to utilize best possible resources to optimize the profit and cost. Initial feasible solution (IFS) to a transportation problem plays an important role in obtaining a minimal total transportation cost solution. In obtaining an IFS to the HTP many heuristics solution techniques have been presented in the literature. In this study, a new algorithm was proposed to find an initial feasible solution for the HTP. Here, we selected some numerical problems from the literature and applied the proposed new method to solve these problems. IFS obtained from the proposed methods was compared to the solutions obtained from North-West Corner Method and Minimum Cost Method. Also, the performance of proposed method is measured by comparing the percentage increases of each of the total costs associated with the IFS from the minimal total cost. According to the comparisons, the new method converges faster than the two existing methods. Moreover, some random HTPs were solved using the new method. Therefore, this method is a good candidate for solving any type of Hitchcock Transportation Problem.

Keywords: Initial feasible solution, Hitchcock Transportation Problem, Linear programming

Science, Technology and Industry

Larvicidal Potential of *Syzygium aromaticum* (Clove) Leaf Powder against *Aedes aegypti* L. (Diptera: Culicidae) Mosquito Larvae

S.N. Ramanayaka[1], P. Wijayawardana[1], G.C. Weerakkody[1],
N.D.A.D. Wijegunawardana[2]*, S.S. Gunawardhana[3] and E.M.B.M. Karunathilake[3]

[1]*Rathnavali Balika Vidyalaya, Gampaha 11000, Sri Lanka*
[2]*Department of Bioprocess Technology, Faculty of Technology,
Rajarata University of Sri Lanka, Mihintale 50300, Sri Lanka*
[3]*Adhitya Research Laboratory, Gunawardhana Ayurveda Holdings (Pvt) Ltd,
Anuradhapura 50000, Sri Lanka*
awijegun@tec.rjt.ac.lk

Dengue is one of the most important arboviral diseases in humans and a rapidly spreading mosquito-borne viral ailment in the world. The primary vector of the dengue virus is the *Aedes aegypti* mosquito. Synthetic insecticides are widely used to repress mosquitoes. However, it instigates problems such as insecticide resistance among insects, bio-accumulation, and ecosystem destabilization. Natural plant-based products are a healthy alternative to synthetic insecticides and can be used as mosquito larvacides. Clove oil, extracted from *Syzygium aromaticum* plant, is a known natural mosquito repellent. This study aimed to assess the larvicidal potential of *S. aromaticum* clove leaf powder against *Ae. aegypti* larva as it has not yet been studied. Leaves (1-10) were sun-dried, ground (10–30 seconds) and a concentration series of 2.33, 0.11, 0.05, 0.02 w/v (g/mL) was prepared by mixing the leaf powder in water. *Aedes* larvae were reared in a special container, which contained seasoned water (6.95 – 7.03 pH) at room temperature. Then, fourth Instar larvae (L4) were exposed to similar volumes of each concentration for six hours while seasoned water was used as a negative control. Four replicates were done (25 larvae per replicate) in accordance with the standard WHO larval susceptibility test methods. The results of the absolute mortality effect against the *Ae. aegypti* L4 larvae were measured by the average time taken for all the mosquito larvae to die. Those were recorded as 33, 42, 132, and 300 minutes for the above mentioned concentration series, respectively. The average effective period of the larvicide activity of *S. aromaticum* leaf extraction was between 8 to 2 weeks correspondingly. The results indicate that Clove plant leaves are effective in killing *Aedes* larvae and that ground clove leaf powder can be used as an alternative method of larval control, thereby minimizing the harmful effects of some larvacide compounds on the environment.

Keywords: *Syzygium aromaticum*, *Aedes aegypti*, Larvicide potential

Direct Treatment of Chemical Laboratory Wastewater Using Microalgae *Chlorococcum aquaticum* and *Chlorella* sp.

M.K.N.A. Jayawardhana[1], W.G.M. Lakmali[2],
S.N.P. Athukorala[2] and K.B. Jayasundera[1]*

[1]*Department of Chemistry, Faculty of Science, University of Ruhuna, Matara 81000, Sri Lanka*
[2]*Department of Botany, Faculty of Science, University of Peradeniya, Peradeniya 20400, Sri Lanka*
*keerthibj@chem.ruh.ac.lk

Chemical laboratory waste consists of various substances such as heavy metals, dyes, organic solvents and other hazardous material. Discharge of such contaminants into natural water bodies can cause adverse effects on the environment, life forms as well as human. Wastewater generated in many laboratories in Sri Lanka is not properly treated according to international guidelines owing to lack of facilities and the cost. Therefore, simple and cost effective methods are needed to treat this water. In this research, the applicability of microalgae to treat chemical laboratory wastewater was investigated. Due to ease of handling and adaptability to environmental conditions, microalgae are practically useful for bioremediation. Wastewater samples were collected from chemistry teaching laboratories of Ruhuna University. Depending on the nature of the chemicals, wastewater samples mainly contained either inorganic substances or organic chemicals. Thus, the water samples were pooled into two categories as inorganic waste and organic waste. Microalgae species, *Chlorococcum aquaticum* and *Chlorella sp.* previously isolated from polluted water were used to treat these two types of wastewaters. After treating with microalgae, wastewater samples were kept under the natural environmental conditions. Over a period of one month, water quality parameters such as pH, conductivity, alkalinity, dissolved oxygen (DO) and chemical oxygen demand (COD) were monitored. In general, both microalgae species tolerated the harsh conditions of the wastewater and they were capable of improving the water quality parameters of the two types of wastewaters. However, a better improvement was observed in wastewater containing more organic chemicals. With the microalgae treatment, DO and the conductivity increased whereas the COD decreased significantly. It suggests that the above microalgae breakdown aggregates as well as organic molecules present in wastewater. Thus, *Chlorococcum aquaticum* and *Chlorella sp.* may provide a simple and cost effective method to treat chemical laboratory wastewater.

Keywords: *Chlorococcum sp., Chlorella sp.*, Wastewater, COD

Statistical Inference for Multidimensional Poverty Index

T.D.D.K. Perera* and B.M.S.G. Banneheka

Department of Statistics, Faculty of Applied Sciences, University of Sri Jayewardenepura, Gangodawila, Nugegoda 10250, Sri Lanka
*kalpanipereratd@gmail.com

Various indexes are used to measure different characteristics of a society and these can be considered as estimates. Statistical properties of an estimator are of general interest to a statistician. However, there is no literature on statistical properties of estimators corresponding to any index. Filling this gap was the main objective of this study. The Multidimensional Poverty Index (MPI) introduced by Alkire and Santos in 2010 is a measure of multiple deprivations at the individual level in health, education and living standards. The MPI was selected for this study due to its practical importance and its complex nature. The sample MPI is the estimator for the population MPI. Data of the Sri Lankan household income and expenditure survey of 2016 (n=21738) were considered as a "population" and its MPI value as the actual value of the parameter. To explore the properties of the sample MPI, three simulation studies were carried out by taking 10000 repeated samples of sizes 1000, 5000 and 10000 from this "population" and calculating estimates for MPI. Moreover, bootstrap 'percentile', 'normal' and 'basic' methods were compared to identify a suitable method to obtain an interval estimator for MPI. All the simulations and calculations were done using R software. The simulation results showed that both the bias and the variance of the sample MPI decrease and the sampling distribution of the estimator approaches the normal distribution as the sample size increases. The 'percentile' bootstrap method was found to give the shortest confidence interval on average, with its observed coverage closest to the nominal coverage. Based on the whole data set, the estimated MPI in 2016 was 0.0169 and a 95% bootstrap percentile confidence interval for MPI was (0.0123, 0.0222). According to the above findings, these estimates could be considered as accurate estimates since they were calculated based on 21738 observations.

Keywords: Sampling distribution, Bootstrap confidence interval

Optimization of Sb$_2$S$_3$ Sensitized Solar Cells by Varying Spinning Cycles of Light Harvesting Material

M.A. Farhana and J. Bandara*

National Institute of Fundamental Studies, Kandy 20000, Sri Lanka
*jayasundera.ba@nifs.ac.lk

Solid state sensitized solar cells have been intensively studied due to their promising cost-effectiveness and stability. Especially, many chalcogenides have been widely investigated as the light absorbing layer in solid-state sensitized solar cells. Among the chalcogenide solar cells, antimony sulfide (Sb$_2$S$_3$) is an excellent candidate for light absorption material in solar cells because of its unique characteristics, which are suitable for solar cell applications. Nevertheless, so far, the efficiency of planar configuration Sb$_2$S$_3$ solar cells is limited to 7%. However, compared to the higher power conversion efficiencies of the typical chalcogenide solar cells such as cadmium telluride (CdTe) and copper indium gallium selenide (CIGS), there are still many places to improve the Sb$_2$S$_3$-based solar cells. In this study, we investigated the performance of Sb$_2$S$_3$ solar cells, based on various spin coating cycles (1-4). The Sb$_2$S$_3$ precursor solution was prepared by mixing 228 mg of antimony chloride (SbCl$_3$), 114 mg Thiourea and 1.5 ml of 2-methoxyethanol. The prepared solution was spin coated on TiO$_2$ compact layer at 4000 rpm for 30 s. After spin coating of Sb$_2$S$_3$, the film was heated on the hot plate at 150 ^{o}C for 1 min and followed annealing inside the tube furnace at 280 ^{o}C for 10 mins under N$_2$ stream. Then, a P3HT layer was used as a hole transport layer. Finally, 70 nm of thick silver (Ag) layer was deposited by thermal evaporation technique to form the top contact. With the final configuration of FTO/compact TiO$_2$/Sb$_2$S$_3$/P3HT/Ag, a 3.63% power conversion efficiency was reached for two cycles of Sb$_2$S$_3$ precursor. The variation of Sb$_2$S$_3$ spinning cycles, significantly controls the device performance. UV-Vis absorption, IPCE and EIS spectra were obtained to characterize the devices and they were in a good agreement. Further improvement of the solar cell performance is underway.

Keywords: Sb$_2$S$_3$, Solid state solar cell, Spinning cycles, Light harvesting

A New Algorithm to Find Any Positive Integer Power of Any Positive Integer

K.G.H.H.K. Senerath*, P.M.N. Dharmawardane and E.M.P. Ekanayake

*Department of Mathematical Sciences, Faculty of Applied Sciences,
Wayamba University of Sri Lanka, Kuliyapitiya 60200, Sri Lanka
kghhks@gmail.com

Exponentiation is an essential mathematical operation used in mathematics. Many researchers have recognized the necessity to improve the way we learn exponentiation and proposed various techniques to supplement or replace traditional methods. However, most of the research is based only on squaring and cubing two-digit numbers. Therefore, the main aim of this study was to present a new algorithm to find any positive integer power of any positive integer. For this purpose, if there are patterns in the squares with the increment of the number of digits, then it will be more convenient to memorize the squares of numbers with more than one digit. This philosophy is general for any exponent. Therefore, there is a high necessity of a tool or a program which can be used to study whether there are such patterns within the powers of numbers. Here, we consider a simple method that squares two-digit numbers, found by Dharmawardane using a new approach based on binomial expansion. By studying the pattern of this operation, we have extended the concept to get an algorithm to find the positive integer power (n) of any number consisting of m-digits ($m > 1$) as follows:

$$(a_1 a_2 \dots a_m)^n =$$
$$(a_1 a_2 \dots a_{m-1})^n \left| \binom{n}{1} (a_1 a_2 \dots a_{m-1})^{n-1} a_m \right| \dots \left| \binom{n}{n-1} (a_1 a_2 \dots a_{m-1}) a_m^{n-1} \right| a_m^n.$$

Here we use $|\quad|$ to separate digits of the result.

Moreover, we developed a program based on the above concept to obtain the pattern of any power of a number with the increment of the number of digits. We observed several special patterns of exponents with the increment of the same digit. According to those patterns, the answers of 33^2, 66^2 and 99^2 are known, the answers of the 333^2, 3333^2, $\dots, 666^2, 6666^2, \dots$ and $999^2, 9999^2, \dots$ can be calculated within a few seconds without using any calculator or any program.

Keywords: Binomial expansion, Digits, Exponentiation, Increment, Patterns

Vibrational Studies of Ionic Liquid Incorporated Sodium Ion Conducting Gel Polymer Electrolytes Based on Poly (Vinylidene Fluoride Hexafluoropropylene)

M.D.M. Nayanakanthi[1]*, H.M.J.C. Pitawala[1] and J.L. Ratnasekera[2]

[1]*Department of Science and Technology, Faculty of Applied Sciences, Uva Wellassa University, Badulla 90000, Sri Lanka*
[2]*Department of chemical Sciences, Faculty of Applied Sciences, Rajarata University, Mhinthale 50300, Sri Lanka*
*mangala_usjp@yahoo.com

Rechargeable Lithium-Ion Batteries (LIBs) have been one of the most popular choices in energy storage devices. However, LIBs are relatively expensive, and lithium resources are not sufficient. Na is more abundant and easy to recycle. In this work, Poly (vinylidenefluoride-co-hexafluoropropylene) (PVdF-HFP), sodium triflate (NaTf) and 1-butyl-3-methylimidazolium trifluoromethanesulfonate (BMIMTf) ionic liquid (IL) was used to synthesize the gel polymer electrolytes (GPEs) using the common solvent casting technique. Samples were prepared on different wt% of PVdF-HFP and NaTf with constant IL weight and varying the IL weight by keeping the polymer and salt amounts constant. Molecular-level structure and interactions of prepared samples were investigated using Fourier Transform Infrared Spectroscopy (FTIR). Results showed a remarkable structural change for the sample having 10 wt% salts, 60 wt% polymers with constant IL weight (30 wt%). Especially, the vibrational modes found at 637 cm^{-1} and 1026 cm^{-1} related to the symmetric vibrations and band found at 1254 cm^{-1} associated with the asymmetric vibration of S-O band of Tf^{-1} anion of IL have changed in the GPE system. Other important vibrational changes of pure IL can be seen in CF_3 stretching bands and C–N deformation bands after incorporated into polymer-salt mixture. When the spectra of pure salt and GPE system were compared, a significant change can be seen for the vibrational modes of Tf^{-1} anion at wavenumber 1631 cm^{-1}. Overall, major differences in these vibrational bands from pure components to mixtures indicates that IL and salt have changed the polymer structure. It will reduce the intermolecular interactions among the constituent groups and will increase polymer chain segment flexibility. Therefore, these results can directly be used to discuss the other physical properties of the GPEs.

Keywords: Sodium batteries, Gel polymer electrolyte, PVdF-HFP, BMIMTf, NaTf

Algal Treatment for Wastewater Reclamation:
Evaluation of Disinfection Byproducts Formation by Chlorination

S.P. Munasinghe-Arachchige[1]*, K.M. Sparks[1], A. Ahmed[2], T. Schaub[2],
P.J. Trainor[3] and N. Nirmalakhandan[1]

[1]Civil Engineering Department
[2]Chemical Analysis and Instrumentation Laboratory,
[3]Economics, Applied Statistics and International Business Department,
New Mexico State University Las Cruces, NM 88003, USA
*srimalip@pdn.ac.lk

Wastewater reclamation has considered as a pathway for locally available water sources for reuse applications. While guidelines for restricted reuse applications require final disinfection of the reclaimed water, the common practice of chlorination can result in carcinogenic disinfection byproducts (DBPs) such as nitrosamines. An algal wastewater treatment system (AWTS) employing *Galdieria sulphuraria* that could treat municipal wastewater to BOD_5 <30 mg/L, NH_3-N <10 mg/L and PO_4 <1 mg/L with non-detectable levels of pathogenic bacteria has been recently demonstrated. Hence, the objective of this study was to evaluate chlorination of the effluent from this AWTS for restricted reuse in terms of water quality measures and potential for formation of nitrosamines. Chlorine stock solutions of different concentrations were used to chlorinate the effluent samples from the AWTS at pH of 4 and 6. The lowest chlorine dose that could satisfy the reuse guidelines (>1 mg/L residual free chlorine after 30 min of chlorination) was considered as the optimum level. Hence, the optimum initial chlorine dose required to chlorinate the AWTS effluent was found as 13.0 mg Cl_2/L at pH of 6. Under this condition, none of the seven nitrosamines analyzed were >50 ng/L. The unchlorinated AWTS effluent was then analyzed through non-targeted screening by liquid chromatography/high resolution mass spectrometry for any amine compounds which were known to be nitrosamine precursors. The analysis revealed only 0.39% alkylamine compounds out of 1,958 compounds identified. Based on the above findings, the AWTS is seen to hold promise as a safe pathway to yield reuse-quality effluent. This study also offered the premise that reclamation technologies that can concurrently remove/inactivate pathogens can reduce disinfectant demand and DBPs formation.

Keywords: Reclaimed water reuse, Algal wastewater treatment, Chlorination, Nitrosamines

Bayesian Model for Heteroscedastic Measurements in Method Comparison Data

S.M.M. Lakmali[1]*, L.S. Nawarathna[2] and P. Wijekoon[2]

[1]Postgraduate Institute of Science
[2]Department of Statistics and Computer Science, Faculty of Science
University of Peradeniya, Peradeniya 20400, Sri Lanka
*manushalakmali91@gmail.com

The evaluation of agreement in different methods is one of the most fundamental topics in clinical sciences. It is performed to determine the agreement of measurements measured by both standard and novel methods under different assumptions. The goal of method comparison is to check whether those methods are agreeable enough to be used interchangeably. If an agreement is satisfactory, then a cheaper, less invasive, and user-friendly method can be selected. In general, it is assumed to be a constant error variability of the methods when modelling method comparison data. However, this assumption is often violated in practice. Therefore, special consideration must be made when the measurements are changed with the magnitude of the measurement. In this study, we propose a Bayesian model for method comparison data when heteroscedasticity is present. To deal with the heteroscedastic measurements, the error variance was measured by a nonlinear equation using two parameters, namely η and Υ. Normal distribution was used as the prior distribution for all parameters. Moreover, the accuracy of the proposed model was evaluated using Root Mean Square Error (RMSE), Mean Absolute Percentage Error (MAPE), and Symmetric Mean Absolute Percentage Error (SMAPE). Further, Concordance Correlation Coefficient (CCC), Total Deviation Index (TDI), and Intra-class Correlation Coefficient (ICC) were used to measure the agreement. A dataset with patient cholesterol levels was used to examine the practical viewpoint of the proposed model. All the error values were less than 8.1, which are relatively low. Moreover, estimated CCC, ICC, and TDI values were 0.9891, 0.4945, and 1.9078, respectively. These results imply that the proposed Bayesian model is an appropriate model with high accuracy. Moreover, findings suggest that the cholesterol dataset has sufficient agreement to interchange the two methods.

Keywords: Agreement evaluation, Bayesian inference, Heteroscedasticity, Measurements, Priors

A Numerical Approach to Explore the Influence of Curb Geometries on Durability of Solid Tires

W.A.A.S. Premarathna[1]*, J.A.S.C. Jayasinghe[2], P. Gamage[1] and K.K. Wijesundara[2]

[1]Department of Manufacturing and Industrial Engineering
[2]Department of Civil Engineering
Faculty of Engineering, University of Peradeniya, Peradeniya 20400, Sri Lanka
*asaranga225@gmail.com

An assessment of tire durability is more important when their applications are mainly engaged in harsh environmental conditions. Solid resilient tires are mainly utilized for heavy-duty work in harsh conditions while impact with numerous obstacles. These unexpected impacts generate high stresses and excessive forces on the rubber layers of the tire as well as on its axle. Therefore, these tires experience unnecessary cracking and layer separations. It is necessary to capture the effect of causes on relevant tire failures to enhance tire performance. But these improvements are not easy to capture experimentally due to complex experimental setups and costly and time-consuming approaches. Hence, this study was mainly focused on developing high fidelity three-dimensional (3D) Finite Element (FE) tire models to study the impact effect on square type, angle type, and circle type curbs at different speeds while investigating stresses and forces generation on the tire and its axle. Initially, the FE model was developed by incorporating the mechanical behaviors of rubber layers. The suitable hyperelastic material models were selected using tensile tests and a curve-fitting approach. The relaxation properties of the materials were obtained using frequency sweep tests. Then the FE model was validated and it showed a good agreement with experimental data. The validated model was used to study the tire performances by changing the mentioned factors. The simulation results showed that the tread layer and side walls in the base layer of the tire contain high stresses for all three types of curbs. Therefore, radial cracks and tire damages are generated on the tire. In addition, it is shown that the square type of curb and large tire rolling speed cause to generate the highest stresses in the rubber layers of the tire and its axle. This study can be further developed to see the heat generation behavior of the tire.

Keywords: Hyperelastic materials, Impact on curbs, Finite element model, Solid resilient tires, Tire durability

Chemical Dynamics of Calcium Ion Adsorption by Core-Shell Adsorbent Granules Fabricated from Sand/Graphene Oxide Nano-Composite

B.G.N.R.M. Premasinghe[1]*, A.R. Kumarasinghe[2], J.A. Liyanage[1], W.P.R.T. Perera[3], W.S.K. Fernando[1] and R. Weerasooriya[4]

[1]Department of Chemistry, Faculty of Science, University of Kelaniya, Dalugama, 11600, Sri Lanka
[2]Department of Physics, Faculty of Applied Science, University of Sri Jayewardenepura, Sri Jayewardenepura 10100, Sri Lanka
[3]Faculty of Indigenous Health Science and Technology, Gampaha Wickramarachchi University of Indigenous Medicine, Yakkala 11870, Sri Lanka
[4]National Centre for Water Quality Research, National Institute of Fundamental Studies, Kandy 20000, Sri Lanka
*nrusitha@gmail.com

A novel adsorbent, core-shell adsorbent granules, engineered from sand/graphene oxide nanocomposite showed a promise to mitigate calcium ion removal from aqueous solution. The novel adsorbent was characterized using Scanning Electron Microscopy (SEM), Energy Dispersive X-ray Spectrometry (EDXAS) and Fourier Transform Infrared Spectroscopy (FTIR). The effect of various operational parameters such as pH, initial calcium concentration of the solution, adsorbent dose and contact time was evaluated in batch procedures at room temperature (26±2 °C). In order to determine the dynamic behavior of the adsorption process, isotherm and kinetic studies were also carried out. Characterization studies revealed that un-uniformed coatings of the graphene oxide had occurred on the sand surface and surface of the Nano-composite containing the oxygen-based functional groups. Before proceeding the kinetic studies, optimization was done for the Ca ion adsorption process by the sand/nanocomposite, and there was no significant effect of pH over a wide range (pH 4-10). Both Langmuir and Freundlich isotherm models have focused on displaying the isothermal adsorption process of Ca(II) on the super sand surface. This study found that Freundlich is the accepted model for the adsorption of the Ca(II) on the adsorbent because the correlation coefficient value (R^2) is 0.9871. However, in the Langmuir isotherm model, R^2 is reported as 0.8936. Thus, according to these results, it can be assumed that the sorption process has happened via multilayer adsorption. KF and n are Freundlich constants correspond to adsorption capacity and intensity, respectively. The n value was 0.0201 and indicates adsorption is a chemical process. Correlation coefficients of the pseudo-second-order model equal to one. Hence, the rate-determining step may be the chemical adsorption step. Finally, super sand granules show high selectivity towards calcium ions, and it is useful for the treatment of the hard water.

Keywords: Graphene oxide, Adsorption, Isotherm, Kinetic, Hardness

Analysing Leptospirosis Incidence and Its Association with Climatic Factors in Sri Lanka

P. Priyadarshana and P. Wijekoon*

*Department of Statistics and Computer Science, Faculty of Science,
University of Peradeniya, Peradeniya 20400, Sri Lanka
pushpaw@sci.pdn.ac.lk

Leptospirosis is one of the most important emerging bacterial zoonotic diseases caused by pathogenic *Leptospira* species. Determining the relationship between climatic factors and the leptospirosis cases in Sri Lanka may help understand the impact of climatic factors on the emergence and the spread of leptospirosis. This may help to design effective mitigation and control strategies for leptospirosis in most threatened areas. The objectives of this study were to conduct hot spot analysis to identify the most threatened areas, and to build a model to understand the relationship between climatic factors (rainfall, temperature, and relative humidity), population density and cultivation area with the reported leptospirosis cases using Generalized Linear Mixed Model (GLMM) approach. The data was collected for seventeen districts from 2010 to 2018. The population density and the size of the cultivation area in each district were also used as additional variables when modelling. The climatic factors, additional variables and leptospirosis cases data were collected from the departments of Meteorology, Census and Statistics, and Epidemiology, respectively. The correlation between climatic factors and leptospirosis cases in each district has been obtained by using Spearman's correlation, and it was found that the correlation results were not statistically significant. From the hot spot analysis based on the Getis-Ord (Gi*) test, it was noted that the hot spots were found in most districts in the Western, Sabaragamuwa, Southern, and North-Western provinces from 2010 to 2017. However, in 2018, hotspots were noted only in the Northern province. Adaptive Gaussian Guadrature (AGQ), Penalized Quasi (PQL), and Laplace likelihood estimation methods were used to fit a GLMM model. The validation results of the predicted values indicate that all three likelihood estimation approaches have approximately the same symmetric mean absolute percentage error. However, the residual analysis depicted that the GLMM model with AGQ likelihood estimation method is better than the other models, and rainfall, humidity, cultivation area and population density were the significant factors of the model. Therefore, GLMM with AGQ likelihood estimation were selected as the best model with 80.6% predictive accuracy.

Keywords: Leptospirosis, Meteorological factors, Spearman's correlation, Hot spot analysis, Generalized linear mixed model

Investigation of the Impact of HDAC Inhibitors on Human HDAC Enzyme: An *In-Silico* Approach

G. Parthiban[1], R. Dushanan[2], M.S.S. Weerasinghe[3],
D.P. Dissanayake[3] and R. Senthilnithy[2]*

*[1]Department of Chemistry, Faculty of Science, Eastern University,
Chenkalady 30350, Sri Lanka*
*[2]Department of Chemistry, Faculty of Natural Sciences, The Open University of Sri
Lanka, Nugegoda 10250, Sri Lanka*
[3]Department of Chemistry, University of Colombo, Colombo 00300, Sri Lanka
*rsent@ou.ac.lk

Histone Deacetylase (HDAC) enzymes in the human body are an important determinant of gene expression. In the last decade, HDAC inhibitors have been explored and used as therapeutic agents for various cancers. In recent years, the development of HDAC inhibitors to obtain new potent lead compounds has been directed using several methods. It is useful to find and develop new potent and selective compounds for treatment of cancer. Hence, this study focuses on the impact of HDAC inhibitors on the secondary structure of the HDAC enzymes through the in-silico approach. The work was carried out by molecular dynamics (MD) simulation for 100 ns with the Gromos53a6 field for two HDAC-inhibitor systems and a free type HDAC system. The studied inhibitors for this study are 2-(diphenylamino)-N-(7-(hydroxyamino)-7-oxoheptyl)pyrimidine-5-carboxamide (inhibitor A), and ((6-fluoroquinolin-2-yl)methyl)((1S,5S)-3-(5-(hydroxycarbamoyl)pyrimidine-2-yl)-3-azabicyclo[3.1.0]hex-6-yl)azanium (inhibitor B). The functions used to investigate the stability of the secondary structure of the systems are root-mean-square deviation (RMSD), the radius of gyration (Rg), and root-mean-square fluctuation (RMSF). The results obtained from the trajectory analysis shows that the average values for RMSD, Rg, and RMSF of HDLP with the inhibitor B (0.32 nm, 1.92 nm, and 0.11 nm) are lower than that for the free type HDLP enzyme (0.36 nm, 1.94 nm, and 0.12 nm). In contrast, the HDAC-A complex shows greater values (0.41 nm, 1.99 nm, and 0.15 nm). Therefore, it can be stated that the HDAC-B complex has become more stable than the free type HDLP and HDLP-A complex. Hence, inhibitor B has more potential to inhibit the HDAC enzymes. Consequently, the results revealed that inhibitor B and inhibitor A have a positive and negative impact on the secondary structure of HDAC, respectively.

Keywords: HDAC enzyme, HDAC inhibitors, MD simulation, RMSD, RMSF

A Novel CTAB (Cetyl Trimethyl Ammonium Bromide) Assisted Zinc Oxide Nanostructures as a Photodetector for UV Sensors

H.M.D. Nisansala[1], N.M.S. Sirimuthu[2], D.P. Pitigala[3], and C.N.K. Patabendige[1]*

[1]Department of Science for Technology, Faculty of Technology
[2]Department of Chemistry, Faculty of Applied Sciences
[3]Department of Physics, Faculty of Applied Sciences
University of Sri Jayewardenepura, Nugegoda 10250, Sri Lanka
*cpatabendige@sjp.ac.lk

The nanostructures exhibit interesting electronic and optical properties due to their low dimensionality leading to quantum confinement effects. Zinc oxide (ZnO) has received special attention due to its suitability for various applications in electronics, optoelectronics and laser technology. Among the various applications, sensor development has gained a specific place due to unique properties of zinc oxide such as broad range of radiation and high photo stability. ZnO nanorods with an average diameter of 76.6 nm were synthesized via a novel method using zinc chloride and potassium hydroxide as reactants. In this study Cetyl Trimethyl Ammonium Bromide (CTAB) was used as the surfactant to prevent the agglomeration of ZnO. The synthesized nanoparticles were characterized using X-ray diffraction, Ultra Violet Visible (UV-Vis) spectroscopy and Scanning electron microscopy (SEM). The synthesized nanorods had maximum UV absorption at 377 nm. In order to study the applicability as a photodetector, synthesized nanostructures were coated on Indium Tin Oxide (ITO), and its behaviour was studied under the wavelength of 365 nm. Moreover, the conductivities of synthesized ZnO and industrial ZnO under 365 nm illuminations were 149.39 nS and 4.01 nS, respectively.

Keywords: Zinc oxide, CTAB, ~~ITO~~, Sensor, Nanostructures, Synthesis, Conductivity

Development of Non Polymer Gel Electrolyte and Their Applications on Electrochromic Devices

H.M.B.I. Gunathilaka[1, 4]*, V.A. Seneviratne[1,2], and H.N.M. Sarangika[3]

*[1]Postgraduate Institute of Science [2]Department of Physics, Faculty of Science University of Peradeniya, Peradeniya 20400, Sri Lanka [3]Sabaragamuwa University of Sri Lanka, Belihuloya 70140, Sri Lanka [4]Industrial Technology Institute, Colombo 00700, Sri Lanka *induwan@iti.lk*

In this study, the development and characterization of a novel electrolyte by fumed silica nanoparticles and their applications on electrochromism were focused. Several experimental methodologies were used to optimize and characterize the electrolyte and the TiO_2 based electrochromic device. The molar ratio of total oxygen moles of ethylene glycol to lithium ions of LiCl was varied from 5:1 to 80:1. The electrolyte and the fabricated electrochromic devices (ECDs) were characterized using alternating current (AC) impedance spectroscopy, Fourier transform infrared (FT-IR) spectroscopy, ultraviolet–visible (UV-Vis) spectroscopy, cyclic voltammetry and scanning electron microscopy (SEM). The best ionic conductivity of 1.27×10^{-2} S cm^{-1} was obtained at room temperature (25 °C) with the molar ratio at 15:1. The best ionic conductivity of the gel electrolyte, 8.935×10^{-3} S cm^{-1}, was obtained at room temperature for the molar ratio of 15:1. Remarkable electrochromic properties of TiO_2/FTO film were observed in this study. High optical modulation of 71.9% at 700 nm and a moderate switching speed of $T_{bleaching} = 46.51$ s and $T_{coloring} = 14.45$ s were observed.

Keywords: Gel electrolyte, Non-polymer, Electrochromic device, Optical modulation

Application of Convolutional Neural Networks in Fruit Image Recognition

K. Niruththana* and W.D.S.S. Pemasinghe

Department of Food Science and Technology, Faculty of Livestock, Fisheries, and Nutrition, Wayamba University of Sri Lanka, Makandura, Gonawila 60170, Sri Lanka
*niruththana@gmail.com

The use of novel technologies for automating tedious manual tasks is of crucial importance for the food sector. To that end, this study illustrates the use of Convolutional Neural Networks (CNNs) for automatic food image classification. A user-friendly graphical user interface (GUI) program has been created as the front end to interact with the user. The program uses the Keras artificial intelligence (AI) library bundled with Python to implement the CNN. This AI program classifies images of apple, banana, and orange. Four thousand eight hundred sixty one (4861) images of apple (with different sub varieties), 1604 images of banana, and 564 images of orange were used as the training dataset, and 2431 images of apple, 809 images of banana, and 274 images of orange were used as testing dataset collected from various internet sources. A sequential CNN model was designed with three convolutional layers, three max pooling layers, one flattening layer and two dense layers. The softmax activation function was used for the final classification. Image resolution was 106 x 106 x 3 pixels each. PAGE drag and drop GUI builder was used to create the GUI interface. The final accuracy and loss of the trained model was 99.8% and 0.1%, respectively. The goal of this research study was to create a user-friendly interface for automated fruit image recognition that is based on deep learning, which will serve as a starting point for more complex analysis such as automated damage recognition of fruit. This initial study is also aimed at promoting enthusiasm in AI-based research in Sri Lanka at the undergraduate level. This simple model can be extended to include more classes of fruit as well. The concept can be further extended for automated quality assurance of fruits in an industrial environment given the availability of appropriate images as training sets.

Keywords: CNN, Keras, Artificial intelligence, Graphical user interface, Deep learning

Use of Computer Vision and Transfer Learning to Identify and Manage Utility Service Invoices

H.L.K.S. Hiniduma and P.M.P.C. Gunathilake*

*Department of Statistics and Computer Science, Faculty of Science,
University of Peradeniya, Peradeniya 20400, Sri Lanka
prabhath@pdn.ac.lk

Every Sri Lankan property which receives utility services gets monthly invoices from their respective service providers. Consumers need to manage printed statements during payment and, there are no electronic records presented concerning previous activity. This has made consumers having to bear an extra effort into handling these invoices. In this research, we introduced a deep learning based user-friendly mobile application where consumers are able to manage their payments and keep records of their previous activities related to utility services in real time. Our work utilised deep learning to identify and extract details in an invoice with less training data consist of only 100 images. The proposed methodology mainly consists of two stages, namely data extraction using transfer learning and optical character recognition (OCR), and integration of transfer learning and OCR to develop the mobile application. Initially, we detected the important details in utility invoices using transfer learning. We focused on state-of-the-art open-source pre-trained object detection models, Faster R-CNN (Regional Based Convolutional Neural Networks), SSD (Single Shot Detector), and YOLO (You Only Look Once) v3 to achieve object detection. Further, we understood the behaviour of these algorithms and achieved the optimal object detection model by performing hyperparameter tuning. The most generalised model was obtained by SSD which achieved an average F1-score of 65% on all 8 object classes. Then the detected details were converted to machine-readable text using the Tesseract OCR Engine. The final stage was to integrate the optimal object detection model and OCR to develop the mobile application. It was proven from this research that deep learning could introduce a business value to the idea of using minimum training data with the aid of transfer learning and OCR to achieve real-time performance since detection and extraction of details from utility invoices were able to be integrated into the mobile application successfully.

Keywords: Deep learning, Transfer learning, Object detection, Optical character recognition

Eco-Friendly Water Filters: Development of New Filtration Module Using *Strychnos potatorum* Seeds, Sand, and Banana Stem Charcoal as Starting Materials

M. Kandiah*, I. Oasha and O. Perera

School of Science, Business Management School, 591, Galle Road, Colombo 00600, Sri Lanka
*mathi@bms.ac.lk

Over 3.5 million people in the Dry Zone of Sri Lanka lack the access to safe drinking water. The availability of drinking water is a critical factor affecting the survival in the dry zone of Sri Lanka. Many village communities utilize groundwater for their day-to-day requirements. The quality of the groundwater in the dry zone is seriously affected by intense agriculture, improper domestic waste management as well as by natural factors such as underground lithology. Various groundwater filtration projects have been introduced in the dry zone of Sri Lanka to overcome this issue. However, the issue remains the same due to low socio-economic status of the dry zone community. This study focuses on developing a low-cost eco-friendly filter and assesses its efficiency by measuring the basic physicochemical parameters of filtered well water. The filtration module is designed using layers of *Strychnos potatorum* seeds (100 g), sand (100 g), and banana stem charcoal (100 g). Groundwater samples were collected from dug wells in 6 selected locations in Anuradhapura and Kurunegala districts and filtered by the designed filter module. Temperature, pH, redox potential were measured and sulphates were analysed by evaporation method. The dissolved oxygen, hardness and chloride were measured using titration method whereas nitrates levels of the water samples were analyzed using spectrophotometry. Aforementioned physicochemical parameters in both filtered and unfiltered water were compared and statistically analyzed using single-factor ANOVA. The designed filter is capable of filtering water at a rate of 4.8 L/hr and reducing the hardness, chloride, and nitrate levels by 53%, 20.3% and 46.3%, respectively. This study suggests that the designed filter module can be used as a low-cost and ecofriendly filter to improve the quality of groundwater.

Keywords: Filtering media, Water quality, Physicochemical tests, Quantitative analysis

Investigation of Light Trapping Techniques That Can Enhance Optical Performance of Solar Cells

L. Samaranayake, W.L. Abeygunasekara, S.J.N.P. Marthinu,
M.A.R.P. Mataraarachchi* and H.J. Munasinghe

*Department of Electrical and Electronic Engineering, Faculty of Engineering,
University of Peradeniya, Peradeniya 20400, Sri Lanka
ranitha@ieee.org

Improving the efficiency of solar cells is an important yet challenging goal to achieve in modern times. This research work is based on building a model using commercially available finite element software COMSOL Multiphysics, which can predict the optical behaviour of a solar cell. This study analyses how surface-texturing on top of the substrate can be used as a light-trapping technique to improve solar cells' optical absorption and consequently the efficiency. Here Zinc Oxide (ZnO) nanowires that can be grown on substrates using low-cost solution processing methods were investigated for their effectiveness as an anti-reflective coating. ZnO nanowire anti-reflective coating was optimised in terms of nanowire shape, height and spacing to minimise the surface reflections. Wire shapes considered in this research were pyramidal, spherical, conical and hexagonal shapes. About 5% reflection was present for normal incidence at the air-glass interface without any surface texturing. Our findings show that out of the different shapes of nanowires considered in this research, hexagonal nanowires show the most efficient surface texturing method with 0.3% reflections at normal incidence. Also, in the hexagonal model, the reflections are minimum when the wire height is 400 nm. Changing the wire spacing makes the efficiency fluctuate, and 250 nm is the optimum spacing from the simulation results. Additionally, findings show that uniform nanowires are more efficient for smaller angles of incidence, while tapered ones are more efficient for larger angles of incidence. We can further investigate the light trapping techniques by modelling the complete solar cell in COMSOL. To increase efficiency, we can surface texture the back electrode as well. Our next research focuses on this combined model.

Keywords: Solar cell, Organic, Light trapping, COMSOL, Surface-texturing

Performance of SPI and PCI Indices for Drought Monitoring in Sri Lanka at Different Time Scales: A Comparative Analysis

N. Alahacoon[1,2]* and C.M. Edirisinghe[1]

[1]*Department of Physics, Faculty of Science, University of Colombo, Colombo 00300, Sri Lanka*
[2]*International Water Management Institute (IWMI), Colombo 10120, Sri Lanka*
**n.alahacoon@cgiar.org*

The global climate is warming significantly and Sri Lanka is also being affected by the unprecedented increase in the incidence of drought during the *Maha* crop season. Therefore, it is especially important to select an appropriate index for drought monitoring that can be easily calculated and represent spatial variability. Therefore, the focus of this study was on the analysis of the potential of the Precipitation Condition Index (PCI) for drought predictions. The Standardized Precipitation Index (SPI) is the most widely used and globally accepted index for drought monitoring. Even though SPI calculation is convenient for location-specific data, it is more complicated to calculate using raster precipitation products. The PCI can be easily calculated at different time frames for both raster and location-specific rainfall data. In the context of drought monitoring, this study analyzed in detail the performance of the two indices SPI and PCI in Sri Lanka using Climate Hazards Group InfraRed Precipitation corrected with Stations (CHIRPS) data. For this purpose, after computing SPI and PCI for the periods of 1, 3, 6, 9, 12, and 24 months covering 25 districts of Sri Lanka during the period 1981 to 2019, the performance of SPI and PCI in determining the severity and occurrence of drought are compared and analyzed in detail. For 25 districts from 1981 to 2019 and the above timeframe (1 to 24 months), the Pearson correlation coefficients of the SPI and PCI index values are represented as 0.69, 0.73, 0.79, 0.83, 0.88, and 0.91, respectively. Furthermore, the results showed that the temporal changes in SPI and PCI are more consistent as the study time frame increases, but there are minor changes in the determination of drought severity. Both SPI and PCI indices can be used effectively to monitor droughts in Sri Lanka. It should also be noted that the performance of SPI and PCI varies over different study periods and regions.

Keywords: Drought, Drought monitoring, SPI, PCI, CHIRPS

A Case Study of Recognizing Causes for Abnormal Lots in a Capacitor Manufacturing Process

H.A.N. Thilakarathna* and N.A.D.N. Napagoda

*Department of Mathematical Sciences, Faculty of Applied Sciences,
Wayamba University of Sri Lanka, Kuliyapitiya 60200, Sri Lanka
nayomithilakarathne@gmail.com

Electrical and electronics is a significant furtherance industry in Sri Lanka and the capacitor industry plays a major role in export-oriented economic growth. The most used capacitor types are ceramic, film, paper, aluminum, polymer, supercapacitors for storing electric charges. Increasing number of defectives is a major problem in many industries. This study assists to reduce the abnormal quantity of defectives in Okaya Lanka (Pvt.) Ltd. An abnormal lot is a lot that exceeds the specified defect rate for a capacitor type and the key causes for generating mentioned lots are critical defects, exceeding the abnormal rate, exceeding the specifications. This study was focused on identifying causes for being abnormal through the key processes winding, *metalicon*, healing, welding. Data of 1000 abnormal lots were used to identify the major abnormal reason "Electrical_D10k" with the assist of a Pareto analysis. Fishbone diagrams were prepared for each of the responsible key processes for the major abnormal reason. Impurity of machinery/ processes, lack of knowledge/ training of employees are the decisive causes that can be seen in almost every fishbone diagram. Hence, maintain cleanliness, conduct a proper training programme at the outset are suggested to avoid critical causes. Another important aspect of our investigation was to find out which process is the most responsible for abnormal lots. Based on the findings, the most responsible process is that the quality checkers cannot discover a specific process for the abnormality of a lot. Therefore, we proposed to hire people with good knowledge in electrical and electronics as quality checkers in the electrical inspection process to identify abnormal reasons by properly checking internal qualities to eliminate the error. Therefore, this study assists in identifying the causes of defect capacitors and provides key solutions for reducing the abnormal quantity in the most occurred process with a better approach.

Keywords: Abnormal, Critical, Defectives, Fishbone diagrams, Pareto analysis

Analysis of Mortality Rates of Plant Species in Sinharaja Forest Dynamics Plot, Sri Lanka

D. Dissanayake[1], P. Wijekoon[1]*, E.P.S.K. Ediriweera[3] and I.A.U.N. Gunatilleke[2]

[1]Department of Statistics and Computer Science
[2]Department of Botany
Faculty of Science, University of Peradeniya, Peradeniya 20400, Sri Lanka
[3]Department of Science and Technology, Faculty of Applied Sciences,
Uva Wellassa University, Badulla 90000, Sri Lanka
*pushpaw@sci.pdn.ac.lk

Although tree mortality is a result of many interacting factors such as tree size, neighborhood competition and topographic factors, their relative influence is still unexplained. The main objective of this study was to examine the relative effect of tree size, some biotic (conspecific and heterospecific neighbors) and abiotic (elevation, slope, and convexity) factors on tree mortality at the community, and three guild levels (size class, abundance class, and growth form) using Generalized Linear Mixed-effects Models (GLMMs). Four census data: census1 (1994–1996), census2 (2001-2003), census3 (2007-2008), and census4 (2012-2013), collected at the 25 ha Sinharaja Forest Dynamics Plot (FDP) were used for the study. The patterns of mortality rates, and species with the highest mortality rates were identified over the forest-wide and under different diameter at breast height (dbh) classes. It was found that the forest-wide mean mortality rate decreases significantly from census interval one to two, and again increases from census interval two to three. Moreover, different species have different mortality rates, and there was no repetitive pattern of species over three census intervals except for the plant species *Melastoma malabathricum.* Among the dbh classes, large (>60 cm) species showed high mortality rates than small (10-30 cm) species. However, the species of *Macaranga indica* in 1-5 cm dbh class, *Symplocos pulchra ssp hispidula* in 10-30 cm dbh class, and *Mesua nagassarium* in >60 cm dbh class showed a repetitive pattern of the highest mortality rates. Further, both elevation and convexity showed a negative impact on tree mortality in the community and all guild levels. Interspecific competition is more important than the intraspecific competition. The study revealed that not only tree size, but also both biotic and abiotic factors are important in regulating tree mortality, although the relative importance of these factors is varied among guild levels.

Keywords: Tree mortality, Tree size, Abiotic and biotic factors, Sinharaja Forest Dynamics Plot, Generalized linear mixed-effects models

In-Vitro Anti-Bacterial Potential of Leaf and Bark Extracts of *Cinnamomum zeylanicum* Blume in Sri Lanka

K.T.S. Madhushika[1], W.M.D.G.B. Wijayaratne[2]* and V.P. Bulugahapitiya[1]

[1]*Department of Chemistry, Faculty of Science, University of Ruhuna, Matara 81000, Sri Lanka*
[2]*Department of Microbiology, Faculty of Medicine, University of Ruhuna, Galle 80000, Sri Lanka*
*bandara@med.ruh.ac.lk

Cinnamomum zeylanicum Blume (Ceylon cinnamon) belongs to the family Lauraceae. Though previous studies have elicited the therapeutic activities of Ceylon cinnamon, anti-microbial properties of cinnamon leaves and bark has not been adequately documented. Therefore, this study was aimed on investigation of anti-bacterial potential of leaf and bark of *C. zeylanicum* against selected gram-positive (*Streptococcus pyogenes*, *Staphylococcus aureus*- ATCC 25923) and gram-negative (*Escherichia coli*- ATCC 25922, *Pseudomonas aeruginosa*- ATCC 27853) bacteria. Water and methanol extracts of leaves and bark obtained via maceration for 72 h were analyzed by agar disk diffusion, agar well diffusion and minimum inhibitory concentration (MIC) assays (in triplicate). Gentamicin and ceftriaxone (*S. pyogene*) were used as the positive controls and dimethyl sulfoxide (DMSO) was used as the negative control. The results revealed more potent antibacterial action against *S. aureus* by methanolic extracts of bark (a maximum zone of inhibition of 14.0±0 mm in agar well diffusion and 12.0±0.2 mm in disk diffusion methods) but no inhibitory action was observed against *S. pyogenes* by methanolic extracts, and all the aqueous extracts were not inhibitory against gram-negative bacteria used in the study. The methanolic extract of leaves indicated a zone of inhibition of 10.3±0.9 mm in agar well diffusion and 7.8±0.8 mm in disk diffusion against *E. coli,* while it showed resistance to the bark extract. When considering activity against *P. aeruginosa* for methanolic extracts of bark and leaves, it showed inhibition zones of 8.3±0.3 mm and 9.2±0.2 mm, respectively. MIC of methanolic extract of leaves against *S. aureus*, *P. aeruginosa* and *E. coli* were 2.5 mgml^{-1}, 5.0 mgml^{-1} and 10.0 mgml^{-1}, respectively. The antibacterial potential of methanolic extract of leaves and bark of *C. zeylanicum* substantiate the possible use of them against food spoilage bacteria due to its significant effect against both gram-negative and gram-positive bacteria, with more promising potent activity against *S. aureus*.

Keywords: Ceylon cinnamon, Methanolic extract, Minimum inhibitory concentration, Antibacterial potential

Effect of Ceylon Cinnamon Leaf and Bark Extracts (In-Vitro) against Selected Fungal Pathogens

K.T.S. Madhushika[1], W.M.D.G.B. Wijayaratne[2]* and V.P. Bulugahapitiya[1]

[1]*Department of Chemistry, Faculty of Science, University of Ruhuna, Matara 81000, Sri Lanka*
[2]*Department of Microbiology, Faculty of Medicine, University of Ruhuna, Galle 80000, Sri Lanka*
*bandara@med.ruh.ac.lk

Ceylon cinnamon (*Cinnamomum zeylanicum* Blum) is well known spice since ancient periods due to its conventional aroma and medicinal properties. Most of the previous cinnamon related antifungal studies are based on its volatile oil composition of inner bark. Only a few studies have been conducted on extracts of cinnamon that deserves further research. The aim of this study was to investigate the antifungal potential of Ceylon cinnamon leaf and bark extracts (methanol and aqueous) by determining the minimum inhibitory concentration (MIC) for selected fungi; *Candida albicans* (ATCC 10231), *Candida krusei* (ATCC 6258), *Candida parapsilosis* (ATCC 22019), *Candida tropicalis* (ATCC 13803), *Microsporum gypseum, Tricophyton mentagraphytes, Tricophyton rubrum* and *Fusarium dimerum*. Freshly collected samples were air-dried for 3-7 days at room temperature and were macerated using methanol or distilled water separately for 3 days. The crude extracts were resuspended in dimethyl sulfoxide (DMSO) and MICs were performed using modified agar dilution method. Fluconazole (MIC range from 15-30 µgmL^{-1}) used as the positive control and DMSO was the negative control. The results showed that MIC values for *Candida spp* ranged from 625 µgmL^{-1} to 78.12 µgmL^{-1} for the methanolic extract of bark; of which the lowest value was obtained by *C. albicans*. Comparatively, the aqueous extracts of leaf and bark demonstrated higher MIC against all tested fungi (range from 1250 µgmL^{-1} to 10000 µgmL^{-1}), with more dominance in *Candida spp*. A MIC value of 625 µgmL^{-1} for *T. mentagraphytes* and *M. gypseum* and that of 156.25 µgmL^{-1} against *T. rubrum* were observed in the methanolic extract of bark. *F. dimerum* has expressed comparatively higher MICs (range from 1250 µgmL^{-1} to 5000 µgmL^{-1}) against all four types of extracts. The prominent in-vitro inhibitory effect of the methanolic extract of the cinnamon bark suggests the possible use of cinnamon bark extracts against superficial fungal infections.

Keywords: Ceylon cinnamon, Leaf, Bark, Methanolic extract, Minimum inhibitory concentration

Some Representations of G −Frames in Quaternionic Setting

M. Khokulan[1]* and M. Sangarthas[2]

[1]Department of Mathematics and Statistics, Faculty of Science
[2]Department of Interdisciplinary Studies, Faculty of Engineering
University of Jaffna, Jaffna 40000, Sri Lanka
**mkhokulan@univ.jfn.ac.lk*

Due to the non–commutativity of quaternions, a quaternionic Hilbert space can be defined in two different ways, one is left quaternionic Hilbert space and another one is right quaternionic Hilbert space. These two are isomorphic versions. In this research, we have shown that every G-frame for a left quaternionic Hilbert space can be written as a sum of three G-orthonormal bases and also that a G-frame can be represented as a linear combination of two G-orthonormal bases if and only if it is a G-Riesz basis. Let $\mathcal{U}_{\mathbb{H}}^L$ and $\mathcal{V}_{\mathbb{H}}^L$ be two left quaternionic Hilbert spaces which are separable and $\{\mathcal{U}_k : k \in \mathbb{I}\} \subseteq \mathcal{V}_{\mathbb{H}}^L$ is a sequence of quaternionic Hilbert spaces, which is a subset of $\mathbb{Z}$. Let $\mathfrak{B}(\mathcal{U}_{\mathbb{H}}^L, \mathcal{U}_k)$ be the collection of all bounded linear operators from $\mathcal{U}_{\mathbb{H}}^L$ into $\mathcal{U}_k$. A family $\{\mathfrak{I}_k \in \mathfrak{B}(\mathcal{U}_{\mathbb{H}}^L, \mathcal{U}_k) : k \in \mathbb{I}\}$ is called a G-frame for $\mathcal{U}_{\mathbb{H}}^L$ with respect to $\{\mathcal{U}_k : k \in \mathbb{I}\}$ if there exist constants $0 < C \leq D < \propto$ such that $C\|\phi\|^2 \leq \sum_{k\in\mathbb{I}}\|\mathfrak{I}_k\phi\|^2 \leq D\|\phi\|^2$, for all $\phi \in \mathcal{U}_{\mathbb{H}}^L$, where C and D are G-frame bounds. If we only have the upper bound, we call $\{\mathfrak{I}_k\}_{k\in\mathbb{I}}$ is a G-Bessel sequence with bound D. We call it $\{\mathfrak{I}_k\}_{k\in\mathbb{I}}$ is G-complete if $\{\phi : \mathfrak{I}_k\phi = 0, \forall k \in \mathbb{I}\} = \{0\}$ and it is G-orthonormal basis for $\mathcal{U}_{\mathbb{H}}^L$ if, $\langle \mathfrak{I}_k^*\psi_k | \mathfrak{I}_l^*\psi_l \rangle = \delta_{k,l}\langle\psi_k|\psi_l\rangle, k, l \in \mathbb{I}, \psi_k \in \mathcal{U}_k, \psi_l \in \mathcal{U}_l$, and $\sum_{k\in\mathbb{I}}\|\mathfrak{I}_k\phi\|^2 = \|\phi\|^2$. We say that $\{\mathfrak{I}_k \in \mathfrak{B}(\mathcal{U}_{\mathbb{H}}^L, \mathcal{U}_k) : k \in \mathbb{I}\}$ is a G-Riesz basis for $\mathcal{U}_{\mathbb{H}}^L$, if it is G-complete and there exist constants $0 < C \leq D < \propto$ such that for $\mathbb{J} \subseteq \mathbb{I}$ and $\psi_k \in \mathcal{U}_k, k \in \mathbb{J}$, $C\sum_{k\in\mathbb{J}}\|\psi_k\|^2 \leq \left\|\sum_{k\in\mathbb{J}}\mathfrak{I}_k^*\psi_k\right\|^2 \leq D\sum_{k\in\mathbb{J}}\|\psi_k\|^2$. Furthermore, if $\{\mathfrak{I}_k \in \mathfrak{B}(\mathcal{U}_{\mathbb{H}}^L, \mathcal{U}_k) : k \in \mathbb{I}\}$ is a G-frame for $\mathcal{U}_{\mathbb{H}}^L$ then there exist G-orthonormal bases $\{\Xi_k\}, \{\mathfrak{Z}_k\}, \{\Psi_k\}$ for $\mathcal{U}_{\mathbb{H}}^L$ and a constant λ such that $\mathfrak{I}_k = \lambda(\Xi_k + \mathfrak{Z}_k + \Psi_k)$, for all $k \in \mathbb{I}$. Finally if $\{\mathfrak{E}_k \in \mathfrak{B}(\mathcal{U}_{\mathbb{H}}^L, \mathcal{U}_k) : k \in \mathbb{I}\}$ is a G-orthonormal basis for $\mathcal{U}_{\mathbb{H}}^L$ then we have a G-frame $\{\mathfrak{I}_k \in \mathfrak{B}(\mathcal{U}_{\mathbb{H}}^L, \mathcal{U}_k) : k \in \mathbb{I}\}$ which can be written as a linear combination of two G-orthonormal bases for $\mathcal{U}_{\mathbb{H}}^L$ if and only if $\{\mathfrak{I}_k \in \mathfrak{B}(\mathcal{U}_{\mathbb{H}}^L, \mathcal{U}_k) : k \in \mathbb{I}\}$ is a G-Riesz basis for $\mathcal{U}_{\mathbb{H}}^L$.

Key words: Frames, G-frames, G-Riesz basis, Quaternionic Hilbert spaces

Science, Technology and Industry

Groundwater with High Hardness: Potent Foulants in Membrane-Based Water Treatment Systems

M.A.C.K. Hansima[1]*, J. Ketharani[2], D.R. Samarajeewa[2], M. Makehelwala[3], K.B.S.N. Jinadasa[2], K.G.N. Nanayakkara[2], A.C. Herath[4] and R. Weerasooriya[5]

[1]*Postgraduate Institute of Science*
.[2]*Department of Civil Engineering, Faculty of Engineering*
University of Peradeniya, Peradeniya 20400, Sri Lanka
[3]*National Water Supply and Drainage Board, Katugastota 20800, Sri Lanka*
[4]*Department of Chemical Sciences, Faculty of Applied Sciences,*
Rajarata University of Sri Lanka, Mihintale 50300, Sri Lanka
[5]*National Center for Water Quality Research, National Institute of Fundamental Studies,*
Kandy 20000, Sri Lanka
*127charithahansima@gmail.com

The complexation of dissolved organic carbon (DOC) with multivalent metal ions, such as Ca^{2+} and Mg^{2+} in high hard groundwater can form complexes (DOC-Ca^{2+}/Mg^{2+}) that can cause fouling of ion-exchange membranes (IEMs) in electrodialysis reversal water treatment systems. DOC contains an array of organic compounds, of which humic acid (HA) and fulvic acid (FA) being the most reactive species. Characterization of HA and FA fractions, determination of their abundance and the amount of Ca^{2+} and Mg^{2+} complexed with them is not only necessary to understand their effect on membrane fouling, but also to perceive methods to mitigate membrane fouling. To investigate this, HA and FA fractions were isolated from shallow groundwater of the north central province (NCP), Sri Lanka using XAD-8 resin extraction method. The pH value of NCP groundwater typically ranges from 6-9. The ratio of HA:FA in NCP DOC fraction of the groundwater was obtained as 1:10. The E_{465}/E_{665} ratio acquired from the UV-VIS spectroscopy data indicated a higher aromaticity and a larger molecular weight for HA as compared to FA. The Fourier Transfer Infrared (FTIR) spectra of the two fractions suggested a relatively higher abundance of O-containing functional groups (i.e., COOH, alkoxy R-OR, C=O and R-OH) in FA than that of HA. For 100 mg L^{-1} of carbon in the DOC-Ca^{2+}/Mg^{2+} complexes, 5.77 mg L^{-1} and 1.04 mg L^{-1} of Ca^{2+} was determined in HA-Ca^{2+} and FA-Ca^{2+} complexes, respectively and 2.21 mg L^{-1} and 0.16 mg L^{-1} of Mg^{2+} was determined in HA-Mg^{2+} and FA-Mg^{2+}, respectively. Therefore, the complexation ability of HA is comparatively high regardless of the presence of a lesser number of O-containing functional groups in the HA structure as compared to the FA structure. To identify the fouling mechanisms of the extracted HA and FA fractions and their respective cation complexes, fouling studies will be performed with IEMs.

Keywords: DOC, Humic acid, Fulvic acid, Calcium ions, Magnesium ions

Reconstruction of Wheel Graphs

M.D.M.C.P. Weerarathna[1]*, A.P. Batuwita[2], K.D.E. Dhananjaya[1] and A.A.I. Perera[1]

[1]*Department of Mathematics, Faculty of Science, University of Peradeniya,
Peradeniya 20400, Sri Lanka*
[2]*Department of Science and Technology, University of Uwa Wellassa,
Badulla 90000, Sri Lanka*
*chinthakaweerarathna@gmail.com

A graph G is a pair of sets $[V(G), E(G)]$, where $V(G)$ and $E(G)$ are the set of vertices and the set of edges in G, respectively. Let $v_1, v_2, v_3, \dots, v_n \in V(G)$ and $G_i = G \backslash \{v_i\}$ be the subgraph obtained by deleting a vertex v_i from G. For a graph, the deck of G, denoted by $D(G)$, is the multiset of isomorphism classes of all vertex-deleted subgraphs of G. Each graph in $D(G)$ is called a card. Two graphs that have the same deck are said to be hypomorphic. Reconstructing the original graph G using the cards is called graph reconstruction. Thus, Ulam introduced "Any two hypomorphic graphs on at least three vertices are isomorphic" as the graph reconstruction conjecture in 1960. After few years later, Harary introduced "Any two graphs with at least four edges and having the same edge-decks are isomorphic" as the edge reconstruction conjecture. Many researchers have paid more attention to graph reconstruction conjecture and proved it is valid for special class of graphs such as trees, disconnected graphs, regular graphs, etc. However, the general case remains unsolved. In this work, we mainly focus on wheel graphs. We have shown that the wheel graph W_n can be reconstructed using the constructive proofing method. In this construction, we remove one vertex at a time and obtain cards. There are two distinct types of cards in this deck. One is a cycle graph with $(n-1)$ vertices and the other type is non – cycle with $(n-1)$ number of isomorphic cards with each other. The degree sequence of wheel graph can be obtained using this deck. Besides, some recognizable properties such as degree sequence in the deck of any wheel graph, the order of the graph, the relation between the number of edges in the deck and the original wheel graph, chromatic polynomial and many other properties of wheel graph can be obtained from the vertex deleted subgraphs. Currently, we are working to expand above result for other types of non-regular graphs.

Keywords: Deck of cards, Graph reconstruction conjecture, Wheel graph

Qualitative and Quantitative Chemical Analysis of
"*Katuwelbatu Deduru Katuka Churna*"

K.G.A.N. Premachandra[1]*, D.N. Wanigasekara[2] and H.P. Wakkumbura[3]

[1]*Gampaha Wickramarachchi Ayurveda Institute, University of Kelaniya, Yakkala 11870, Sri Lanka*
[2]*Department of Biochemistry, Faculty of Medicine, University of Ruhuna, Galle 80000, Sri Lanka*
[3]*Department of Kaumarabruthya and Stree Roga, Gampaha Wickramarachchi Ayurveda Institute, University of Kelaniya, Yakkala 11870, Sri Lanka*
*niroshanuaa@gmail.com

This study investigates the physico-chemical parameters and phytochemical parameters of a poly-herbal Ayurveda formulation called "*Katuwelbatu Deduru Katuka Churna*" which is widely used in Ayurveda pediatric practices. In order to assess the purity of the drug, total ash content, water soluble ash content, acid insoluble ash content, water extractable matter (both hot and cold) and ethanol extractable matter were analyzed. Qualitative analysis of phytochemicals such as tannins, flavonoids, coumarins, saponins, steroid glycosides and cardiac glycosides was carried out to determine the pharmaceutical quality of the drug using standard protocols. The formulation was prepared according to the standard methodology using dried plant materials of *Picrorrhiza kurroa, Solanum xanthocarpum, Clerodendrum serratum, Cuminum cyminum* and *Nigella sativa.* The obtained values for total ash content, hot ethanol extractable matter, cold water extractable matter, ethanol extractable matter, hot water extractable matter, acid insoluble matter and water soluble ash content were 5.45±0.26 %, 413.00±15 mg/g, 34.60±6 mg/g, 129.00±9 mg/g, 114.00±1 mg/g, 0.18±0.03 % and 4.47±0.23 %, respectively. Tannins, flavonoids, saponins, coumarins and cardiac glycosides were detected in both water extract and the ethanol extract of the formulation. Steroid glycosides were present only in water extract while they were absent in ethanol extract. Low acid insoluble ash content indicates the high purity of the formulation.

Keywords: Antioxidants*, Katuwelbatu Deduru Katuka Churna,* Phytochemical, Quality

Antibacterial Property of Aqueous and Methanolic Extracts of *Bauhinia racemosa* Leaves against Selected *Escherichia coli* Strains

M.L.M.D.T. Udayashantha[1]*, H.B.I. Dilrukshi[1], W.N. Jayawardhana[1], H.P. Wakkumbura[2] and D.N. Wanigasekara[3]

[1]*Kg/Dehi/Humbaswalana Kanishta Vidyalaya, Humbaswalana, Ruwanwella 71300, Sri Lanka*
[2]*Gampaha Wickramarachchi Ayurveda Institute, University of Kelaniya, Yakkala 11870, Sri Lanka*
[3]*Department of Biochemistry, Faculty of Medicine, University of Ruhuna, Galle 80000, Sri Lanka*
*mohanhumbaswalana@gmail.com

Bauhinia racemosa leaves are used in indigenous medicine to treat urinary tract infections. However, its antibacterial efficacy has not been studied widely. This study was carried out to determine the potential of *B. racemosa* leaf extract to inhibit *Escherichia coli*, which is a major causative agent of urinary tract infections. The study aimed to investigate the presence of any potential in-vitro antibacterial efficacy towards the selected *E.coli* strains. Antibacterial activity of both aqueous extract and methanolic extract against *E.coli* (ATCC 23922), *E.coli* (ATCC 8739) and clinically isolated *E.coli* were evaluated using Agar well-diffusion method. Dried *B. racemosa* leaves were used to prepare methanolic extract and aqueous extract was prepared with fresh leaves. Overnight bacterial cultures (McFarland 0.5, 100 μl each) were pipetted out onto Mueller Hinton Agar plates separately and spread evenly to obtain a uniform lawn. Four wells were cut on each inoculated agar plate for positive control, negative control, aqueous extract and methanolic extract. Amoxicillin (50 μl, 10mg/ml) and 20% Dimethyl sulfoxide (DMSO) (50 μl) were added as positive control and negative control, respectively, whereas aqueous extract (50 μl) and methanolic extract dissolved in DMSO (20%, 50 μl) were added to remaining wells. Then the agar plates were incubated at 37 ºC for 24 hours. The test was triplicated. After incubation, the zone of inhibition was recorded in mm. No susceptibility was observed for both methanolic and aqueous extracts by *E.coli* (ATCC 23922) and *E.coli* (ATCC 8739) while clinically isolated *E.coli* was found to be susceptible to methanolic extract showing a mean inhibition zone diameter of 12.33±0.56 mm. All three strains were resistant to the aqueous extract. This study concludes that no in-vitro antimicrobial activity is possessed by aqueous leaf extract of *B. racemosa* against all three strains while methanolic leaf extract was effective against clinically isolated *E.coli*.

Keywords: Antimicrobial, *Bouhinia racemosa, E.coli,* Leaves

Simulation of Performance of a Bill Payment Service: A Case Study

P.M.G.N.M. Jayarathne[*], M.W.A.M.P. Muthukuda, B.R.B. Mendis,
D.R.S. Ranaweera and T.M.H.P. Tennakoon

*Department of Industrial Management, Faculty of Applied Sciences,
Wayamba University of Sri Lanka, Kuliyapitiya 60200, Sri Lanka
nimasha.jayarathne1@gmail.com

Customer satisfaction affects the performance of any organization. But, waiting in queues for a long time to pay utility bills may cause customer dissatisfaction. The identified problem was the long waiting times at two bill payment counters in a selected organization. The main objective of this study was to design a model to reduce queuing times at payment counters. The sample size of this study was 152 customers. The primary data were collected for inter-arrival times and service times of the customers in the queues. They were observed during a typical busy time for a period of four consecutive hours. The times recorded for both arrivals and departures using a stopwatch. Respective service times were then calculated. The Arena simulation software was used to model this multi-server queuing system. The data were simulated for a replication length of 240 minutes. The study assumed the serving of customers to be First-In, First-Out, and the servers to be identical. Also, the waiting space was unlimited and no customers left the queue until served. The distribution patterns for arrivals and service provisions were obtained using the Input analyzer. At paying counters one and two, arrival patterns followed Triangular and Exponential distributions while their service provisions followed Weibull and Exponential distributions, respectively. The average waiting times of those respective counters were 8.65 and 13.80 minutes. Feasible alternatives were simulated to improve the efficiency of the bill payment process. Considering the feasibility analysis, the study suggested an additional counter to the system in its rush hours. Thus, average waiting times were reduced to 1.17 and 0.83 minutes respectively in the counters one and two, and the waiting time for the new counter was 2.01 minutes.

Keywords: Arena simulation, Performance of bill payment service, Queuing system, Waiting time

Science, Technology and Industry

Association between the Abundance of Dengue Larvae and Water Quality Characteristics of Available Breeding Habitats in Selected Localities in Kurunegala District

J.M.M.K. Herath[1,2]*, W.A.P.P. de Silva[3], T.C. Weeraratne[3],
H.T.K H.T.K. Abeyasundara[4] and S.H.P.P. Karunaratne[3]

[1]*Entomological Surveillance Unit, Office of Regional Director of Health Services, Kurunegala 60000, Sri Lanka*
[2]*Postgraduate Institute of Science*
[3]*Department of Zoology, Faculty of Science*
[4]*Department of Statistics and Computer Science, Faculty of Science*
University of Perdeniya, Peradeniya 20400, Sri Lanka
*manelherath15@yahoo.com

Quality of the water and availability of larval food are considered as the major factors which determine the selection of breeding habitats by mosquitoes. In this study a systematic survey was conducted to determine the association between water quality parameters and the abundance of dengue larvae (*Aedes aegypti* and *Aedes albopictus*) in available breeding habitats of selected localities in Kurunegala district. The study locations represent urban areas (Bandarnayakapura, Meegahkotuwa), a semi-urban area (Galgamuwa), and a rural area (Buluwala). Entomological survey was carried out from January to December 2019. Water quality parameters of preferred breeding sites of dengue mosquitoes were measured using standard techniques at each sampling site. Multiple regression analysis was conducted using XLSTAT Version 2012.2 to determine the association between the water quality parameters of the breeding sites and the larval density. There was a significant variation of the density of larvae at different breeding sites ($p < 0.001$). Concrete slabs (n=24, 25%) and bamboo stumps (n=15, 33%) were the most common breeding sites in urban areas while tyres (n=6, 50%) were the common breeding sites in semi urban areas. Gutters (n=9, 55%) and concrete slabs (n=4, 45%) were the preferred breeding sites in rural settings. *Aedes albopictus* larvae were reported from all container types (n=15). *Aedes aegypti* larvae was reported from 75% of the observed container types (n=10) and the highest density was reported from unused commode/cistern (28 larvae per 350ml). Multiple regression analysis showed a strong association (R-sq=94.78%, $p < 0.1$, VIF<2) between pH (p=0.02), Ammonia (p=0.039), Iron (p=0.01), Chloride (p=0.021) concentrations of each breeding habitat with the abundance of dengue larvae. The results of the study provide important information about the characteristics of preferred breeding sites of *Ae. aegypti* and *Ae. albopictus* mosquitoes in study locations.

Keywords: Water quality parameters, *Aedes aegypti*, *Aedes albopictus,* Breeding sites

Science, Technology and Industry

Green Extraction of Nanocellulose from Banana Pseudostem

K.M.P.P.K. Pamunuwa[1, 2], P.D. Wathudura[3], S.R. Gunatilake[3],
N.M.S. Sirimuthu[1, 2] and P.K.D.M.C. Karunarathne[1]*

[1]*Department of Chemistry, Faculty of Applied Sciences*
[2]*The Center for Nanocomposite Research*
University of Sri Jayewardenepura, Nugegoda 10250, Sri Lanka
[3]*College of Chemical Sciences, Institute of Chemistry Ceylon, Adamantane House,*
Rajagiriya 10107, Sri Lanka
*mck@sjp.ac.lk

With the increasing environmental concerns on the use of fossil fuel-based raw materials, nanocellulose has enthralled many material scientists due to its unique properties, renewability and abundance. Nanocellulose has become a promising material for a broad spectrum of potential applications such as packaging, biomedical applications, hygiene products and biosensors. In this study, extraction of cellulose nanofibrils was carried out from the pseudostem of sour banana, *Musa acuminata* cv. Mysore, AAB. Banana crop generates an ample amount of pseudostem waste once the fruit is harvested. Therefore, another focus of this study is converting pseudostem residue into a value-added industrial material. The mechanochemical extraction protocol with the aid of microwave digestion and ultrasonication follows five green chemistry principles. The current process involves three main steps; chemical purification, bleaching, and ultrasonic fibrillation. Pretreatment of raw fibers with sodium hydroxide under microwave irradiation is effective in hemicellulose and lignin removal. However, complete removal of lignin was achieved by subsequent bleaching of the samples with hydrogen peroxide. Ultrasonic fibrillation in water facilitated the erosion of amorphous domains of cellulose fiber, resulting in crystalline nanocellulose. Mercerization of raw cellulose fibers followed by sonication was found to be effective especially in particle diameter reduction. Extracted nanocellulose was characterized by X-ray powder diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), thermogravimetric analysis (TGA), Raman Spectroscopy, and Particle size analyzer. XRD, FTIR and Raman Spectroscopic data confirmed the successful extraction of crystalline cellulose, whilst Particle size analysis along with Scherrer equation confirmed the diameters and crystallite sizes to be in the nanoregime. This research confirms that the adopted green method addresses some of the major drawbacks involved with the conventional extraction method such as low efficiency and excessive consumption of energy, time, and harsh chemicals. Thus, this green method can be proven environmentally friendly and economically viable in extracting nanocellulose from abundant plant waste materials.

Keywords: Green extraction, Nanocellulose, Microwave digestion, Ultrasonication

Evaluation of Sugarcane Smut Resistance in *Saccharum officinarum* L. and Wild Sugarcane Accessions Available in Sri Lanka

A.N.W.S. Thushari[1]*, A. Wijesuriya[1], B.W. Wijesuriya[2] and D.M. De Costa[3]

[1]Sugarcane Research Institute, Udawalawe 70190, Sri Lanka
[2]Rubber Research Institute, Dartonfield, Agalawatta 12200, Sri Lanka
[3]Department of Agricultural Biology, Faculty of Agriculture, University of Peradeniya,
Peradeniya 20400, Sri Lanka
*asumedhathushari@yahoo.com

Breeding for resistance is the most effective approach to manage sugarcane smut, caused by the fungus, *Sporisorium scitamineum*. This study evaluated the smut disease reaction of different *Saccharum officinarum* L. and wild sugarcane accessions available in Sri Lanka to develop parental core-collection for directional breeding of sugarcane accessions resistant to smut disease. Seventy one (71) accessions of *S. officinarum* and 40 accessions of wild sugarcane (i.e. 21 accessions of *Erianthus arundinaceus* Michx. and 19 accessions of *Saccharum spontaneum* L.) were inoculated with smut spores by dip inoculation technique and a field trial was established using completely randomized design with two replicates. Smut -inoculated six varieties having established-ratings for smut disease under local conditions were used as standards. Disease incidence was recorded in terms of the number of infected stalks per plot at monthly intervals over a period of one year. Disease severity was assessed in terms of the number of days to appear the first smut whip and Area Under Disease Progress Curve (AUDPC) was determined based on the disease incidence of each accession. All the above parameters were measured for both plant and ratoon crops. The regression equations derived from average disease incidences of the standard varieties versus their established ratings were used to assign the resistance ratings to all tested accessions. The ranks obtained for the severity assessment index of accessions were analyzed by Kruskal Wallis test and ANOVA was done for AUDPC assessments. The results revealed that six *S. officinarum* and 32 wild sugarcane accessions were highly-resistant to smut with a 0% disease severity and 0 AUDPC value in both plant and in the first ratoon crops. Therefore, these 38 accessions can be used for the development of parental core-collection for breeding for resistance to smut disease for further development of sugar industry in Sri Lanka.

Keywords: Breeding, Resistance, *Sporisorium scitamineum*, Sugarcane smut, Wild sugarcane

Microwave-Assisted Solvent-Free Synthesis of 3-(4-Dimethylaminobenzylidene) Indolin-2-One and Investigation of Its Anti-Oxidant Activity

H.P.S.K. Wijekoon[1], N.P.L.N. Palliyaguru[1], T.D.C.P. Gunasekara[2,3],
S.S.N. Fernando[2], P.P.M. Jayaweera[1] and K.G.U.R. Kumarasinghe[1]*

[1]*Department of Chemistry, Faculty of Applied Sciences*
[2]*Department of Microbiology, Faculty of Medical Sciences*
[3]*Center for Plant Materials and Herbal Products Research*
University of Sri Jayewardenepura, Nugegoda 10250, Sri Lanka
**upulk@sjp.ac.lk*

The recent emergence of 3-benzylidene-indoline-2-ones as an important group of oxindole derivatives is gaining much interest in the pharmaceutical field. These oxindole derivatives have been shown a broad spectrum of biological activities including anti-cancer, anti-viral, anti-bacterial, anti-oxidant and anti-inflammatory. The development of an effective method for the synthesis of these compounds in an environmentally benign manner will be a tremendous benefit to the society. Microwave-assisted organic reactions in solvent-free conditions are considered an effective, eco-friendly synthetic tool in organic chemistry as it acts fast and produces high yield and low by-products. The present study is focused on the development of a novel green method for the synthesis of 3-(4-dimethylaminobenzylidene) indoline-2-one and to investigate its anti-oxidant activity. Oxindole and 4-(dimethylamino)benzaldehyde was thoroughly mixed with 3-aminopropyl)triethoxysilane (APTES) modified silica and irradiated inside a modified microwave oven for 12 minutes. The product was obtained with 76% yield and characterized by Nuclear Magnetic Resonance (NMR) and Fourier-Transform Infrared (FTIR) spectroscopic techniques. The compound was tested for in-vitro anti-oxidant activity using 2,2-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid (ABTS) assay. Both ^1H NMR and ^{13}C NMR spectra confirmed the formation of 3-(4-dimethylaminobenzylidene) indoline-2-one. The FTIR spectrum of the resulted compound show characteristics peaks related to the functional groups present in the targeted compound. The half-maximum inhibitory concentration (IC-50) of resulted product and the standard drug (ascorbic acid) was calculated using linear regression analysis. IC-50 values of the synthesized compound and the positive control, ascorbic acid were 0.028 ± 0.008 mg/mL and 0.029 ± 0.004 mg/mL, respectively. These findings revealed that 3-(4-dimethylaminobenzylidene) indoline-2-one shows a strong anti-oxidant activity. Microwave-assisted, eco-friendly, solvent-free, green synthesized biologically active oxindole derivative (3-(4-dimethylaminobenzylidene) indoline-2-one) will be applicable for the future development of novel therapeutic agents.

Keywords: Microwave-assisted, Solvent-free, Oxindole, 3-benzylidene-indolin-2-ones, Anti-oxidant

Detecting Possible Mosquito Breeding Sites Using Aerial Imaging and Deep Learning

M. Pravina[1]*, A.M. Gnanaruby[1], K. Southran[1], M.B. Dissanayake[1] and M. Niranjan[2]

[1]Department of Electrical and Electronic Engineering, Faculty of Engineering, University of Peradeniya, Peradeniya 20400, Sri Lanka
[2]Electronics and Computer Science, University of Southampton, Southampton, SO17 1BJ, UK
*pravimyl3@gmail.com

Dengue is a mosquito-borne viral disease. To eradicate Dengue, it is essential to eliminate mosquito breeding sites. However, in practice it is difficult to detect all sources of stagnant water by visual inspection as some are not easily accessible, such as roof gutters and objects on rooftops. A potential cost-effective solution is to use aerial photography in combination with computer vision techniques to automatically identify these potential sites. We explored this approach, by developing a Convolution Neural Network (CNN) to automatically detect mosquito breeding objects in aerial images with high efficiency. As a pilot implementation, a dataset of most common water retention objects, tins and tires were collected using drone images. Data augmentation was used to increase the training set from 10,000 to 21,000 images. The quality of the captured images depends on the sensor capacity of the drone camera and the Ground Sampling Distance (GSD). We have considered a GSD of 7cm or larger, which is sufficient to identify the objects clearly using the classification system. We propose a CNN with two convolutional layers, consisting of 287,107 parameters. To prevent overfitting and induce generalization, we used the technique of dropout. Finally, with unseen data, the model was able to achieve a high accuracy of 99% in identifying the two water retaining objects from RGB images. Further the system showed an average F1 score of 99.5%, precision of 99.11% and recall of 99.18% in 10-fold cross-validation. To confirm the problem posed was not too easy, we re-did the training and testing with gray-scale images and obtained an accuracy of 97%, confirming that the main discriminant features were the shapes of the tins and tires. Successful application of this study can help identify mosquito breeding sites in need of dengue eradication, thereby facilitating a better community health system.

Keywords: Dengue, Mosquito breeding sites, Drone, CNN

Envestigator: Artificial Intelligence-Based Crime Analysis and Prediction Platform

H.M.M.I.S.B. Herath* and D.M.R. Dinalankara

*Department of Computer Engineering, Faculty of Applied Sciences,
University of Sri Jayewardenepura, Nugegoda 10250, Sri Lanka
isbsachitha@gmail.com

As a global socio-economic problem, crime has shown complex correlations with spatial-temporal, socio-economical, and environmental factors. Thus it is important to understand patterns and interactions in crimes. This study focused on research and development of crime analysis and prediction platform, based on crime data from the city of San Francisco, drawn from a publicly available dataset of 2.1 million crime incidents with 38 crime categories and US Census data. In this study, spatial-temporal, socio-economical, psychological, and environmental factors were investigated with crime occurrence. Results indicate that the significant Pearson correlations are, White ethnic group to Income Per Capita (0.88), Education (0.79), unemployment (-0.5) and Black while Hispanic ethnic groups to poverty (0.54), unemployment (0.46), crime incidents (0.34) and arrests (0.49). Light Gradient Boosting Machine (LightGBM) was developed with crime features; date, time, cyclic representation of hour, city grid cell location, census tract, geo-location for crime prediction and evaluated using the multi-class log loss, having the minimum multi-class log loss of 0.824. Grid cell location of crime feature engineered by dividing the city into grid map and assign crimes into relevant grid cell according to geo-location. Using the grid map of the city and LightGBM crime prediction model with Q-learning, a safest route-finding service was developed. The crime probability of current cell and its eight neighbouring cells in the grid are calculated using LightGBM. Using these calculated probabilities, current grid cell id and hour as values of Q-tables a Deep Q-learning agent was developed and deployed. The agent was design to simulated behaviour of the safest route-finding in a high crime-dense environment. Ultimately, this 'Envestigator' crime analysis & prediction platform provides critical information on root causes and statistical patterns of crime and future crime predictions for the policymakers and security officials to create strategies to minimize the crime in society.

Keywords: Crime analysis and prediction, Data science, Machine learning, Q-learning

Electrodialysis Reversal Plant Performance on Groundwater Treatment in Dry Zone of Sri Lanka: A Pilot Study

H.M.D.C. Herath*, A.A.G.D. Amarasooriya,
W.B.M.L.I. Weerasekara and S.K. Weragoda

China Sri Lanka Joint Research and Demonstration Centre for Water Technology, China Sri Lanka Research Grant Project, Ministry of Water Supply, Peradeniya 20400, Sri Lanka
*diliniherath39@gmail.com

Electrodialysis, involving electrochemical separation of ions across charged membranes from a solution to another, is being widely applied in the water treatment industry. In this study, performance of the Electrodialysis Reversal (EDR) water treatment plant installed for the first time in Sri Lanka (Kahatagasdigiliya, Anuradhapura, GPS: 8°25'14.6"N 80°41'58.8"E) was studied while assessing its water quality and quantity. The averaged operational conditions of the plant were as; voltage of the membrane stack- 65 V, current -9 A, inflow rate -15.5 m^3/h. The concentrations of trace elements were determined following USEPA 200.8 method. The rejection percentages for the chemical species of Ca^{2+}, Mg^{2+}, Na^+, K^+, F^-, SO_4^{2-}, NO_3^-, NO_2^- were observed as 36.1, 33.1, 8.8, 7.5, 34.5, 61.8, 50.0, 34.6, respectively. The rejection percentages of heavy metal Cr, Mn, Fe, Ni, Cu, Zn were observed as 0.0, 50.0, 43.3, 7.7, 10.0, and 98.1, respectively. Nevertheless, Cd, Pb, Ru, Ir, Ti, Pt were not detected in both raw and treated water. The heavy metal analysis confirmed that none of the metal species were leached into the water from the electrode material. The averaged removal efficiencies of colour, turbidity, TDS, hardness, alkalinity were 27.7 ± 6.9, 22.0 ± 14.0, 36.69 ± 7.76, 56.57 ± 10.02, and $57.37 \pm 28.60\%$, respectively. The average volume reduction factor value of the plant was 7.05 ± 0.46, and the average recovery rate was $68 \pm 10\%$. Individual chemical species removal percentages varied as $SO_4^{2-} > NO_3^- > Ca^{2+} > NO_2^- > F^- > Mg^{2+} > Na^+ > K^+$ under the prevailing operational conditions and meets the Sri Lankan water quality guideline of SLS 614:2013. The results suggest that this treatment technology could be appropriately adopted to ensure the water supply and resolve the water quality related issues in Sri Lanka.

Keywords: Electrodialysis reversal, Groundwater, Water treatment, Performance

Preliminary Observations on Innovation in *Macaca sinica aurifrons*

I.A.W.W. Idirisinghe and S.H. Boyagoda*

*Department of Zoology, Faculty of Science, University of Peradeniya,
Peradeniya 20400, Sri Lanka*
*suyamam@pdn.ac.lk

Non-human primates live in complex hierarchical social groups, where the social status affects their daily life. However, primate behavioural studies are typically carried out in laboratories or zoos with few individuals, ignoring important effects of social interactions and relationships of the troop. A 33-member Dusky Toque monkey (*M. s. aurifrons*) troop in Deltota, Sri Lanka, were observed in their natural habitat to determine their puzzle-solving abilities and interaction among troop members during presence of excess food. A setup of five linearly arranged wooden lidded boxes with bananas were used to study behaviour. The boxes and the surrounding area was continuously video recorded during the troop's presence (247.23 hours) and behavior of each individual was later sampled from the videos. The first to open a box was a sub-adult male who observed two adult males sniffing the boxes from a distance for few minutes. By observing the adults' behaviour, the sub-adult appeared to have figured out the presence of food inside the boxes and directly came to open the box that was sniffed by one of the adults. Sub-adult males are reported to be more inquisitive, exploratory and even smarter individuals in the troop. Members were very attentive to behavior of others and all participants learned to open the boxes by observing others, which is a clear sign of social learning. Whenever the troop went past the study site they remembered to check the boxes. In seven out of 18 trials, the first monkey to open boxes did so in a sequence, while 11 times they were opened randomly. More than half of the bananas were consumed by the alpha male (44/82) and alpha female (11/82) throughout the nine month study period. When food was in plenty, passive sharing of food by the alpha male with another adult male, likely an ally of his, was observed.

Keywords: Toque monkeys, Intelligence, Primates, Behaviour

Understanding Temperature Effect on Lithium-ion Transportation in an Electrolyte: A Molecular Dynamics Study

Y.M.I.B. Samarakoon[1]*, R.J.K.U. Ranatunga[2],
H.W.M.A.C. Wijayasinghe[1] and T.H.N.G. Amaraweera[3]

[1]*National Institute of Fundamental Studies, Kandy 20000, Sri Lanka*
[2]*Department of Chemistry, Faculty of Science, University of Peradeniya,
Peradeniya 20400, Sri Lanka*
[3]*Department of Applied Earth Sciences, Faculty of Applied Sciences,
Uva Wellassa University, Badulla 90000, Sri Lanka*
*indika.sa@nifs.ac.lk

Lithium- ion rechargeable batteries (LIBs) are well known for their durability, long cycling life, lightweight and physical and chemical stability. Understanding and integrating novel ideas into LIBs are still an extensive area of research. During temperature variations static and dynamic properties of Li^+ ions in the electrolyte could be changed, hence the overall battery performance. However, few computational studies have been conducted to investigate the effect of the temperature on the electrolyte. Therefore here, with the aid of molecular dynamics simulations, investigations have been carried out to analyze the displacement, diffusion, electrical conductivity, distribution of molecules, their coordination with other molecules, ion pair and cluster formation and their ion pair lifetimes using four different temperatures with the aid of a model of 1 M lithium hexafluorophosphate ($LiPF_6$) in Ethyl Carbonate (EC) and Di Methyl Carbonate (DMC) (1:1). Generalized Amber Force Field (GAFF) was used to represent the parameters of ions and molecules. Most static and dynamic properties obtained are in good agreement with experimental values. Increments in mean square displacement, diffusion coefficient and conductivity were observed with increased temperature in the electrolyte. Furthermore, as temperature increased coordination number of Li^+ ions with the carbonyl group of DMC and EC decreased from 2.23 to 1.85. On the other hand coordination number of Li^+ ions with F^- ions increased from 1.89 to 2.05 with increasing temperature. This may indicate the competition among DMC, EC molecules and PF_6^- ions to bind with Li^+ ions. Furthermore, ion-pair lifetimes of Li^+ ion with EC, DMC molecules and PF_6^- ions were calculated. It showed that ion-pair lifetimes were decreased with increasing temperature. Overall, this study implies that many dynamics and static properties of the electrolyte have changed critically with the increasing temperature where they may significantly affect LIBs performance.

Keywords: Molecular dynamics, Li-ion rechargeable batteries, Electrolytes, Diffusion

                                        Science, Technology and Industry

Solid and Hollow SiO_2-TiO_2 Core-Shell Nanostructures and Their Photocatalytic Activities

P.S. Thilakaratne*, H.C.S. Perera and B.S. Dassanayake

*Department of Physics, Faculty of Science, University of Peradeniya,
Peradeniya 20400, Sri Lanka
sandeepanithilakaratne@gmail.com

TiO_2 nanoparticles (TiO_2-NPs) are proven to be an excellent photocatalytic semiconducting material and hence useful in semiconductor-mediated photocatalysis. The major disadvantage of TiO_2-NPs is particle agglomeration which limits the light accessibility of inner particles. In this project, solid and hollow SiO_2-TiO_2 core-shell nanoparticles (ST-CSNPs), were synthesized and characterized in order to enhance the performance of TiO_2 as a photocatalyst by providing efficient light scattering with a low refractive index core and high refractive index shell compared to the pure TiO_2-NPs. Smooth spherical SiO_2 nanoparticles with optimized particle size were synthesized via Stöber process using tetraethyl orthosilicate in the presence of ammonium hydroxide and ethanol. Homogeneous nanocrystalline anatase TiO_2 coating was obtained by hydrothermal treatment using titanium isopropoxide followed by repeated washing and re-dispersion in isopropanol. The final product was calcined at 450 °C. According to field-emission scanning microscopy (FE-SEM) and transmission electron microscopy (TEM) images, anatase TiO_2 nanoparticles with high surface area were coated on SiO_2 spheres (20-150 nm) in the form of ST-CSNPs. In Fourier-transform infrared (FT-IR) spectrum of SiO_2-TiO_2, the peaks at 955 cm^{-1} and 1053 cm^{-1} were assigned to the asymmetric vibration of Ti-O-Si bond. The bands at 800 cm^{-1} and 1090 cm^{-1} were ascribed to the symmetric and asymmetric stretching vibrations of Si-O-Si bonds, respectively. The peaks around 470 cm^{-1} were attributed to the Ti-O-Ti bond. Diffraction peaks at $2\theta = 25.68°$, $38.39°$, $48.79°$, 55.94 °, and $63.73°$ corresponded to (101), (004), (200), (211), and (204) crystal planes of the X-ray diffraction (XRD) spectra suggested the presence of anatase TiO_2. The wide diffraction peak at 2θ around $19.88°$-$25.19°$ was ascribed to the amorphous SiO_2. The results of photocatalytic degradation of methylene blue under UV irradiation showed that ST-CSNPs have enhanced the photocatalytic activity compared to TiO_2. Further, SiO_2-TiO_2 hollow core-shell nanoparticles had the highest photocatalytic activity.

Keywords: Semiconductor-mediated photocatalysis, SiO_2-TiO_2 core-shell particles, Stöber process, Photocatalytic degradation

Science, Technology and Industry

Development of a Cinnamon Adulteration Detection Pipeline with Bar-HRM Technology and Cluster Analysis

F.H.C. Silva[1], M.A.L.M. Peiris[1], S.P. Abeysundara[2] and W.R.P. Wijesinghe[3]*

[1]Postgraduate Institute of Science
[2]Department of Statistics and Computer Science, Faculty of Science
[3]Department of Botany, Faculty of Science
University of Peradeniya, Peradeniya 20400, Sri Lanka
*priyangaw@pdn.ac.lk

Sri Lanka is the premier exporter of true cinnamon in the world. True cinnamon is also known as *Cinnamomum verum* or Ceylon cinnamon. It has all the desirable qualities of cinnamon while containing a significantly lower amount of hepatotoxin coumarin compared to its main competitor, Cassia. In the international market, there are mainly 3 substitutes for true cinnamon, *Cinnamomum aromaticum* (Chinese cinnamon), *Cinnamomum burmannii* (Indonesian cinnamon) and *Cinnamomum loureiroi* (Vietnamese cinnamon). These cinnamon types compete with true cinnamon for global market share and are often used to adulterate true cinnamon. Therefore, it is paramount to develop robust and reliable adulteration detection technology. The overarching goal of this study was to develop a Barcode DNA-High Resolution Melting (Bar-HRM) based test system to distinguish the four types of cinnamon and here we present our streamlined bioinformatics pipeline in line with the above goal. In this study, a modified CTAB method was used to extract DNA from cinnamon bark and *psbA-trnH* barcoding region was amplified with primers for HRM analysis. Melting curves were generated from 65 ^{o}C to 95 ^{o}C at ramping rate of 0.5 ^{o}C. Data for sixteen melting curves were normalized and the fluorescent values emitted from 70 ^{o}C to 80 ^{o}C were extracted for downstream analysis. Hopkins statistics was used to assess the cluster tendency of melting curves followed by a principal component analysis. Three principal components, which accounted for 99% of total variability, were extracted to perform the cluster analysis. The K-means algorithm was used to cluster the melting curves and it demonstrated a clear distinction among cinnamon types without misclustering. This pipeline has great potential to be used as a mainstream adulteration detection method for cinnamon and there is a potential to develop a classification model in order to accurately identify cinnamon type with high resolution melting curve data.

Keywords: Ceylon cinnamon, Adulteration, Clustering, Bar-HRM

Science, Technology and Industry

Significance of Chundikkulam National Park, Sri Lanka, for Bird Conservation

W.M.C.S. Wijesundara[1]* and P. Rajkumar[2]

[1]Department of Zoology, Faculty of Science, University of Peradeniya, Peradeniya 20400, Sri Lanka
[2]Divisional Secretariat, Chundukkuli, Jaffna 40000, Sri Lanka
chamindaw@sci.pdn.ac.lk

Chundikkulam National Park (09°29′55″N 80°30′25″E; area ~19,500 ha), originally designated as a Sanctuary from 1938 to 2015 and upgraded as a National Park (NP) thereafter, is a crucial area for bird conservation in the Northern Province of Sri Lanka. The park is renowned for its high abundance of Greater Flamingo (*Phoenicopterus roseus*), an uncommon winter migrant. However, the park has not been studied for a considerable time due to the three decade long civil war that prevailed in the area. Hence, the objective of the present study was to determine the park's avifaunal diversity, with special reference to waterbirds. Point counts were used to determine bird diversity, along the 13-km stretch of gravel road running parallel to the beach from Mulliyan to the estuary where Chundikkulam main lagoon drains to the Indian Ocean, and from points inside the park close to Jaffna-Kandy highway near Elephant Pass. The study was undertaken from 2015 to 2018, including both migratory and non-migratory seasons. Binoculars (8×40 and 10×42) and spotting scopes (30-90×100) were used for observations. We recorded 107 bird species, of which 60 are waterbirds. The most abundant species was the Greater Flamingo (2668 individuals). Its highest abundance (1821) was recorded in February 2017; however, the park regularly harbored large flocks of this species both in and outside the migratory season; hence it is a crucial area for this rare migrant. Another important species occurring in large numbers included the Eurasian Spoonbill (*Platalea leucorodia*), a rare breeding resident, even though the present study did not record nests of this species. Apart from this, the park supports a large number of migratory species (35), and a significant population of Gray Francolin (*Francolinus pondicerianus*), a species restricted to the northern avifaunal region. Even though the Shannon Diversity index (H) for waterbirds is low (1.70) compared to non-water birds (3.08), due to the disproportionate abundance of the Greater Flamingo, overall, the park scores a H of 2.19, indicating high avifaunal diversity. Furthermore, H was higher (2.19) for the migratory season compared to the non-migratory season (1.64), confirming the park's importance for migratory birds. Given the findings of the present study, the park is undoubtedly a significant area for bird conservation.

Keywords: Waterbirds, Greater Flamingo, Migratory species, Northern Avifaunal Region

Effect of Agile Software Development Practices on Knowledge Management in Sri Lankan Software Companies

H. Asela

Department of Electrical and Information Engineering, Faculty of Engineering, University of Ruhuna, Galle 80000, Sri Lanka
asela.h@eie.ruh.ac.lk

Agile software development (ASD) is an iterative approach to deliver software components throughout the project's life cycle and it was introduced to overcome the bottlenecks in traditional project management methodologies. There is a set of agile software development practices based on the values and principles expressed in the agile manifesto. Most Sri Lankan software companies adopt these practices to improve their project performance. Knowledge management (KM) involves the process of creating, sharing, and applying knowledge and information. The software industry is knowledge-driven with an important requirement of managing knowledge in an effective manner. Therefore, investigation about the relationship between agile software development practices and the knowledge management in software companies in Sri Lanka is crucial. The objective of this research study is to analyze the effect of agile software development practices on knowledge management in software companies in Sri Lanka. This study used an electronic questionnaire as the research instrument. The indicators covering the dependent variable and the independent variable were derived from previous literature. Responses were collected from information technology professionals who are engaged in different job roles in small to large-scale software companies. 94.1% of the respondents had experience working with agile methodologies in their organizations. The study followed a convenient sampling technique with sample size of 205. The research variables were tested for validity and reliability. Hypothesis testing is done using correlation analysis and multiple linear regression analysis. With a statistically significant Pearson's correlation coefficient value of 0.537 and standardized beta coefficient value of 0.441, this study was able to prove that there is a strong positive relationship between agile software development practices and knowledge management in Sri Lankan software companies. Therefore as the conclusion, it is important to consider agile software development practices for improving knowledge management in software companies in Sri Lanka.

Keywords: Agile, Software development practices, Knowledge management, Sri Lankan software companies

Sorptive Removal of Methylene Blue from Aqueous Solutions by Carbonized Batik Textile Waste Material

A.G.J. Chathurika[1]*, P.L.A.T. Cooray[1] and A.U. Rajapaksha[2]

[1]Department of Chemistry [2]Instrument Centre
Faculty of Applied Sciences, University of Sri Jayewardenepura,
Nugegoda, 10250, Sri Lanka
*jinalichathu@gmail.com

The discharge of textile dye contaminated wastewater to the environment is a serious environmental hazard and a health risk. Sorption is an efficient and widely used technology over the other methods due to many advantages. The use of various carbonized compounds for the sorption of various dyes in wastewater has been widely investigated. To our knowledge, carbonized products derived from waste batik textile material have not been used as an adsorbent in dye removal. The objective of this research was to investigate the ability of carbonized batik textile waste material (CBTM) for the removal of methylene blue from aqueous solutions as a novel approach. First, the Batik textile material was treated with 80% (v/v) phosphoric acid and then carbonized in an inert atmosphere. The removal capacities of methylene blue from aqueous solution at various pH values by CBTM obtained at 300 ˚C was assessed, using the adsorbent dosage as 1.0 g L^{-1}, and a contact time of 24 h with an initial dye concentration of 8 mg L^{-1} at 298 K. The point zero charge of pH= 5.06 was obtained by pH drift method. The experimental results indicated that the highest percentage yield of 33.96% was obtained at 300 ˚C and the lowest percentage yield of CBTM was 18.44% at 600 ˚C. The sorption capacity of CBTM for the methylene blue was higher in basic solutions than in acidic solutions. The maximum sorption capacity of 6.9 mg g^{-1} was obtained at pH=10 and the minimum of 2 mg g^{-1} was at pH=3. According to many literature, CBTM shows a higher sorption capacity than common carbonized products but lower capacity than commercial activated carbon. Therefore, CBTM could be employed as a low-cost adsorbent for the removal of dyes. Further experiments will be carried out to check the kinetics and isotherm studies.

Keywords: Carbonized batik textile material, Dyes, Sorption, Point zero charge, pH drift method

Application of Low-Cost Graphite Counter Electrode for Dye-Sensitized Solar Cells: A Comparative Study on Sintering Temperature

J.M.K.W. Kumari[1,2]*, M.A.K.L. Dissanayake[1,2] and G.K.R. Senadeera[1,3]

[1]National Institute of Fundamental Studies, Kandy 20000, Sri Lanka
[2]Postgraduate Institute of Science, University of Peradeniya,
Peradeniya 20400, Sri Lanka
[3]Department of Physics, Faculty of Natural Sciences, The Open University of Sri Lanka,
Nawala, Nugegoda 00500, Sri Lanka
*kalpani.ku@nifs.ac.lk

In dye sensitized solar cells (DSSCs), a thin film of platinum (Pt) is extensively used as the catalytic material on the counter electrode (CE) due to its higher conductivity and electro-catalytic activity. However, there is a considerable effort to replace Pt CEs due to high cost and limited supply of Pt. In order to replace Pt CEs with low cost materials with high electronic conductivity and comparable catalytic effects for tri-iodide reduction, various alternative materials have been investigated. In this study, Sri Lankan natural vein graphite is used to fabricate low cost CEs for DSSCs. Sri Lankan natural vein graphite has become more attractive and demanding in the world due to its high purity and high crystallinity. In order to improve the adhesion of vein graphite on conducting glass substrate, Polyvinylidene fluoride (PVDF) polymer was used as a binder. To investigate the effect of sintering temperature on the performance of CEs, a series of graphite CEs were prepared with different sintering temperatures ranging from 150 ^{o}C to 550 ^{o}C. Results confirmed that the DSSCs prepared with sintered CEs exhibit a better photovoltaic performance compared to the DSSCs made with un-sintered CEs. DSSCs with CEs sintered at 450 ^{o}C have exhibited the highest efficiency of 4.45 % with an overall efficiency increase of 158% compared to un-sintered CEs (η = 1.72%). DSSCs fabricated with the graphite CEs prepared either with sintering at temperatures below 450 ^{o}C or above 450 ^{o}C showed poor performance possibly due to the presence of more undecomposed binder at lower temperatures and residual burnt particles left over at higher temperatures in the CEs. This low cost and novel graphite CE exhibits good stability and acceptable solar cell efficiency of close to 60% of that of Pt (η = 7.82%) CE in DSSCs operating under similar conditions.

Keywords: Dye-sensitized solar cells, Counter electrode, Graphite, Sintering temperature

Development of a Fluoride Test Paper Using a Modified SPADNS-Zr Dye Method

W.A.D.D. Fonseka*, P.L.A.T. Cooray and K.G.U.R. Kumarasinghe

Department of Chemistry, Faculty of Applied Sciences,
University of Sri Jayewardenepura, Nugegoda 10250, Sri Lanka
*waddaupadee@gmail.com

Fluoride in drinking water has both beneficial and detrimental effects on human health. Hence, determination of fluoride is an essential tool in water quality analysis. Laboratory-based analytical techniques such as potentiometry, ion chromatography and colorimetry are often used in fluoride detection. However, they are expensive and not suitable for *in situ* analysis. The main objective of this research is to develop a fluoride test paper based on the Sulfanilic acid azochromotrop-Zr(IV) (SPADNS-Zr) dye method for quantitative analysis of fluoride in aqueous solutions. The fluoride test paper is made out from a Titania coated Whatman 41 ashless filter paper and SPADNS-Zr dye is chemically grafted on the surface. Unlike in the conventional SPADNS-Zr method where the SPADNS reagent is acidic, in this method, the Titania coated paper strip was chemically grafted at neutral pH using a SPADNS-Zr dye solution containing excess Zirconium to avoid acid damage to filter paper. The resultant test paper was thoroughly washed with deionized water to remove excess and chemically non-bonded dye and air dried overnight. The test papers were first soaked in a dilute Tween 20 solution to improve wettability and then immersed in fluoride test solutions. The test paper shows a rapid colour change from purple to pink while turning the colourless fluoride solutions into red, the colour of SPADNS solution by permitting it as a qualitative method. The starting time of the colour change and colour intensity depend on the fluoride concentration. For a quantitative analysis, the test strip was calibrated against the starting time of colour change using a standard fluoride concentration series. Colour change is started within 3 min in 10 ppm fluoride solution while 1 ppm solution takes about 30 min accordingly. The next step of this research is to study interferences and homogenize the SPADNS-Zr dye grafted Titania coating on the test paper.

Keywords: Fluoride, Titania, SPADNS-Zr dye, Tween 20, Test paper

A Lower Dimensional Approximation of Mammography for Breast Cancer Detection

H.S.I. Wijerathna*, A.N.S. Ambegedara and U.G.I.G.K. Udagedara

[1]*Postgraduate Institute of Science*
[2]*Department of Mathematics, Faculty of Science*
University of Peradeniya, Peradeniya 20400, Sri Lanka
**isuriwijerathne1994@gmail.com*

Breast cancer is one of the major causes of mortality among women in many countries. Currently, Mammography is the most used anatomic modality for detecting, diagnosing, and staging breast cancers. However, approximately 30% of screening tests are inconclusive due to radio-dense or distorted breast tissues. For this reason, a proper diagnosis is necessary for designating necessary treatments, so that cancer could be treated at its early stages. In this work, an approach based on Reduced-Order Modeling (ROM) was used for early cancer detection. ROMs are usually thought of as computationally inexpensive mathematical representations that offer the potential for near real-time analysis. In many stages of developing new techniques in radiation detections, ROM has been used with radiation transport codes to compare efficiency and performance. The basic idea of the use of ROM approach is to use "training data" to develop a low-dimensional model of a system that can be used for rapid predictions at other conditions. Here, cancer-identified Mammogram images were used as training data. Then, Proper Orthogonal Decomposition (POD) was used to generate basis functions of the data and reduce the dimensionality of image data. POD captures the most variations of the cancers in the training data set. We present the results showing the reconstruction ability of the ROM of Mammograms. Further, the ROM can reconstruct the screening including the location of cancer. Future work will be focused on the use of ROM to identify cancers from the inconclusive screening tests.

Keywords: Breast cancer, Mammogram, Proper orthogonal decomposition, Reduced-order modeling

Paradoxical Antimicrobial Activities of Some Terpenoids and Terpenoid-Derivatives

P.D.U. Pavithra[1], D.N. Wanigasekara[1], M.T. Napagoda[1]*, K. Wijesekara[2], G.B. Wijayaratne[3], B.G. Bag[4], A.C. Barai[4], S. Ghorai[4], S.K. Panja[4] and S. Patra[4]

[1]*Department of Biochemistry, Faculty of Medicine* [2]*Department of Pharmacy, Faculty of Allied Health Sciences* [3]*Department of Microbiology, Faculty of Medicine University of Ruhuna, Galle 80000, Sri Lanka* [4]*Department of Chemistry and Chemical Technology, Vidyasagar University, Midnapore 721102, West Bengal, India* **mayurinapagoda@yahoo.com*

The emergence of resistance to currently available antimicrobial agents has become a major issue worldwide that has to be answered with alternative approaches. In this respect, herbal extracts and the phytochemicals thereof have been emerging as potential antimicrobial agents to combat antibiotic resistance. Interestingly, our previous investigations with some terpenoids and terpenoid-derivatives revealed a paradoxically reduced antibacterial effect at high doses. Thus the present study was undertaken to further evaluate the paradoxical antibacterial activity of those selected secondary metabolites against some Gram-positive and Gram-negative bacterial species. The antibacterial activity of five phytochemicals, namely andrographolide, stigmasterol, lupeol, maslinic acid and bixin, was determined against clinically isolated methicillin-resistant *Staphylococcus aureus* (MRSA), *Staphylococcus saprophyticus, Enterococcus faecalis*, *Klebsiella* sp., *Salmonella typhi*, and *Proteus mirabilis* by broth micro-dilution method. Andrographolide and stigmasterol displayed a paradoxical behavior against *S. saprophyticus*, however, a similar phenomenon was not observed with bixin, lupeol, and maslinic acid. None of the phytochemicals exhibited a paradoxical behavior against *S. typhi, P. mirabalis*, *E. faecalis, Klebsiella* sp., and MRSA. Despite having a minimum inhibitory concentration (MIC) of 0.007 mg/mL against *S. saprophyticus*, 0.710 mg/mL was found as the highest concentration of both andrographolide and stigmasterol that inhibited the growth of this bacterial species. Concentrations higher than 0.710 mg/mL failed to inhibit *S. saprophyticus* growth. These observations resemble the "Eagle effect" that has been referred to as the paradoxically reduced antibacterial effect of some antimicrobial agents at high doses. Usually, this type of paradoxical effect has been observed with classical antibiotics against Gram-positive bacteria. Thus, according to the results, it can be concluded that stigmasterol and andrographolide inhibited the growth of *S. saprophyticus* where lower concentrations were more effective than higher concentrations. More detailed experiments are in progress to further explore the underlying mechanisms.

Keywords: Antimicrobial, Inhibition, Paradoxical, Terpenoids

Identifying Correlations between Groundwater Quality Parameters in High CKDu Prevalence Region in North Central Province, Sri Lanka, and Their Impact on Membrane Fouling

J. Ketharani[1]*, M.A.C.K. Hansima[2], D.R. Samarajeewa[1], M. Makehelwala[3], K.B.S.N. Jinadasa[1], S.K. Weragoda[3,4], R.L.M.D. Rathnayake[1] and R. Weerasooriya[5]

[1]*Department of Civil Engineering, Faculty of Engineering* [2]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya 20400, Sri Lanka*
[3]*China Sri Lanka Join Research and Demonstration Centre for Water Technology, Ministry of Water Supply, Peradeniya 20400, Sri Lanka*
[4]*National Water Supply and Drainage Board, Katugastota 20800, Sri Lanka*
[5]*National Centre for Water Quality Research, National Institute of Fundamental Studies, Kandy 20000, Sri Lanka*
*ketha94@eng.pdn.ac.lk

Chronic Kidney Disease of unknown etiology (CKDu) is a contemporary pre-eminent issue in Sri Lanka, mostly observed within the North Central Province (NCP). Consumption of groundwater could be a major contributor for the increased cases of CKDu patients reported in NCP, as the NCP groundwater has high hardness (20-750 mg/L), fluoride (0.2-8 mg/L), trace elements (As - 3 µg/L, Cd - 0.2 µg/L), and low molecular weight dissolved organic carbon (DOC) (0-11.3 mg/l). The influence of DOC, which has not been studied broadly thus far, is considered as a common precursor for membrane fouling that affect membrane-based water purification processes such as reverse osmosis and nano-filtration. This study aims to explore the correlations between organic substances and cations notedly the DOC and aromaticity of organic substances. Groundwater samples (40) were collected from high CKDu prevalence regions in NCP to measure the concentrations of DOC and inorganic cations (Na^+, K^+, Ca^{2+}, Mg^{2+}, Co^{2+}, Fe^{2+}, Bi^{2+}, Cu^{2+}, As^{3+}, Cd^{2+}, Cr^{3+}, Mn^{2+}, Ba^{2+}, Zn^{2+}, Mo^{2+}, Al^{3+}, Sr^{2+}, Ag^+, Pb^{2+}) using the total organic carbon analyser and the Atomic adsorption spectroscopy and Inductive Coupled Plasma–Optical Emission Spectroscopy, respectively. Bivariate statistical analysis was performed using Pearson correlation coefficient. Possible foulants in/on membranes were identified from the obtained correlations and their concentrations in groundwater. Significant positive correlations were observed between DOC and ions such as Na (0.570), Mg (0.589), As (0.511), Bi (0.394), and Ba (0.321). The aromaticity (Specific Ultraviolet Absorbance) showed positive correlations for Fe (0.354) and Cr (0.587) and negative correlations for Cd (0.558) and Ca (0.391). Cu, Mn, Al, Zn and Pb did not show any significant correlations with DOC. DOC-Ca and DOC-Mg complexes are identified as possible foulants in the membrane systems due to the presence of higher concentrations of Ca and Mg in groundwater and the solubility of the complexes. These will negatively impact membranes through intensified fouling formation upon the purification of groundwater.

Keywords: CKDu, DOC complex, Groundwater, Reverse osmosis, Nanofiltration

Nano Filtration for Groundwater Treatment in Dry Zone of Sri Lanka: A Pilot Study

A.A.G.D. Amarasooriya*, H.M.D.C. Herath and S.K. Weragoda

China Sri Lanka Joint Research and Demonstration Centre for Water Technology, China Sri Lanka Research Grant Project, Ministry of Water Supply, Peradeniya 20400, Sri Lanka
*gayanamarasooriya@gmail.com

Nanofiltration (NF) is a leading water treatment technology and capable of eliminating almost all dissolved organic contaminants, viruses, and divalent salts. Even though NF is world-leading technology, Sri Lanka is having little experience of practicing it. To investigate the applicability and cost effectiveness of NF in Sri Lanka, a pilot-scale NF unit (20 m^3/day) was installed in September 2018, at Nildiya Community Based Organization (CBO), Sirimapura in Anuradhapura District, Sri Lanka. The NF system is capable of supplying water to 164 households in the village as well as external customers. Continuous water quality sampling for 2.5 years assured that treated water quality is up to the Sri Lanka Standard (SLS) for potable water quality guideline 614; 2013. Average concentrations of Alkalinity (as $CaCO_3$)-241.2 mg/L, Hardness as $CaCO_3$-230 mg/L, Fluoride-1.30 mg/L, Chloride-53.4 mg/L, and Nitrates-2.46 mg/L were observed in groundwater samples. The averaged removal percentages of Alkalinity, Hardness, Fluoride, Chloride and Nitrates were observed as 86.6, 87.1, 84.0, 69.9 and 23.57 %, respectively. While the production cost of the water treated by NF is Rs 0.20/ L, it is sold at a rate of Rs. 1.00/L, which is affordable and cheaper than the other water supply systems in the area. The NF production cost is less than that of the reverse osmosis membrane filtration, which is commonly available in the area, for Rs. 0.25 /L (i.e. production cost was calculated without considering the water bill). The selling price of the water was set for Rs 1.00 /L and the profit generated by this is utilized for paying the electricity bill and for providing a stipend for the operators and maintainers.

Keywords: Nanofiltration, Groundwater, Affordable

Distance Regularity of Generalized Hadamard Graphs

W.V. Nishadi* and A.A.I. Perera

*Department of Mathematics, Faculty of Science, University of Peradeniya,
Peradeniya 20400, Sri Lanka
vindinisha@hotmail.com

Distance regular graph is a regular graph which acquires numerous combinatorial symmetries. Distance regular graphs have applications in diverse fields such as design theory, classical coding, information theory, and telecommunication. In this work, we focus on the distance regularity of generalized Hadamard graphs having $2p^2$ vertices and p^3 edges obtained from generalized Hadamard matrix $GH(p, C_p)$ of order p, where C_p is the cyclic group of order p and $p \geq 3$ is prime. For a given graph $G = (V, E)$, the number of edges in a shortest path between vertex u and vertex v, where $u, v \in V$ is called the distance between two vertices. The maximum distance from a vertex v to all other vertices is called the *eccentricity* of the vertex and the maximum eccentricity from all the vertices is considered as the *diameter* of the graph G. The eigenvalues of G are the eigenvalues of the adjacency matrix A of G. The main objective of this work is to identify a relationship between the diameter and the number of distinct eigenvalues of a graph with the distance regular property of the graph. Here, we proved that any generalized Hadamard graph has diameter 4. Further, we established a formula for the characteristic polynomial of the adjacency matrix as $\lambda^{2x}(\lambda^2 - p)^y(\lambda^2 - p^2)$, where $x + y + 1 = p^2$. It was observed that, the generalized Hadamard graphs have 5 distinct eigenvalues and equal to one greater than diameter of generalized Hadamard graphs. This result was used to investigate the existence of distance regular property and could be used in applications of Sciences.

Keywords: Distance regular, Eccentricity, Generalized Hadamard Graph, Generalized Hadamard Matrix

Synthesis and Characterization of Carrageenan Submicron-Particles for Controlled Release of Resveratrol

M.F.F. Reesha[1,2], D.N. Karunaratne[1,2]*, A.D.L.C. Perera[1,2], N.L.V.V. Karunaratne[1,2], J.M.S.J. Menike[1,2] and G. Pamunuwa[3]

[1]Department of Chemistry, Faculty of Science [2]Postgraduate Institute of Science University of Peradeniya, Peradeniya, 20400, Sri Lanka
[3]Department of Horticulture and Landscape Gardening, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila 60170, Sri Lanka
**nedrak@pdn.ac.lk*

Resveratrol is a natural polyphenolic compound having antioxidant, antitumor, antiflammatory, antiaging and cardio protective properties found in grapes, berries, peanuts etc. In this study, hydrophilic carrageenan (CR) submicron particles were used to encapsulate resveratrol as controlled release drug delivery system to overcome hydrophobicity, high photosensitivity and low oxidative stability. CR is a linear sulphated polysaccharide extracted from certain red seaweeds of the *Rhodophyceae* class consisting of repeating D-galactose and 3,6-anhydro-D-galactose units having gelling, thickening and stabilizing abilities. Ionotropic gelation was utilized in synthesizing these particles using $CaCl_2$ as the cross linking agent after solubilizing resveratrol using Tween 20. The characterization was performed using particle size analyzer and Fourier transform infrared spectroscopy (FTIR). By varying the CR: $CaCl_2$ mass ratio, concentration of CR and $CaCl_2$, particle size was optimized to obtain a minimum particle size of 221.3±21.2 nm. A loading capacity of 14.19% was obtained with the optimization using a constant amount of CR and $CaCl_2$ along with the increasing amount of resveratrol with an encapsulation efficiency of 64.29 %. Upon the preparation of submicron particles, peaks corresponding to sulphate group and glycosidic linkage at 1234 cm^{-1} and 1028 cm^{-1} shifted to 1223 cm^{-1} and 1066 cm^{-1}, respectively. The bands at 913 cm^{-1} and 833 cm^{-1} which belong to 3-6-anhydrogalactose and galactose-4-sulphate linkages shifted to 923 cm^{-1} and 846 cm^{-1} and a new peak appeared at 1372 cm^{-1} for C-O stretching characteristic to resveratrol. In-vitro release of resveratrol from submicron particles showed a highest cumulative release percentage of 9.76±0.58% and 9.38±0.73 % at pH 2 and pH 6.8, respectively, indicating the pH independence in release. But the results from digestion study showed a slower release of resveratrol from particles in simulated saliva and simulated gastric fluid and an increment in bioaccessibility percentage up to 28.73±1.40% in simulated intestinal fluid.

Keywords: Carrageenan, Resveratrol, Nanoparticles, Encapsulation

Colloidal Mobilization and Colloidal Transport in Saturated Porous Media: A Geo-Environmental Insight into Chronic Kidney Disease of Unknown Etiology (CKDu) Problem in Sri Lanka

B. Banithy[1], T.K.K.C. Deepagoda[1]* and K.G.I.D. Kumari[2]

[1]*Department of Civil Engineering, Faculty of Engineering, University of Peradeniya, Peradeniya 20400, Sri Lanka*
[2]*China-Sri Lanka Joint Research and Demonstration Center for Water Technology, Peradeniya 20400, Sri Lanka*
*chaminduk@pdn.ac.lk

Chronic Kidney Disease with Unknown aetiology (CKDu) can be identified as one of the most significant non-communicable health concerns among Sri Lankan community, particularly in North Central Province (NCP) of Sri Lanka. Despite extensive scientific attention to solve the problem, no single causative factor could be pinpointed yet. In spite of the presence of numerical (HYDRUS 1D Model) and experimental studies in CKDu-affected regions in the NCP focusing on measurements in soil and groundwater quality, no scientific study has been initiated to investigate the role of colloids (i.e., soil particle in the range of 1 nm-1 μm) on carrying contaminants to groundwater, and their potential implications to groundwater contamination. This study quantifies colloid transport and colloid-facilitated contaminant transport (CFT) in a heterogonous porous media where colloid mobilization, sorption and desorption kinetics are the underlying processes. A series of soil column experiments (diameter=74 mm, height=250 mm) with a standard porous media as soil were conducted applying colloids extracted from a high CKDu-affected area (Medawachchiya) and a low CKDu-affected area (Horowpothana) in NCP. The experiments were carried out at different physical (flow rate) and chemical (ionic strength) conditions of the eluent solution. Colloid breakthrough curves were obtained for three flow rates (0.5 ± 0.05 cm^3/s, 1.65 ± 0.05 cm^3/s, 2.75 ± 0.05 cm^3/s and 4.10 ± 0.05 cm^3/s) and three ionic strength (0.01M, 0.05M and 0.1M NaCl) conditions. The experimental results were numerically characterized based on the advection-diffusion/dispersion modeling framework coupled with attachment, detachment and straining parameters which were inversely estimated using HYDRUS 1D software. The experimental and model results clearly demonstrated that the attachment coefficients of soil colloids were significantly higher at low flow rates and in high ionic strength and it acts as the key retention mechanism in saturated porous media. In practical field scale application a conceptual soil profile was simulated using estimated parameters (Attachment, Detachment & Straining coefficient). It is concluded that the time taken for the migration of colloids to reach the groundwater table increases with the increase of ionic strength of the colloidal solution.

Keywords: Chronic kidney disease of unknown aetiology, Soil column, Breakthrough curves, Soil colloids, Numerical model (Hydrus 1D)

Performance Comparison Analysis of Docker Container and Virtual Machine in Cloud Computing Environment for Database Management Systems

M.L. Weerarathna

Department of Statistics and Computer Science, Faculty of Science,
University of Kelaniya, Dalugama 11600, Sri Lanka
m.laksith456@gmail.com

Recently, Virtual Machine (VM) and Container Technology have become widely used virtualization technologies in the industry. The VM provides better mechanisms for solving many existing manageability issues in database systems. Therefore, database systems are predominantly running on VMs. But with the introduction of container technology, it has gained increasing attention in recent years and has become an alternative to traditional VMs. The core motivations for the enterprise to adopt containerization technologies include application integration and deployment, lightweight operations, resource sharing efficiency, and flexibility. The additional abstraction layers provided by virtualization come from the interchange between performance and cost in a Cloud Computing environment where everything is on a pay-per-use basis. Therefore, containers considered to be the future of virtualization are being developed to address mainly this issue. However, a systematic comparative study of the performance of the database services in the container environment and the VM environment is still missing. Accordingly, the main objectives of the research study are to monitor, analyse and evaluate the performances of different database servers on both virtualization technologies and to study which is better for microservice-related database deployments. The proposed comparison environment was designed in the Cloud Computing environment with separated VMs and Docker containers. The study of comparing VMs and containers for the overhead of running a database workload and a critical assessment of each database metric and its behaviour of the standard databases were presented. Although the results have shown that the container gets the manageability benefits of virtualization with the percentages of performance efficiency between 0.5% and 25% over the VM, the high query latency is quite noticeable when fetching more than 100000 data records from container-based database services. After reviewing the results and discussing the limitations, the conclusion of this study will be useful for future research studies and database service deployments.

Keywords: Virtual machines, Docker containers, Cloud computing, Microservice-related databases, Database metrics

Science, Technology and Industry

Palmyra Fibre Reinforced Polyethylene Composite for Thermal Insulation Application

H.M.N.M. Amarathunga[1]*, W.K.S.F.R. Perera[1], T. Thanihaichelvan[1],
R. Ramachandran[1] and H.M.C.C. Somarathna[2]

[1]Department of Interdisciplinary Studies
[2]Department of Civil Engineering
Faculty of Engineering, University of Jaffna, Jaffna 40000, Sri Lanka
*amarathunga@eng.jfn.ac.lk

Most researches focus on manufacturing new products with the use of waste material and ultimately contribute to sustainable waste management globally. Natural fibres have become attractive to researchers recently, as an alternative reinforcement for fibre-reinforced polymer composites and as a replacement for synthetic fibres due to better mechanical properties, low cost, high specific strength, eco-friendliness and biodegradability characteristics. This project was carried out to investigate the feasibility of producing thermal insulation material using palmyra as the reinforcement material and low-density polythene (LDPE) as the matrix. The properties of palmyra fibre reinforced low-density polythene composites depend on the content of matrix and reinforcement, the orientation of fibre, length of the fibre and also influenced by the interfacial adhesion between the matrix and the fibre. In this study, weight fractions of continuous fibre were considered as 10, 30, 50, 70 and 90 wt%, while lengths of discontinuous fibre were kept as 3, 5, 7, 9 and 11 cm. Natural fibre reinforced composite (NFC) was made using a compression moulding machine. American Standard Testing Methods (ASTM) were followed to prepare test specimens and to investigate the characteristics of NFCs. The ratio between fibre to LDPE was found by focusing on the ultimate tensile strength, young's modulus and flexural stress. Lee's disk method was used to investigate thermal properties. The mechanical and thermal properties of the natural fibre reinforced composites were enhanced with the addition of fibre up to an optimum value, reduction of the properties was observed with further addition of fibre. The continuous fibre reinforced composites showed enhanced thermal and mechanical properties than discontinuous fibre reinforced composites. Among them, 50 wt% of fibre content in the continuous fibre reinforced composite showed optimum mechanical properties with much lesser thermal conductivity compared with other composites showing suitability for thermal insulation applications.

Keywords: Palmyra fibre, Thermal conductivity, Lee's disk, Composite, Polyethylene, Mechanical properties

A Statistical Approach to Delineate Areas with Chronic Kidney Disease of Unknown Etiology (CKDu) in Dry Zone of Sri Lanka Using Hydrogeochemical Data

H.M.A.D. Rathnayake[1]*, L.S. Nawarathna[1] and R. Chandrajith[2]

[1]*Department of Statistics and Computer Science*
[2]*Department of Geology*
Faculty of Science, University of Peradeniya, Peradeniya 20400, Sri Lanka
*s15527@sci.pdn.ac.lk

Chronic Kidney Disease of unknown etiology (CKDu) is ranked as one of the most attended public health issues in Sri Lanka. The etiology of the disease is believed to be environmentally induced as it appears in geographically discreet regions of the dry zone of Sri Lanka. Girandurukotte and Wilgamuwa are two regions where CKDu is highly prevalent. This study performs a comparative analysis with the objective of separately identifying the quantitative differences of hydrogeochemical parameters of groundwater samples consumed by the patients and non-patients in the two regions. Moreover, different classification techniques were used under the predictive analysis to predict the presence or absence of the disease by using hydrogeochemical data as the predictor variables for the models. In addition, groundwater quality data of 421 wells from Girandurukotte and Wilgamuwa were used for the analysis. Out of 421 samples, 310 samples were collected from wells where patients were reported. In addition to descriptive statistics, correlation analysis and factor analysis, binary logistic regression, support vector machine, random forest, gradient boosting classifier, artificial neural network (ANN), K-Nearest neighbours algorithm and quadratic discriminant analysis techniques were performed as the classification techniques for the data sets. The best performance was obtained by the ANN model which provided the highest accuracy (90.83%), sensitivity (96.63%) and F-score (0.9399). Results of comparative analysis conclude that means of iron (Fe) content in groundwater from Wilgamuwa with CKDu patients (371 µg/L) and without CKDu patients (731µg/L) exceeds the WHO permissible limits. In Wilgamuwa, mean contents of F^-, Cl^-, NO_3^-, SO_4^{2-}, Na^+ and water hardness in wells where CKDu patients are present were 0.71, 19.74, 2.04, 17.5 and 37.4 mg/L, respectively while 0.46, 10.24, 1.55, 11.57 and 26.3 mg/L in wells where patients are not present. Trace elements such as As, Cd, and Pb do not exceed the WHO recommended limits in both regions. Generally, except for Fe ion concentration, almost all the other ion concentrations are within the WHO recommended limits.

Keywords: CKDu, Classification techniques, Disease prediction, Factor analysis

iPURSE 2021 – 529   *Science, Technology and Industry*

Effect of Sesame Seed Meal and Sweet-Potato Leaf Meal as an Alternative Mixed Plant-Protein Source in Diets of Juvenile Guppy (*Poecilia reticulata*) Fish at Experimental Farming Conditions

K.M. Nishshanka[1]*, K. Radampola[1] and V.P. Bulugahapitiya[2]

[1]Department of Fisheries and Aquaculture, Faculty of Fisheries and Marine Sciences & Technology, [2]Department of Chemistry, Faculty of Science
University of Ruhuna, Matara, 81000, Sri Lanka
*krishnimanesha@gmail.com / krg226@yahoo.com

A feeding trial was carried out to evaluate effects of different ratios of sesame seed meal (SS) and sweet-potato leaf meal (SP) to replace fishmeal (FM) in diets of juvenile guppy (*Poecilia reticulata*) fish reared in experimental conditions. Tested experimental diets (protein; 24.6%, gross energy; 353.3 K cal/g) were control diet (CD) (30%FM), 15FM (15%FM, 10%SS, 5%SP), 10FM (10%FM, 10%SS, 5%SP), 8FM (8%FM, 15%SS, 5%SP) and 0FM (0%FM, 15%SS, 5%SP). Fish (initial total body length; 1.85±0.12 cm, initial body weight; 0.07±0.03 g) were randomly allocated across 15 fiber glass tanks (126 L of capacity) with three replicates per treatment at a stocking density of 30 fish per tank and fed adlibitum three times per day for an eight week period. Final total length and final body weight were significantly higher in fish fed on CD (3.55±0.35 cm; 0.59±0.15 g) and 15FM (3.58±0.27 cm; 0.59±0.13 g) diets compared to fish in other treatments. The highest specific growth rate (%SGR) was recorded in fish fed on 15FM diet (4.09±0.06 g day^{-1}). Feed consumption (%Body Weight/day) and feed conversion ratio (FCR) of fish ranged from 14.90±8.04 to 18.27±11.52 and 2.20±0.19 to 3.20±0.18, respectively. Percentage survival ranged from 94.5±3.9 to 100±0 in all treatments. Fish in CD and 15FM treatments showed better growth performance and feed utilization without any negative effects on their survival compared to fish fed on other diets. Moreover, as FM inclusion decreased from 15% to 0%, there was a reduction in fish growth. Total cost of 1 kg of CD was Rs. 206, while costs for the other four diets were lower (Rs. 158, 146, 137, 127 for 15FM, 10FM, 8FM and 0FM, respectively). Present study indicates that sesame seed meal and sweet-potato leaf meal can be successfully mixed at 10:5 ratio with 15%FM as a low-cost alternative protein source in diets for guppy fish in experimental conditions.

Keywords: Sesame seed meal, Sweet-potato leaf meal, Fishmeal, Guppy

Ranking the Performance of Batsmen in IPL-2020 by Principal Component Analysis

G.M.S. Dinushika* and L.A. Kalashini

Department of Mathematics, Faculty of Science, University of Ruhuna, Matara 81000, Sri Lanka
*salithadinushika@gmail.com

Ranking players is an important task in cricket. Normally players are ranked based on individual parameters like runs, average. However, it is difficult to find an overall ranking that has been done considering all the parameters. The objective of this study was to build an overall measure for batting performance by combining correlated variables. This study explores the suitability of the principal component analysis (PCA) technique for ranking based on batting performance. For this analysis, we used Indian Premier League (IPL)-2020 data. because it is a leading tournament. Secondary data of 100 batsmen were obtained from espncricinfo.com and analyzed using SPSS-25 software. Number of innings_batted, runs_scored, highest_score, average, balls_faced, strike_rate, number of half-centuries, number of fours, and sixes were used as variables in the analysis. The sphericity is checked by Bartlett's Test of Sphericity. The p-value of Bartlett's Test of Sphericity was 0. This meant that, our sample is not drawn from a population which the correlation matrix is an identity matrix. The most correlated variables in the correlation matrix were chosen instead of standardizing variables. Therefore, the first principal component captured a large percentage of the total variance. This new variable was used to replace the original variables without losing much information. According to the PCA, 78.09% of the total variability was explained by the first principal component. Hence it was reasonable to use the first principal component to measure the batting performance. The coefficients of the first principal components for number of innings_batted, runs_scored, highest_score, balls_faced, strike_rate, number of half-centuries, number of fours, and number of sixes are 0.888, 0.989, 0.927, 0.965, 0.507, 0.906, 0.940, and 0.855 respectively. Based on this, the top five batsmen in IPL-2020 were chosen as KL_Rahul, Shikhar_Dhawan, David_Warner, Shreyas_Iyer, and Ishan_Kishan. The website espncricinfo.com has named the same players as the top five.

Keywords: Cricket, Principal component analysis, Ranking players

Utilization of Rice Straw Ash as a Filler Material for Rubber Compounding

A.N.A. Fernando, W.G.A. Pabasara*, K.Y. Gayashini and D.N. Liyanage

Department of Engineering Technology, Faculty of Technology, University of Ruhuna, Kamburupitiya 81100, Sri Lanka
*ayomiwalagedara@gmail.com

Rice is the highest consumed food crop in Sri Lanka, occupying 34 percent of the total cultivated land. It is recorded that around 800 Gt of rice straw waste is generated annually. In present practice, rice straw is utilized for animal feed, fertilizer, and most of them are either incorporated into the soil or open burned without taking any commercial advantage. It is found that rice straw ash contains a significant amount (62%-82%) of silica which is a prominent reinforcing filler in rubber compounding. The present research work focuses on incorporation of rice straw ash as an alternative filler material in rubber compounding. Rice straw ash was obtained from a widely cultivated rice straw variety in Southern Province Sri Lanka, followed by controlled burning at 550 °C for 2 hours inside a muffle furnace. Different ratios (ranging from 10 phr to 40 phr) of rice straw ash were incorporated with selected rubber compound gradually reducing the silica filler loading and tensile, tear, compression set, and hardness properties were investigated. These mechanical properties were compared with those of the reference sample prepared according to the same formulation but without adding rice straw ash. The tensile properties showed a significant increase for different rice straw ash filler loadings and hardness, tear strength, compression set values declined after the addition of rice straw ash. The sample which contained the same proportions of rice straw ash and silica showed the highest tensile strength (26.09 MPa) compared with the control sample (16.86 MPa). Further, the tensile strength of the sample that contained only rice straw ash was also higher than the control sample. Therefore, within this limited scope of study, it can be concluded that, rice straw ash can be applied as a cheaper filler for rubber products that need superior tensile properties.

Keywords: Rice straw waste, Rice straw ash, Reinforcing filler, Rubber compounding, Silica

Science, Technology and Industry

Comparative Study on Catalytic Activity of Green Copper Nanoparticles from Ginger (*Zingiber officinale*) and Clove (*Syzygium aromaticum*) Extract

S.M.S.W. Sivirathne, S.A. Senevirathne and N.B. Jayaratna*

*Department of Chemical Sciences, Faculty of Applied Sciences,
Rajarata University of Sri Lanka, Mihinthale 50300, Sri Lanka
naleen@as.rjt.ac.lk

Green synthesis of metal nanoparticles using plant extracts have received increased attention due to the use of non-toxic solvents such as water and relatively non-toxic chemicals. Copper nanoparticles (CuNPs) are well known as multifunctional metallic nanoparticles including catalytic activity on wide range of organic reactions. The present investigation is the synthesis of CuNPs using the mixture of dried *Syzygium aromaticum* (Clove) bud and *Zingiber officinale* (Ginger) rhizome hence, the study of their catalytic activities. Aqueous plant extract was prepared by heating crushed ginger rhizomes and clove buds with water (1 hour at 50 °C). CuNPs were synthesized by mixing plant extract and copper sulphate solution in a ratio of 3:5 followed by either heating (50 °C) or sunlight irradiation for 4 hours. Immediate colour change from light to dark brown in each solution indicated the reduction of Cu^{2+} to Cu^{0} and formation of heat and photo derived CuNPs as confirmed by UV-Visible peak maxima at 412 nm and 404 nm respectively. Fourier transform infrared spectra have demonstrated the biomolecules in ginger-clove mixture extract that had involved in the synthesis of CuNPs. Particle size analysis will be performed using Scanning Electron Microscopy (SEM). The catalytic activities of the synthesized CuNPs were tested using the reduction reactions of methylene blue (MB) and methyl orange (MO) in the presence of excess $NaBH_4$. The rate constants of the reduction reaction of MB and MO with heat derived CuNPs were 67.1×10^{-3} min^{-1} and 3.9×10^{-3} min^{-1} and with photo derived CuNPs were 22.9×10^{-3} min^{-1} and 0.9×10^{-3} min^{-1} respectively. Rate constants of the reduction reaction of MB and MO in the absence of the CuNPs were 8.1×10^{-3} min^{-1} and 0.2×10^{-3} min^{-1} respectively. The as-prepared CuNPs have acted as catalysts in the reduction reactions of MB and MO with excess $NaBH_4$, where heat derived CuNPs have shown faster kinetics.

Keywords: Copper nanoparticles, Clove-ginger, Green synthesis, Catalytic degradation, Photo-irradiation

Green Synthesis of Nanocellulose Using Two Selected Invasive Plants in Sri Lanka

S.A. Senevirathne*, N.B. Jayaratna and M.C.S. Godage

Department of Chemical Sciences, Faculty of Applied Sciences,
Rajarata University of Sri Lanka, Mihintale 50300, Sri Lanka
*suchithra@as.rjt.ac.lk

Nanocelluloses, including cellulose nanofibers (CNF) and cellulose nanocrystals (CNC) exhibit improved properties including significantly higher surface area, and advantageous thermal and mechanical properties, which lead to the production of novel materials in various fields. Several methods of chemical, mechanical and enzymatic syntheses have been studied for nanocellulose production. The objectives of this research work include eco-friendly isolation of cellulose biopolymer from *Panicum maximum* (illuk) and *Eichhornia crassipes* (Japan jabara)*,* two invasive plants of Sri Lanka, and subsequent synthesis of nanofibers using Deep Eutectic Solvents(DES), a subcategory of ionic liquids which have emerged as a new generation of green solvents. Cellulose from dried plant parts were isolated using potassium carbanate-glycerol DES followed by bleaching treatment with hydrogen peroxide. To compare the efficiencies of cellulose extraction process, cellulose was also extracted using a conventional method, which involves treatment with concentrated sodium hydroxide solution followed by bleaching with aqueous chlorite and acetate buffer solution. Moreover, several DES have been studied in this research. An extracted cellulose sample was pretreated with ammonium thiocyanate-urea DES followed by fibrillation using high intensity ultrasonication. Further, sulfation of cellulose sample was carried out using sulfamic acid-urea DES instead of utilizing more toxic sulfuric acid, followed by high intensity ultrasonication. FTIR, SEM techniques confirm the sulfation and incomplete nanofibrillation of cellulose. Additionally, lignin biopolymer was isolated from *Panicum maximum* and *Eichhornia crassipes* using a novel method utilizing ammonium thiocyanate-urea DES. Characteristic UV-vis absorption band with λ_{max} at 205 nm and FTIR spectra verifies the extraction of lignin from the plant materials. Approximately, 17% and 20% of cellulose from *Panicum maximum* and 19% and 18% of cellulose from *Eichhornia crassipes* have been extracted from conventional and green method, respectively. Further, 4% and 9% lignin have been extracted using green method from *Panicum maximum* and *Eichhornia crassipes*, respectively.

Keywords: Cellulose, Nanofibers, Deep eutectic solvents, *Panicum maximum*,
Eichhornia crassipes

Synthesizing Dry-Spinnable MWCNT Arrays Using Facile Post-Treatment Method

C. Sandaruwan[1], E.V.A. Premalal[2]* and G.A.J. Amaratunga[3]

[1]Sri Lanka Institute of Nanotechnology (SLINTEC), Homagama 10200, Sri Lanka
[2]Department of Civil and Environmental Technology, Faculty of Technology,
University of Sri Jayewardenepura, Pitipana, Homagama 10206, Sri Lanka
[3]Department of Engineering, University of Cambridge, Trumpington Street,
Cambridge CB21PZ, UK
*vikum@sjp.ac.lk

Production of carbon nanotubes (CNTs) at an industrial scale has drawn so much attention as large quantities are needed when targeting applications. Most of the commercializing CNTs are produced by Chemical Vapor Deposition (CVD) method, as it is possible to grow CNTs in bulk and selectively. When compared to arc discharge and laser ablation methods, CVD has the advantages of mild operating conditions, high purity, low costs, and easy parameter controllability, thus becomes the most suitable method for CNT mass production. Most of the commercial CNTs are powder type. Though there are a large number of publications on synthesizing CNT arrays, only a very few groups are synthesizing spinnable CNTs as the spinnability depends on the purity, areal density, and length of CNTs. Hence, various type of research has been carried out on synthesizing the spinnable CNTs where the process optimization on the amount of catalysts, growth temperature, feedstock flow, substrate conditions, and vacuum conditions inside the CVD chamber are extensively studied in order to obtain such spinnable CNTs. In this study, vertically aligned CNTs were synthesized by the CVD method using $FeCl_2$ as catalyst materials and acetylene gas as the carbon feedstock. CNTs were grown on quartz substrates keeping the furnace temperature at 800 °C. Synthesized CNT arrays were characterized using SEM, TEM, and XPS. The height of the array was observed as 300 µm. Though CNT arrays are dense and vertically aligned, the CNT array was not fully spinnable. Then the CNT carpet was treated with Cl_2 gas at 800 °C under vacuum with the intention of removing $FeCl_2$ and amorphous carbon residues attached to the surface of the CNT structure. The reduction of residual contamination has been confirmed using XPS studies. Hence, non-spinnable CNT arrays were transferred to fully spinnable samples possibly due to the improvement of Van der Waals interaction among CNTs. This technique is very simple as well as significant to make repeatable spinnable CNT arrays for the production of CNT yarn and sheet.

Keywords: Carbon nanotubes, Spinnable, CNT yarns, Chemical vapor deposition, Post-treatment

A Review of Multidimensional Data Visualization in Immersive 3D User Interfaces

A.S.K. Wijayawardena[1]* and G.D.S.P. Wimalaratne[2]

[1]*University of Vocational Technology, Dehiwala-Mount Lavinia 10390, Sri Lanka*
[2]*University of Colombo School of Computing, Colombo 00700, Sri Lanka*
*asithask@gmail.com

Many of the larger datasets found today have multiple dimensions that are too complicated to interpret by the human brain. New methods of data visualization are needed to convert such datasets with multidimensional attributes into easily readable and understandable forms while reducing the cognitive burden and improving usability. This work attempts to critically examine the recent literature and seek for research gaps and trends in visual analytics of multidimensional datasets in 3D space. However, several recent works have been carried out to overcome the limitations of multidimensional data exploration. One of the emerging areas is 3D metaphoric information visualization. According to the literature, the types of metaphors for visual data analytics can be broadly categorized into two, as metaphors for interaction and metaphors for visualization. The interaction promotes the user engagement such as data Drill-Down and Roll-Up operations by incorporating metaphors like 3D cube and Carousel. Visualization metaphors provide an interactive representation of data while amplifying the human cognition in order to get useful insights into the dataset. Several works can be found based on metaphors like city, buildings, solar system, 3D cone trees and 3D cartography. Implementations of these interactive visualizations are mostly based on 3D immersive technologies. Recent literature emphasizes that state-of-the-art immersive technologies are capable of certain aspects like direct manipulation of objects in 3D space, free body movement and infinite 3D space to position visual components. Those are significant reasons to consider data visualization towards immersive technologies. Literature reveals that 3D metaphoric information visualization is evolving new area of research which is capable of giving better insights into complex datasets. Therefore, the review finds a strong need of novel intuitive and interactive 3D metaphor-based user interfaces to visualize different types of modern complex datasets to extract useful insights.

Keywords: Multidimensional data visualization, Immersive technology, 3D metaphor, Visual data analytics

A Novel Approach to Model Autocorrelation Functions of Wind Speed Data

H.M.D.P. Bandarathilake[1]* and G.W.R.M.R. Palamakumbura[2]

*[1]Faculty of Arts and Sciences, Sri Lanka Technological Campus,
Padukka 10500, Sri Lanka
[2]Department of Engineering Mathematics, Faculty of Engineering,
University of Peradeniya, Peradeniya 20400, Sri Lanka
darshanab@sltc.ac.lk

Modeling of autocorrelation function of a moderately large set of wind speed, plays a major role in analyzing the stationary and ergodic properties of wind speed variations. A time series of wind speed usually exhibits both stationary and non-stationary features. According to the literature survey, it has been indicated that the underlying autocorrelation function of wind speed data can be primarily modeled by an exponentially decreasing function. But it is not capable to successfully capture the characteristic variation of the empirical autocorrelation function where the set of wind speed data includes non-stationary features. In such case, a convex combination of exponentially decreasing functions has been incorporated to trace the weak stationary properties of the dataset. But it is also not capable to fully capture the minor cyclic variations and temporal trends depicted in the autocorrelation function. Therefore, in this work, a new functional, which consists of modified exponential terms and cosine terms, has been introduced to approximate the autocorrelation functions of wind speed data that exhibit weak stationary features. The functional was constructed to meet the rho-mixing properties of a corresponding stochastic process which satisfies the weak regularity properties. A set of constraints were derived to preserve the uniform convergence property of the selected functional. The existence of a proper stationary probability distribution in the positive time domain, corresponding to the theoretical autocorrelation function was then proved. The new functional was applied to approximate the autocorrelation function of a set of wind speed data which were recorded at Kokkilai of the Northern coast, Sri Lanka from February, 2015 to February, 2016. The goodness of fit statistics indicated that the new approach has successfully captured the variation of the initial portion of empirical autocorrelation in comparison to the theoretical autocorrelation functions based on the combinations of exponential functions.

Keywords: Autocorrelation function, Rho-mixing properties, Stationarity, Uniform convergence

Science, Technology and Industry

Radiological Risk Assessment of Naturally Occurring and Anthropogenic Radionuclides in Marine Sediments of Sri Lanka

R.K.D. Madhusha*, W.A.T.L. Weerakkody, W.P.P.C. Weerasinghe, T.N Attanayake, H.M.N.L Hadagiripathira, W.M.I. Dissanayake and V.A. Waduge

Sri Lanka Atomic Energy Board, Colombo 10600, Sri Lanka
*dula142019@gmail.com

As a consequence of Fukushima Nuclear Power Plant (FNPP) in Japan in 2011, huge amount of radioactivity was released into the Pacific Ocean contaminating marine eco-system. There was also a possibility of increasing natural and artificial radioactivity in marine environment of Sri Lanka due to mineral sand processing and nuclear power generation activities in the neighboring countries. In order to assess the existing level of radioactivity, 21 surface sediment samples were collected randomly from the selected locations of the shallow sea (approximately 1 km away from the shoreline and at 10 m water depth) around Sri Lanka in 2019. The samples were dried at 105 ^{0}C, weighed and filled into calibrated geometries before storing for measurements. The samples were analyzed for specific radioactivity of ^{226}Ra, ^{232}Th, ^{40}K and ^{210}Pb ^{137}Cs and ^{134}Cs by gamma ray spectrometry following standard procedures at Sri Lanka Atomic Energy Board. No contamination was detected in sediments due to the artificial radionuclides ^{137}Cs and ^{134}Cs. The mean specific radioactivity of ^{226}Ra, ^{232}Th, ^{40}K and ^{210}Pb in sediment samples were found to be 16±3, 35±2, 314±20, and 60±9 in Bqkg^{-1}, respectively. These values were compared with world averages reported in 2008 by UNSCEAR (United Nations Scientific Committee on the Effects of Atomic Radiation) for ^{226}Ra, ^{232}Th and ^{40}K as 32, 45 and 420 Bqkg^{-1}, respectively, and found to be lower than UNSCEAR values. The samples with 80% sand particles and small amounts of silt and clay have lower radioactivity level compared to other samples because of their small specific surface areas. Radium equivalent activities, absorbed dose rate, external hazard indices, and annual external effective dose rate are less than the recommended limits. The results of this study could serve as important set of radiometric data required for future environmental radiation surveillance programs of the country and the region.

Keywords: Environmental radioactivity, Marine sediments, Gamma ray spectrometry, Radiological risk

A Statistical Binary Classification Approach to Identify Phosphate Solubilizing Bacterial (PSB) Viability in Soil Environment

T.H.D. Darshani

Department of Information Technology, Hardy Advanced Technological Institute, Ampara 32000, Sri Lanka
dinusha@sliate.ac.lk

Phosphate Soluble Bacteria (PSB) are able to solubilize inorganic phosphorus from non-soluble compounds, hence, enhance crop growth. Identification of suitable soils to grow PSB is beneficial for annual crop growth promotion. This research seeks a distinctive and an efficient statistical binary classification model for the identification of PSB viability. Hence, this research concentrates on how the decision tree algorithm approach can be beneficial towards the identification of suitable soils for annual crops growth promotion by predicting PSB viability that can be identified by analysing the soil's physical conditions. 1015 soil samples are collected from rhizosphere of different agricultural crop areas in Matara district of Sri Lanka by using opportunity sampling method. The learning of data is completed using Classification and Regression Trees (CART) algorithm. The soil physical condition parameters such as pH, electrical conductivity, bulk density, porosity and moisture content from soil samples were collected, trained and tested to achieve the stable results through binary classification model. The soil dataset was split randomly where 70% of the data was used as the training set and the remaining 30% as the testing set. The result of this study indicates that the model is successful in predicting the PSB viability with the particular parameters. The training and testing of data under the binary classification model helps in, not only minimizing the errors but also maximizing the reliability and durability of the predicted data. The accuracy was measured with the logistic regression model having a value of 79.02%, the random forest having a value of 94.75%, the support vector machine having a value of 90.16% and the CART algorithm having a maximum classification accuracy of 97%. The results of the study highlights that the CART algorithm is the most suitable model for the PSB viability prediction.

Keywords: Phosphate soluble bacteria (PSB), Statistical binary classification, Decision tree, Classification and regression trees (CART)

Selection of Best Tissue Type for Population Scale Molecular Detection of Phytoplasma Associated with Weligama Coconut Leaf Wilt Disease

P.H.P.R. De Silva[1], K.P.R.N. Attanayake[2]* and S.A.C.N. Perera[3]

[1]Coconut Research Institute, Lunuwila 61150, Sri Lanka
[2]Department of Plant and Molecular Biology, University of Kelaniya,
Kelaniya 11600, Sri Lanka
[3]Department of Botany, University of Peradeniya, Peradeniya 20400, Sri Lanka
renuka@kln.ac.lk

Weligama Leaf Wilt Disease (WCLWD) in coconut is an uncontrollable and a devastating disease caused by phytoplasma. Molecular based disease diagnosis is commonly practiced to detect phytoplasma around the world. Due to the stature of the palms, unlike many other field crops, sampling plant tissues to collect sufficient pathogen for molecular detection is challenging. The objectives of the current study were to determine the tissue distribution of the pathogen within the coconut palm and to identify the best sampling tissue type. Tissue samples were collected from twelve coconut palms each from WCLWD symptomatic and asymptomatic categories selected from a commercial coconut field in Weligama, Matara district. From each palm, bud leaves, young inflorescence and roots were collected at two sampling rounds in 2020 and transported to the Coconut Research Institute, Sri Lanka. Total of 36 tissue samples from WCLWD symptomatic and 36 from asymptomatic palms were tested. Total genomic DNA was isolated from each sample and phytoplasma was detected by nested Polymerase Chain Reaction (Nested PCR). PCR was positive for 75%, 25% and 41% of the symptomatic and 75%, 16% and 25% of the asymptomatic bud leaf, inflorescence and root tissues samples, respectively. Sanger sequencing of the PCR products of 880 bp and BLASTn results confirmed that the pathogen causing WCLWD was 99-100% similar to Sugarcane White Leaf or Grassy Shoot Disease Phytoplasma. Pathogen detection in root and inflorescence samples was possible only when the bud leaf samples were positive. The results revealed that coconut bud leaf to be the best sampling tissue for population scale molecular detection of phytoplasma from symptomatic as well as asymptomatic palms.

Keywords: Coconut, Nested PCR, Phytoplasma, WCLWD, Grassy shoot disease

Musical Chord Recognition for Electronic Dance Music Data Using Neural Networks

M.A.K.H. Udayanthi and A.J. Pinidiyaarachchi*

*Department of Statistics and Computer Science, Faculty of Science,
University of Peradeniya, Peradeniya 20400, Sri Lanka
ajp@sci.pdn.ac.lk

Music can be described as a structured sequence consisting of sounds, noise, and silence. A musical chord is often defined by the pitch class of its root note (usually rock bottom note) and therefore the type (major or minor) of the harmonic relations among the notes. Analysing the general harmonic structure of the music piece often starts with labelling every chord in it. Some earlier studies have used pitch-class-profiles, chroma features, and various other techniques to identify the chords in songs. Although various genres of music have been used to identify chords, one area that has not been discussed a lot is the area of Electronic Dance Music (EDM). It is difficult to recognize chords in EDM compared to other genres of music due to its versatility as many instruments are used and a lot of complex beats generated from computers are integrated heavily into these types of songs. This study was carried out on Isophonics and Beatport EDM Datasets. To preprocess the data, Constant-Q-Transformation was used as it produces the same frequency support to all semitones and varying bins in between them. Two models were implemented to identify the chords. A Recurrent Neural Network, together with bidirectional Long Short Term Memory (LSTM) with 2 hidden layers of size 128 and 0.4 dropout to recurrent block, was used. Random Forest assigned one of the 12 mid tones to a short segment of audio or determined the absence of chords in it. With an accuracy of 78.19% resolution of chord recognition in EDM dataset, the LSTM model was identified as the best model compared to the Random Forest model. Furthermore, using different types of feature extraction methods as zero crossing rate which gives high values for beat sounds would be beneficial to improve the performance of the proposed method.

Keywords: Electronic dance music, Musical chords, Random forest, Recurrent neural network

Human Elephant Conflict Management through Community-Based Elephant Early Warning System

P.D. Buddika[1]*, U.H. Abewickrama[2] and R.M. Weerasinghe[1]

[1]Electro Technology Laboratory, Industrial Technology Institute, 363, Bauddhaloka Mawatha, Colombo 00700, Sri Lanka
[2]IFS RnD International, Access Tower II, Union place, Colombo 00200, Sri Lanka
*dushmantha@iti.lk

The natural ecosystem in Sri Lanka is disturbed due to the increased population and their needs. Thus, elephants struggle to survive with limited resources and wander into villages, especially for food and water. This causes an immense social and economic burden, leading to increased human elephant conflicts (HEC). Presently, the most widely-used measure to overcome HEC is the electric fence. Due to functional shortcomings, elephants bypass these fences and enter villages. This emphasizes the need for development of an integrative HEC mitigation approach with the involvement of the community to ensure sustainability. The current study is an attempt to implement a community-based elephant early warning system (CEEWS) to mitigate HEC through collective decision making by the community. CEEWS comprises a controlling station, a siren in the field and a mobile application for smart-phones. Once an attack from a wild elephant is detected by any villager, they can immediately dial a service centre number or click a specific icon in a smart-phone application. This will result in the sending of a warning text message to all individuals in the community. At the same time, the field siren activates to get the attention of the villagers. People who use smart-phones can view the location of the wild elephant. Due to the text message and the sound of the siren, the community can collectively gather and take necessary action to mitigate the conflict. This system currently functions in Wathupolagama and Ehetuwewa in Galgamuwa Divisional Secretariats, where it was implemented as a pilot project with the collaboration of Ecosystem Conservation and Management Project (ESCAMP), under the Department of Wildlife Conservation. The system has given promising results by mitigating over fifty HEC events in last six months with the involvement of the community as a team.

Keywords: Human, Wild elephant, Conflict, Community, Early warning

Low-Cost Orbital Shaker and Incubator to Support Serum Analysis Using Bio-Pro Rabies ELISA Antibody Kit

P.D.L. Gomis, U.A.H. Udagedara, H. Rathnadiwakara* and M. Gunatilake

Department of Physiology, Faculty of Medicine, University of Colombo, Colombo 00800, Sri Lanka
hasanthirathnadiwakara.pdn@gmail.com

Bio-Pro Rabies ELISA kit measures the presence or absence of rabies-antibodies in serum samples. The protocol of ELISA includes steps of incubation at different temperatures; 4–8°C (using a refrigerator), 37°C (using an incubator) and 18-25°C (in the air-conditioned room), with gentle agitation by an orbital shaker to obtain accurate and validated results. In the process of making this ELISA kit more convenient to use, we have made a user friendly, less sophisticated orbital shaker. The shaker has vibrational and rotational movements with adjustable speed. It contained a brush motor with gear wheels and the voltage requirement was 3V–9V DC and 0.5W. Further, the shaker could withstand a wide temperature range (0-60°C). Due to the non-availability of an incubator where samples need to be incubated at 37°C on a shaker, we also tried to produce a low-cost incubator. Our incubator contained an insulated box and a thermoregulating device to adjust the temperature. For comparison, in addition to the locally produced orbital shaker, the ELISA was also performed using a company manufactured orbital shaker. Optimal working conditions of the ELISA kit was checked using control sera at three different concentrations in three replicates per shaker. Positive control and negative control were analysed in duplicates in three independent runs per shaker (6 runs per sera on each shaker). Results were analysed using Students' t test. As there was no statistically significant difference observed in the ELISA results between the two shakers tested, it is concluded that the above ELISA could be routinely performed by using the locally produced orbital shaker. These innovations under low-resource or low-finance setting would support the progression of scientific research in the country.

Keywords: Orbital shaker, Incubator, Bio-Pro rabies ELISA kit, Antibody

Molecular Detection of Haemoparasites in Sheep in Horrakelley Farm, Sri Lanka

A.M. Jayaweera[1], W.A.S.M. Premaratne[2], A.G.S. Dilinika[3],
R.P.V.J. Rajapkse[1] and T.A.N. Mahakapuge[1]*

*[1]Department of Veterinary Pathobiology, Faculty of Veterinary Medicine and Animal Science, University of Peradeniya, Peradeniya, 20400, Sri Lanka
[2]Horrakelley NLDB Farm, Kudawewa, 61226, Sri Lanka
[3]Department of Animal Science, Faculty of Agriculture, University of Peradeniya, Peradeniya, 20400, Sri Lanka
thilinianupama1984@gmail.com

Tick borne parasitic diseases play a major role in reducing the livestock production worldwide. When considering the sheep industry, the common haemoparasites causing losses include *Babesia*, *Anaplasma*, *Ehrlichia* and *Theilaria*. In the context of Sri Lankan sheep industry, many animals were imported; thus, they may harbour haemoparasitic diseases. The presence of the haemoparasitic diseases may not have been reported due to the lack of confirmatory diagnostic tools used in the field. Therefore, this study was conducted to diagnose and confirm the above mentioned hemoparasites present in sheep. Sixty blood samples were collected from the jugular vein of randomly selected clinically healthy sheep from the National Livestock Development Board (NLDB) farm, Horrakelley located in the Northwestern Province, which has the largest sheep flock. Thin blood smears were prepared, and Leishman's staining was performed to screen the samples for the haemoparasites using microscopic examination. Then, DNA was extracted from the blood samples and PCR was conducted using specific primers for *Babesia ovis*, *Anaplasma ovis, Ehrlichia ruminantium, Theilaria ovis* and *Theilaria lestoquardi*. The PCR amplification demonstrated 71% haemoparasite infection rate in Horrakelley farm, while microscopic examination only demonstrated 46.6%. The molecular analysis of the sheep blood samples identified five haemoparasites, namely *Babesia ovis* (12/60: 20%), *Anaplasma ovis* (41/60: 68.3%), *Ehrlichia ruminantium* (6/60: 10%), *Theilaria ovis* (10/60: 16.7%) and *Theilaria lestoquardi* (36/60: 60%). Molecular diagnosis of above haemoparasites revealed high infection rate in comparison to microscopic examination. The confirmatory diagnosis of haemoparasitic diseases using established molecular method is not only important for confirmatory disease diagnosis but also for the disease control and screening of sheep during importation.

Keywords: Haemoparasites, Sheep, PCR, Confirmatory diagnosis

iPURSE 2021 – 544   *Science, Technology and Industry*

Evaluation of ISSR-PCR Primers to Determine Genetic Variability among Cattle in Sri Lanka

W.M.R.R. Wijethunga[1]*, P.P. Jayasekara [2],
G.A. Gunawardana[2] and M.W.C.D. Palliyeguru[2]

[1]Vitebsk State Medical University, Vitebsk, 210009, Belarus
[2]Veterinary Research Institute, Peradeniya, 20400, Sri Lanka
*rrwijethunga@gmail.com

Knowledge of existing genetic variation is the key to implement efficient breeding programs to uplift the dairy industry in any country. Inter Simple Sequence Repeats (ISSR) molecular markers could be used for the genetic analysis of cattle. In establishing the ISSR-PCR for local cattle, it is essential to test ISSR primers for their discriminative ability. Thus, a study was conducted to evaluate two ISSR primers selected through literature, P01 (5'AGAGAGAGAGAGAGAGAGAGC3') and P02 (5'GAGAGAGAGAGAGAGAGAGAC3') in order to produce informative polymorphisms. DNA was extracted from blood samples obtained from two cattle populations in two ago-climatic zones; Trincomalee in Eastern Sri Lanka (n=12) and Gampola in Central Sri Lanka (n=10). PCR was performed with following conditions; initial denaturation followed by 35 cycles of 1 min at 94°C, 1 min at 55 ^{0}C, 2 min at 72°C and final extension at 72°C for 10 min. Amplified PCR products were visualized in 2% agarose gels and analysed using GelAnalyzer 2010 software. Binary data matrix was generated based on presence (1) or absence (0) of bands and was analysed using GenAlEx 6.503 add-in Microsoft excel. ISSR P01 primer amplified a total of 8 bands, of which 5 (62.5%) showed polymorphisms. P02 primer amplified a total of 15 bands, of which 8 (53%) showed polymorphisms. The amplicons of both P01 and P02 ranged from 400 to 2000bp. P02 produced 6 rare polymorphic bands that were present in fewer than 50% of the accession; whereas P01 produced none. Furthermore, P02 was found to be more effective in genetic differentiation between the two populations compared to P01 (Nei's genetic distance; 0.3515 and 0.159, respectively). This study indicates that P02 primers could be used to study the genetic variations of cattle population in Sri Lanka due to its higher discriminative capabilities.

Keywords: Genetic diversity, ISSR- PCR, Cattle, Sri Lanka

Characterisation of MCIR Gene in a Mongrel Dog Population in Mullaitivu, Sri Lanka

R.A.M.K. Rathnayake*, T.L.K. Ediritilaka and S. Wickramasinghe

Department of Basic Veterinary Sciences, Faculty of Veterinary Medicine and Animal Science, University of Peradeniya, Peradeniya, 20400, Sri Lanka
*mihiprabha.r@gmail.com

Coat colour and pattern in dogs vary due to the variation in the production of eumelanin and phaeomelanin by melanocytes. Seven genes are responsible for the variation in coat colour and pattern in mongrel dogs. One of the major genes responsible for the variation in coat colour is the melanocortin 1 receptor (MC1R) gene, which controls the production of black and red pigments that determine the basic colours. Previous studies suggested the presence of a termination mutation at the 306th codon of the above gene in dogs with red-yellow coat colours. Black and brown dogs have shown to possess CGA coding for the amino acid arginine at 306th position. There were no studies conducted on the molecular genetic basis of skin colour in mongrel dogs of Sri Lanka. Therefore, the aim of this study was to identify the molecular basis of the coat colour variations of a mongrel dog population in Mullaitivu district by sequencing 942 base pairs of MC1R gene. Genomic DNA was extracted from buccal cells collected from seven mongrel dogs with brown (n=4) and black (n=3) coat colour. Sequence trace files were obtained and analysed using codon code aligner and Mega X software. Twenty-two SNPs in the sequenced region of MC1R gene were identified. Neither black nor brown dogs processed TGA or CGA in their 306th codon. Black dogs had CCT and CCT at 306th codon, while brown dogs processed CTG, CTC and CCT codons. The phylogenetic tree has shown a significant variation in the MC1R gene even among dogs with the same coat colour. High polymorphisms in the MC1R gene observed in this study may be due to increased cross breeding. Further, it appears that the R-306 termination mutation may not play a significant role in determining the coat colour in the studied population of mongrel dogs.

Keywords: Mongrel dog, Coat colour, MCIR gene, DNA sequence

SOCIOECONOMIC PROGRESS
AND GOVERNANCE

Nature of Poverty Experienced by Contemporary Gemstone Mining Community in Sri Lanka

L.K. Bamunu Arachchi

*Department of Sociology, Faculty of Arts, University of Colombo,
Colombo 00300, Sri Lanka
lilanthakperera97@gmail.com*

Among the communities experiencing poverty in the country, the gemstone mining community experiences chronic or transient poverty during most parts of their lifespan. This research was carried out to gain an insight into the contemporary gemstone mining community and their current position in the social fabric. One objective of this research focused on building a profile of gemstone mining labourers including their current social, economic, and educational status. Another objective was to quantitatively present the poverty status of the contemporary gemstone mining community. The quantitative information was complemented by qualitative explorations. Two villages situated in the Pelmadulla area – Kattange and Jayanthipura - were the research field. 20 gemstone mining labourers (10 labourers from each village) were selected. Sampling was done based on purposive sampling. Questionnaires and unstructured interviews were used to collect data. During data analysis more weight was placed on the quantitative aspect along with substantial qualitative analysis. The significance of this research is marked by the use of Experimental Livelihood Security Index (ELSI) which is a logical and scientific framework that is used to measure the degree of poverty and vulnerability within specific communities. The findings of the research are as follows. In the contemporary context, the main source of income for most gemstone mining households is mining and most of these households happened to be *Samurdhi* recipients. It was evident that the youngsters of the gemstone mining households are less likely to be involved in mining. Most gemstone mining labourers are middle-aged men who lack adequate education. Most of them have been educated only until their O/Ls. It was evident that if alternatives were available, most of the gem mining workers would be more likely to quit mining and seek out less risky and less laborious formal or informal jobs. Mining is not a satisfactory job in terms of income as the mine workers get only 2% of the total income of the mine.

Keywords: Poverty, Vulnerability, Culture of poverty, Culture of dependency, Gemstone mining labourer

Key Necessaries to Promote Value-Added Products in
Sri Lankan Cinnamon Industry

S. Nirmal and V. Sachitra*

*Department of Commerce, Faculty of Management Studies and Commerce,
University of Sri Jayewardenepura, Nugegoda 10230, Sri Lanka
vilani@sjp.ac.lk

Being a heritage crop that cannot be successfully grown in any other country, Sri Lanka has more opportunities to achieve a comparative advantage from value-added products in cinnamon. The Government of Sri Lanka intends to enhance cinnamon based value-added products by providing many grants and support. However, few options such as cinnamon incentives, soap, burn oil, different types of cleaning agents and mosquito coils, are available. The study aims to identify technical issues and marketing issues related to value chain manufacturers in the Sri Lankan cinnamon industry. An exploratory qualitative research approach was used. Snowball sampling method was utilized to select cinnamon peelers (04), oil producer, trader, manufacturers (02) and officers (02) who represented the Cinnamon Cultivators' Association (CINCA) in Galle. Data were collected through in-depth semi structured interviews. The content analysis method was used to determine whether certain words, themes, or concepts are present in certain qualitative data. The study quantified and analyzed the existence, meanings and relationships of such specific words, themes or concepts. The respondents highlighted that there are enough opportunities to obtain required knowledge and expertise related to value-added products; however few producers are trying to make new productions from cinnamon. Lack of technology, poor infrastructure facilities and lack of management techniques are the main obstacles. There are very few technical applications in the industry and most of them are not viable or suitable in the long run. Further, attitudes and perceptions regarding the operational aspects of technological applications were at a very low level. Manufacturers have a moderate level of concern about consumer orientation; however, they believe that overall marketing strategies were not satisfactory. Though we are in a knowledge-intensive era, the industry is operating at the same traditional level and it seems that the value of the entire industry has not been properly understood by most of the stakeholders. The findings could be used by government institutions, intergovernmental organizations and international non-profit organizations to make an impact on cinnamon value-added products, acting as the influencers in its own interconnected market system.

Keywords: Value-added product, Cinnamon, Barriers, Technology, Marketing

Factors Affecting Financial Performance: Evidence from Commercial Banks in Sri Lanka

S. Balagobei

Department of Financial Management, Faculty of Management Studies and Commerce, University of Jaffna, Jaffna 40000, Sri Lanka
saseelab@univ.jfn.ac.lk

The financial performance of companies is a subject that has attracted a lot of attention, comments and interest from financial experts, researchers, the general public and the management of corporate entities. The aim of this study is to examine the firm-specific factors affecting the financial performance of Commercial banks in Sri Lanka. It has been argued that profitability is the main pillar for any company to survive in the long run. Although maximizing the shareholder wealth is the primary goal of all business ventures, scant attention has been paid to the factors affecting the financial performance in developing countries. This study investigates the factors affecting financial performance of Commercial banks in Sri Lanka. The analysis of data was based on a sample of 28 Commercial Banks. The study utilized secondary data which were collected from annual reports of Commercial Banks in Sri Lanka over the period of 2014 to 2019. Models used in the study were pooled OLS model, fixed effects model and random-effects model. This study used 'financial performance' measured by return on assets and return on equity as the dependent variable, while the explanatory variables are firm size, financial leverage, efficiency, firm age, and firm growth. The findings show that firm size and efficiency have a significant positive impact on financial performance whereas financial leverage significantly and positively impacts on financial performance of Commercial banks. Moreover, firm age and firm growth are insignificant in affecting the financial performance of Commercial banks. These results benefit internal users (such as managers, shareholders, and employees). They can realize the determinants of enhancing the financial performance of their company and therefore concentrate more on the factors that enhance their companies' profitability. On the other hand, other external users (such as investors, creditors, newly established companies, tax authorities) also may get advantages from these results.

Keywords: Efficiency, Financial performance, Firm size, Financial leverage, Commercial banks

Identifying the Impact of Proposed Central Expressway of Sri Lanka on Humans and Animals

A.G.I.U. Alagalla

Department of English Language Teaching, University of Peradeniya,
Peradeniya 20400, Sri Lanka
ishaniua55@gmail.com

The Central Expressway is an ongoing road project of Sri Lanka which primarily links Colombo and Kandy along with some other economically important commercial centres. The objective of this project is to bring about economic and social benefits to the country. This study presents a comparative analysis of the positive and negative impacts of this construction on the humans and animals who dwell in the affected areas of the expressway. Primary data was collected through questionnaires which were distributed among the residents of the affected areas, responsible personnel of the Road Development Authority, Rural Development Authority, and the Department of Wildlife Conservation. Further, data was collected through library research analysis. For the purpose of sample identification and selection, cluster sampling and purposive sampling methods were used. Questions about subjective information and open ended and close ended questions were used to get responses from the general public whereas factual questions were directed to the other respondents. The responses highlight the drastic reduction in the travelling time, development of the comparatively under-developed areas thereby uplifting the living standards of people, creation of new employment opportunities, increased investments of both local and foreign investors, development of the country's Tourism and Hospitality Management industry and sustainable economic development as the major benefits. However, a greater part of the respondents showcased the uprooting of human settlements which would also impact education and occupation, pose a threat to the animals and their natural habitats, cause an acceleration in the rate of natural disasters, have an unfavourable impact on farming activities, cause disturbance in the flow of natural water resources and impact on agriculture-based livelihoods as the primary negative impacts. The results of this study show that the expected vast socio-economic development is outweighed by the threats to the livelihoods of people, small-scale agriculture, and the eco-systems of the affected areas.

Keywords: Central expressway, Effects of urban development, Wild-life conservation, Economic benefits, Social benefits

How Does Senescent of Workforce Impact Economy? : Sri Lankan Experience

A.N.N.M. Gunasekara

Department of Economics, Faculty of Arts, University of Colombo,
Colombo 00800, Sri Lanka
niniscg@gmail.com

Demographic changes are vital as they can direct a country's journey towards development. The Sri Lankan population is growing older at a faster rate in the South Asian region. According to the United Nations population projections, Sri Lanka's population inclines to reach its peak of around 22.2 million by 2038 and is beginning to contract gradually with various alarming adverse effects. As such, this paper examines the current state and pattern of population aging and the identification of the extensive challenges and prospects in the Sri Lankan context. The study employs data collected by the Department of Census and Statistics, Central Bank, and United Nations World Population Prospects, while field data were collected through key informants' interviews conducted using a purposive sampling method. The findings under a thematic analysis confirm that aging brings several social and economic challenges in the context of the Sri Lankan economy. Reduction in workforce population, increase in fiscal cost in terms of pension cost, health care, long term care cost along with the old age income security have an adverse impact on the economy. Social norms ensure the protection of elders by their own families. Currently, policymakers focus on creating a realistic pension strategy, along with increasing working age. This can be enabled through continuing the efficiency gained by the health sector. Moreover, the results reinforce the argument in favour of expeditiously implementing effective multidimensional policy response on increasing productivity and the creation of fiscal balance for additional expenditure through improving labour force participation. The long-term care services should be integrated into one focal point. Public awareness campaigns about the implementation of government procedures for elders would encourage the minimizing of the fragmentation of the long-term care system. Moreover, the integration of public-private partnership with a vision and proper coordination would be needed in achieving the challenges ahead effectively and efficiently.

Keywords: Demographic changes, Economy, Multidimensional policy, Workforce, Ageing

Growth of Spice Garden Entrepreneurs
with Reference to Matale District, Sri Lanka

S.S.W. Jayasooriya

33/7, Galmaduwawatta, Green Garden Avenue, Kundasale 20168, Sri Lanka
sachimck2@gmail.com

As a major part of eco-tourism, agro-tourism is most beneficial to the community development of a developing country. Since the ancient period, Sri Lanka has been well-known for its agriculture-related practices. Matale is a well-known tourist destination with rich natural and cultural heritage values. This area is most famous among tourists for its spice gardens, which has resulted in a high demand from tourists who want to experience authentic Sri Lankan culture. Therefore, as an objective, this study presented potential, opportunities, and challenges for the spice garden entrepreneurs in the Matale district. This study followed the constructivism paradigm, is inductive in its approach, practices qualitative explorations using in-depth interviews to generate effective results based on the Straussian grounded theory with the entrepreneurs who are actively participating in the business. The researcher identified the potential for spice gardens to be promoted as a new trend to attract tourists, and they can be promoted as a niche concept within the country to attract tourists' attention. Less government involvement, unregistered spice gardens, climate changes, competition, and less income can be identified as major challenges to developing spice garden tourism. The researcher concluded the study with the recommendations for spice garden entrepreneurs to increase the level of income by implementing new strategies such as the green product concept and enough consideration from the government authorities by establishing rules, regulations, and policies to maintain the quality and the standards of the existing spice garden business. As a result, the findings of the study can help all spice garden entrepreneurs to improve their businesses and seize new business opportunities as a developing country.

Keywords: Eco-tourism, Entrepreneurship, Niche tourism, Rural tourism, Spice gardens

Urban Politics and Citizenship: A Discourse on Social Identity of Slum Dwellers with Special Reference to Peliyagoda Urban Council in Gampaha District

D.M. Chandradas[1]* and H.D.H. Jeewanthi[2]

[1]Department of Political Science and Public Policy, Faculty of Arts, University of Colombo, Colombo 00300, Sri Lanka
[2]Department of Political Science, Faculty of Arts, University of Kelaniya, Kelaniya 11600, Sri Lanka
*manesha02chandradas@gmail.com

Urban areas in Sri Lanka are pivotal spaces where socio-economic and political discourses of the state mechanism take place. This study focuses on the formation of social identity through the lens of citizenship in the urban areas. The purpose of this study was to examine the challenges of community-based identity through the concept of citizenship within the urban political discourse. This was investigated based on five Girama Niladhari Divisions namely Peliyagodawatta, Meegahawatta North, Pattiya East, Rohana Vihara Pedesa and Gurukula Vidyala Pedesa in Peliyagoda Urban Council, Gampaha District. To achieve the purpose, the researchers employed qualitative and quantitative methodology, with secondary sources as instrument of data collection. Data were collected using a questionnaire, focus group discussions and structured interviews. Using a stratified random sampling, 100 subjects were selected based on sex, age and ethnicity. The study is based on the concepts of social identity theory, such as social categorization and identification. The study shows that citizens of Peliyagoda were excluded from the socio-economic and political discourses of the central government [due to/based on] their birthplace or community identity. The results of the study demonstrate that they are becoming stateless citizens and are identified as a citizen of secondary position. Hence, their citizenship has become merely symbolic. This research found that they demonstrate a high level of civic participation with regards to political and social issues in the immediate environment i.e., the Paliyagoda area. However, negative social recognition, social status based on their vulnerable economic status and discrimination based on their social and community-based identity were major issues that impact their civic participation. In addition, study also reveals that they have limited access to government services and land tenure. The study shows that negative community identification due to living conditions or birthplace has a significant connection with urban politics, citizenship, and community-based discrimination.

Keywords: Citizenship, Urban politics, Homeland, Social identity, Slum dwellers

Explaining Fertility Transition in Sri Lanka: A Case Study of Kandy District

P.P. Masakorala

Department of Geography, Faculty of Arts, University of Peradeniya,
Peradeniya 20400, Sri Lanka
cpmalawige@yahoo.com

Fertility is defined as the number of children per family in this study. As a developing country, the trend of fertility transition in Sri Lanka is remarkable. The existing theories state that the main reason/ explanation for fertility transition in developing countries is modernization. Can we explain fertility transition in Sri Lanka using modernization? The main objective of this study is to explain the fertility transition in Sri Lanka. Many researchers who explained the fertility transition in Sri Lanka using quantitative analysis have concluded that there is a weak relationship between fertility and socio-economic indicators. They have questioned how Sri Lanka achieved such a low level of fertility being a developing country. Although there are considerable amounts of quantitative analysis of fertility transition in Sri Lanka, the qualitative analyses are limited. With the understanding of the above limitation, a qualitative approach was taken in this research. The data was collected using a questionnaire survey (743 participants) and it has two parts. The first part included structured questions where the participants' level of agreement was measured. The second part had open-ended questions which asked the reasons for the decline in fertility other than the reasons mentioned in the structured question. The data was analyzed thematically. The analyses revealed, six contributory factors to fertility transition in Sri Lanka. These are (i) economic crisis and civil unrest, (ii) financial burden of bringing up children, (iii) growing desire to have material comfort, (iv) women working outside the home, (v) insufficient childcare facilities, and (vi) use of contraceptives. This study concluded that the fertility transition in Sri Lanka was mainly due to economic hardships and civil unrest rather than modernization. Therefore, modernization theories are not adequate to explain the fertility transition in Sri Lanka.

Keywords: Fertility, Modernization, Civil unrest, Economic hardship

Institutional Voids: Emerging Entrepreneurial Opportunities or Vicious Cycle? (Study of Intermediaries in Small Scale Farmer Development in Point Pedro, Vadamaradchy North)

S. Tharmila* and S. Maheswaran

Department of Operations Management, Faculty of Management, University of Peradeniya, Peradeniya 20400, Sri Lanka
*santhu0927@gmail.com

Institutional voids occur because government and non-government organizations did not fulfil their duties and responsibilities sufficiently. Through these institutional voids, intermediaries identify entrepreneurial opportunities. The study area especially focuses on small scale farmers in the paddy field sector in Point Pedro, Northern Province, Sri Lanka. Farmers have limited resources such as the lack financial resources, marketing facilities, technologies and information resources, which is exacerbated by the fact that the government and non-governmental organizations fail to meet their duties and responsibilities towards the farmers. The study explores the types of institutional voids that have emerged, types of entrepreneurial opportunities created, and how intermediaries use these favourably for their survival. This study adopts an inductive case method. As this study is based on the qualitative method, results were obtained through thematic analysis with data collected from semi-structured interviews based on open–ended questions and observing farmers and intermediaries in Point Pedro. A sample of 10 farmers and 08 intermediaries were selected using the convenience sampling technique for data collection. The data analysis indicated the following main themes: quickness, easiness, hopes, easy loan services, complete co-operation and other services as determinants of institutional voids. The results of the study reveal that as institutional voids prevail, intermediaries continue to identify the needs and the problems of the farmers with regard to financing and marketing. Accordingly, intermediaries provide complete and efficient services to farmers. They recognize the opportunities through their quickness, easiness, hopes, easy loan services, complete co-operation and other services. Institutional voids are thus perceived as opportunities for motivated entrepreneurs. Using these opportunities favourably, they influence farmers and continue to provide services such as marketing and the provision of microloans. However, farmers perceive that intermediary eventually reduce their income letting farmers fall into a 'vicious cycle' situation. Finally, the study, recommends that intermediaries should invest in improving their reputation among farmers for their long-term survival in this context.

Keywords: Institutional voids, Entrepreneurial opportunities, Intermediaries, Vicious cycle, Sri Lanka

Impact of Underemployment on Shadow Economy: Experimental Evidence from Sri Lanka

D.I.J. Samaranayake[1]* and O.G. Dayaratna-Banda[2]

[1]Department of Management Studies, Faculty of Management
[2]Department of Economics and Statistics, Faculty of Arts
University of Peradeniya, Peradeniya 20400, Sri Lanka
*dijs@pdn.ac.lk

Underemployment appears to be one of the emerging factors in the underdeveloped nations, which determines the degree of public enrollment in the shadow economy. Though the literature derives this idea from regress empirical research, proper theoretical verification is required. Thus, Samaranayake (2017) attempted to derive the structural relationship having the rate of underemployment as a proxy of underemployment statistics. This paper discusses the applicability of theoretical insights through a laboratory experiment on 240 undergraduates from the University of Peradeniya, Sri Lanka. The experimental framework is developed using the behavioral benchmarks and utility model introduced in Akerlof & Kranton (2000). The experiment consisted of eight equally facilitated sessions having thirty respondents per each in a computer laboratory. Each session was designed as a game with some sequential tasks in the application developed using open-source software to ensure a cross-platform computing environment. The instruction and payoffs are provided by the researcher to the respondent within the game. The experimental data was reviewed using both descriptive and econometric tools. According to the findings, it was observed that the pressure created through dynamics in the own given characteristics reduces the respondent's satisfaction with the occupation assigned. No significant difference was made by the awareness of the shadow economy on the respondent's willingness to engage in similar activities, because the majority are motivated for private gains rather than societal gains. Even the respondents who prefer to enroll in the shadow economy are less ambitious and favor transactions in effect out of the official tax schemes. Further, the income-driven underemployment stimulates respondents to improve their engagement in the shadow economy. Thus, careful concerns on income-driven underemployment can hinder the intensity of individuals in participating shadow economy.

Keywords: Job satisfaction, Personal characteristics, Socially assigned status, Shadow economy, Underemployment

Impact of Political Stability on Economic Growth in Selected Asian Countries

W.M.T.J. Wanigasuriya

Department of Economics and Statistics, Faculty of Arts, University of Peradeniya, Peradeniya 20400, Sri Lanka
tharangizzzz@gmail.com

The Political instability can be considered a serious and harmful issue which causes problems to the performance of economy. If a country is politically stable, it will move toward economic growth. When considering the South Asian region, it is generally perceived to be a volatile area of the world. Some countries in South Asia face issues with political stability. Sri Lanka, for example, suffered from a civil war for a period of 30 years. In 2019, the Easter Sunday attack took place. During these times, there were major changes in political parties as well. However, there is not much literature that focuses on the current political situation. Therefore, the main goal of this study is to fill up that research gap by identifying the impact of political stability on economic growth in Selected Asian Countries, namely, Sri Lanka, India, Bhutan, Pakistan, and Bangladesh between 1996 to 2019. The data for the study was collected from *WDIs* and *WGIs*. Political Stability Index ranges from approximately -2.5 (weak) to 2.5 (strong) governance performance. Per Capita Gross Domestic Product Growth Rate was taken as a proxy for economic growth. This study employed the Panel Generalized Method of Moment to explain the relationship between the explanatory variables namely political stability, FDI and inflation and the Per Capita GDP Growth Rate. The results show that political stability affects economic growth positively and significantly. Foreign Direct Investment, which was taken as a control variable, also shows a positive and significant impact on economic growth. This study concluded that political stability has a remarkable role in a country's economic growth and with a stable political environment, the country can achieve sustainable development. Therefore, by strengthening political stability, a country can increase its economic growth.

Keywords: Political stability, Economic growth, GMM, South Asia

Impact of Foreign Direct Investment Inflows on Balance of Trade Deficit in Sri Lanka

A.M.K. Weerakoon

Department of Economics and Statistics, Faculty of Arts, University of Peradeniya, Peradeniya 20400, Sri Lanka
araliya.weerakoon@gmail.com

Foreign Direct Investment (FDI) is an essential avenue to promote economic growth in developing countries. The Keynesian theory explains that FDI is a key determinant of balance of trade. Sri Lanka has undergone a trade deficit in which imports exceed its exports, and the export performance was inadequate to reduce the trade gap over the past four decades. The level of high trade deficit resulted in harmful influences on the Sri Lankan economy. It is important to reallocate FDI into productive investments that require to be undertaken. The relationship between FDI and trade balance has not been examined extensively in Sri Lanka. Hence, this research strives to analyse the impact of FDI on trade deficit using econometric techniques. Time series annual data from 1978 to 2019 was used for the analysis. The study adopted Augmented Dickey-Fuller (ADF), Auto-Regressive Distributed Lag (ARDL) and Error Correction Model (ECM) tests to check the Stationarity, Long-run and Short-run relationships respectively. The trade balance is the dependent variable and FDI, real GDP, exchange rate, inflation rate, and openness are the independent variables. According to the findings, all the variables are stationary and not integrated in the same order; and there is a significant negative impact of FDI on balance of trade deficit at 5% significance level while GDP, openness have negative impacts; exchange rate has a positive impact and inflation has insignificant impact respectively on trade deficit in the long run and short run. Hence, this study confirms that a 1% increase in FDI inflows will reduce trade deficit by 29.1% in Sri Lanka. Therefore, the Sri Lankan government should implement proper policies; enhance and diversify exports through FDI, decrease expenditure on imports and improve ways of attracting FDI. It is vital to encourage more domestic value-adding processes with greater export performance in Sri Lanka.

Keywords: Foreign direct investment, Balance of trade deficit, Economic growth, Openness, Exchange rate

Inequalities in Financial Literacy in Sri Lanka:
An Assessment of Financial Knowledge, Behaviour and Attitudes

W.M.D.V. Wijekoon

*One Health Poultry Hub, Faculty of Veterinary Medicine and Animal Science,
University of Peradeniya, Peradeniya 20400, Sri Lanka
dinethriewijekoon@gmail.com

In an increasingly complex financial world, personal financial decision-making has become extremely crucial for the average individual. Thus the lack of financial literacy is one of the greatest challenges to the improvement of financial inclusion and financial well-being in Sri Lanka. The study has as its central axis, the development of a multi-dimensional measurement of financial literacy encompassing the three constructs: financial knowledge, financial behaviour and financial attitudes which facilitate the understanding of the existing patterns and the levels of disparity in financial literacy among Sri Lankans. For data collection, a random sample of 100 individuals was selected from Kandy district through stratified sampling considering the age and gender composition of the populace. Each respondent was given a financial literacy score based on their answers to a set of multiple-choice and Likert-like questions in a self-administered questionnaire. A non-linear model was estimated using logit and probit methods for testing the socio-economic and demographic determinants of financial literacy among the respondents. Financial literacy was the dependent variable of the model while gender, age, marital status, occupation, dependent family members, education, income and parental education were explanatory variables. The low level of overall financial literacy reported was of particular significance due to the comparatively lower scores for financial behaviour demonstrated by the participants as opposed to the higher scores for financial knowledge and financial attitudes. The results indicated that the inequalities in the financial literacy levels across respondents was dependent upon gender, age, marital status and income. Therefore, the ideal policy implementation towards the achievement of improved levels of financial literacy in Sri Lanka would be a combination of a national strategy to enhance financial literacy through the provision of formal financial education and policy measures specifically targeting the most vulnerable groups and thereby minimising inequalities in financial literacy.

Keywords: Financial literacy, Inequality, Socio-economic variables, Demographic variables

Impact of Monetary Policy and Exchange Rate Interaction on Flexible Inflation Targeting: The Case of Sri Lanka

Y.K.N. Kandewatta[1]* and A.N. Fernando[2]

[1]Department of Economics, Faculty of Humanities and Social Sciences, University of Ruhuna, Matara, 81000, Sri Lanka
[2]Department of Economics, Faculty of Arts, University of Colombo, Colombo 00300, Sri Lanka
**kamalkandewatta@econ.ruh.ac.lk*

The persistence trade deficits have amplified the importance of foreign financial flows as a significant determinant of the foreign exchange rate in Sri Lanka. On the other hand, the country has been advocating a flexible inflation targeting regime recently. Against this backdrop, the study intends to investigate the impact of monetary policy conduct on exchange rate since changes in exchange rate could create inflationary presure on import dependant domestic economy. To do so, the long-run relationship between some selected monetary policy variables and the exchange rate from 1978-2019 was investigated. The bank rate as a proxy for interest rate and reserve money as a proxy for money supply were utilized as regressors, while the American Dollar, Rupee exchange rate was used as the regressand since it is the major trading currency. The results of Augmented Dickey-Fuller Unit Root Test indicates that all the variables are stationary at their first difference. The cointegration procedure of the Trace and Maximal Eigenvalue proposed by Johansen's were calculated to test the presence of co-integrating vectors among the variables of interest. The Trace test statistics illustrate the existence of at least one cointegration relationship among variables in the model and it was confirmed with the Maximal Eigenvalue. The Pairwise Granger Causality Test was performed to identify the direction of the causality which indicated an unidirectional causality running from interest rate to exchange rate. The Vector Error Correction term indicated that about 5.4 % of deviations from long run equilibrium is corrected in each period. Thus, the results indicate interest rate and the exchange rate are moving towards a long run equilibrium while it is not for money supply. Overall, small open economies suffering from prolonged trade deficits would generate further macroeconomic complications in using monetary policy to keep the inflation within targeted levels due to its impact on exchnage rate.

Keywords: Exchange rate, Flexible inflation targeting, Monetary policy, Sri Lanka

Elasticities of Foreign Demand for Sri Lankan Agricultural Commodities

G.A. Ilangarathna* and N. Nayanthara

*Postgraduate Institute of Agriculture, University of Peradeniya,
Peradeniya 20400, Sri Lanka
emgaillangarathna@gmail.com

Agricultural exports account for around 21% of the total exports in Sri Lanka. The elasticities of foreign demand for exports are important to determine the effects of global market disruptions and various policy approaches such as export promotion on the export demand. However, empirical estimates of agricultural foreign demand elasticities for Sri Lankan exports are scarce in literature. The objective of this study is to estimate price and income elasticities of foreign demand by the rest of the world for Sri Lankan agricultural commodities at a disaggregated level. Demand elasticities of the main export agricultural commodities namely; tea, rubber, coconut and all the other agricultural commodities were estimated for the period from 1980 - 2018. The annual export volumes and the export values were extracted from the Annual Reports of the Central Bank of Sri Lanka for various years and the real values of world GDP data were obtained from the World Bank. The cointegration relationship was tested using the bound testing approach followed by the ARDL model and results indicated the presence of long-run relationships. The short-run and long-run export demand elasticities were estimated using the Error Correction Model. The results showed that for all the commodities, export price plays an important role in determining the export demand in the long-run. The price elasticities were negative and statistically significant which implies that the foreign demand will increase when the export price decreases and vice-versa in the long-run. GDP had a positive and statistically significant relationship with the exports of tea and other agricultural commodities in the short-run while in the long-run, for GDP, a statistically significant relationship was not observed.

Keywords: Agricultural export demand elasticities, Error correction model, Bound testing, Sri Lanka

Between Liberty and Equality: Assessing the Impact of Proliferation of 'International Schools' in Sri Lanka from a Right-to-Education Perspective

R.L. Perera

Department of Legal Studies, The Open University of Sri Lanka,
Nawala, Nugegoda 10250, Sri Lanka
rlper@ou.ac.lk

The phenomenon of 'international schools' has become a well-established fact in today's Sri Lankan educational setting. Although the general legal framework in the country prohibits the establishment of private schools, from the 1980s, permission was granted to establish 'international schools' to serve children of expats living in Sri Lanka. Today, the number of these fee-levying profit-oriented entities has expanded and locals constitute most of their studentship. The study aims to assess the implications of this phenomenon from the perspective of the right to education. The research is a qualitative study deriving primary data from international human rights instruments, General Comments of International Human Rights bodies, domestic judicial decisions, stakeholder interviews and secondary data from literature on the Sri Lankan education system. According to the interpretation of international human rights bodies, the 'liberty dimension' of the right to education recognizes the liberty of individuals to establish private schools, provided that this liberty does not lead towards extreme educational inequalities. Since international schools are not regulated by the ministry of education, there is no restriction on the maximum fee limit. These schools largely draw their students from relatively affluent classes and tend to function as a separate elite system. Thus, the study identifies that the consolidation of such a system has contributed towards exacerbating existing educational inequalities in the country. This outcome is inconsistent with the primacy international human rights law affords to equality of opportunity. However, a problem arises in incorporating this interpretation into domestic law due to the dualist nature of our legal system and the absence of a constitutional right to education. The paper suggests overcoming this obstacle by interpreting right to equality (article 12) along with the State Policy Directive of ensuring universal and equal access to education (article27(2)h) to construe equal access to education as a fundamental right.

Keywords: International schools, Right to education, International human rights law, Equality of opportunity, Educational inequalities

Impact of Public Debt on Domestic Investment in Sri Lanka

S. Shiyalini

Postgraduate Institute of Humanities and Social Sciences (PGIHS),
University of Peradeniya, Peradeniya 20400, Sri Lanka
Shiyalini06@gmail.com

Governments tend to borrow money from domestic as well as external financial sources when the government revenue from tax and non-tax sources are not sufficient to meet the required financial needs. In the Sri Lankan context, since the post liberalization period, public debt continued to rise enormously and put high pressure on the government's budget through increasing the debt service payments which in turn limits the space available for public investment and causes unfavourable effects on the economy. Thus, this study aims to examine the impact of public debt on domestic investment in Sri Lanka using annual data for the period between 1990 and 2019. The study used Augmented Dickey-Fuller and Phillips-Perron unit root tests to check the stationary properties and they confirm that all the variables are stationary at their first difference. Thus, Johansen Co-integration and Vector Error Correction Model are employed to find-out the existence of Co-integration relationship and long-run impact. The findings revealed that both domestic and external debts crowd-out domestic investment in the long-run in Sri Lanka, implying that higher government borrowings from domestic and external sources lower the volume of investment. Moreover, the impact of domestic debts on domestic investment is greater than external debts. Further, debt service payment also adversely affects the volume of domestic investment in the long-run. In contrast, real GDP growth rate affects positively on the growth of private investment in the long run, suggesting higher GDP growth rate provides further expansion in domestic investment. The results further revealed that trade openness adversely affects gross domestic investment in Sri Lanka in the long run. Hence, this study recommends that the government strives to reduce its higher debt profile by improving its revenue base and formulate better debt management strategies in order to increase the volume of investment in the country.

Keywords: Crowding-out effect, Domestic debt, External debt, Domestic investment, Sri Lanka

Chronic Kidney Disease of Unknown Etiology (CKDu): Application of the Value of Statistical Life Approach in Sri Lanka

R. Gangahagedara[1]*, S.Y. Bandara[3], V. Ratwatte[1],
M. Karunarathna[2] and W. Athukorala[2]

[1]*Postgraduate Institute of Humanities and Social Sciences*
[2]*Department of Economics and Statistics, Faculty of Arts*
University of Peradeniya, Peradeniya 20400, Sri Lanka
[3]*Lady Ridgeway Hospital for Children, Colombo 00800, Sri Lanka*
*gangahagedara.ruchira@gmail.com

In the last three decades, chronic kidney disease of unknown etiology (CKDu) has emerged as a significant contributor to the burden of health in several Asian countries including Sri Lanka. At present, the prevalence of CKDu has significantly affected rural families while creating many socio-economic problems. Some recent studies in this area show that the incidence of CKDu in Sri Lanka is doubling every four to five years. Given this background, this study is attempting to estimate the economic loss of CKDu using values of statistical life approach in Sri Lanka. The study also investigates the impacts of CKDu on the livelihood of the affected families. A survey conducted covering 348 randomly selected CKDu patients in Anuradhapura, Polonnaruwa, and Kurunagala districts in 2019, and of the 342 observations were used to estimate the value of the patients' statistical life assuming the retirement age as 60 and monthly income of the patients are expected to receive until the retirement age. The results show that the average value of statistical life is Rs. 7.5 million for the sample. The number of CKDu patients in all three districts was at 22,542 by October 2019. Accordingly, the estimated direct economic loss is Rs. 70.35 billion for those three districts which will be approximately Rs.109.22 billion for the country. The result of the study also reveals that the prevailing situation of the CKDu in these districts has seriously affected the health and wellbeing of their family members (87%), their stress levels (92%), consumption (71%) as well as the education of their children (69%). The results of this study will help policymakers to understand the severity of the issue and the need for the taking step to control CKDu cases in the country while giving priorities to overcome the issues faced by the family members of the affected people.

Keywords: Chronic kidney disease, Economic loss, Value of statistical life, Sri Lanka

Financial Contagion Effects on Stock Market: A Literature Review

I.D.W. Samarawickrama* and A. Pallegedara

*Department of Industrial Management, Faculty of A Faculty of Applied Sciences,
Wayamba University of Sri Lanka, Kuliyapitiya 60200, Sri Lanka
isuri.samarawickrama@gmail.com

The 'new global economy' has brought in vast opportunities to fuel capital requirements of economies. However, the risks brought through the global economy are equally colossal due to the interdependence and interconnectedness in the global financial system. The most distinctive recent event was the 2007-2009 US housing crisis that affected the world economy causing an international financial contagion. The aim of the paper is to address the different views on contagion effects with special reference to financial contagion effects on global stock markets. The paper reviews over 50 academic publications during 2000-2020 in identifying the evolution of financial contagion and its transmission channels. According to preceding literature, a local event changing the structural relationships within a country has the potential to threaten the global financial system through a 'Contagion' effect initiation. Due to restricted definitions, financial contagions in the classical research (in early 1990s) only considered impacts of events in the banking industry. However, modern studies have broadened the definition of a contagion effect in economic terms, and has identified socio-political, economic and financial contagion effect types. The range of events considered by the preceding studies include Mexican devaluation, East Asian crisis, Russian default, Brazilian devaluation and 2007-2009 US housing crisis. However, due to the complexity of entanglements in the global economy, authors identify the inability of defining cornerstones for pure contagions. International trade and finance is the commonly accepted transmission channel of contagion. Sri Lankan literature on contagion effects are scarce and only the 2007-2009 US housing crisis has been identified as an event of direct impact and no indirect impacts have been considered. Based on literature review, the study concludes that countries have both direct and indirect/ spillover effects from contagion effects on a global scale. Preceding authors accept that financial contagion cannot be eliminated. However, the proper identification of early warnings could mitigate the damage by reducing vulnerability to a catastrophic event through vigorous policy making.

Keywords: Contagion effect, Early warning, Financial contagion, Stock market

Efficacy of Collective Actions Approach for Sustainable Fishing in Palk Bay Region

H.N. Damayanthi

Department of Legal Studies, Department of Humanities and Social Sciences,
The Open University of Sri Lanka, Nawala 10250, Sri Lanka
hndam@ou.ac.lk

The fisheries sector plays an important role in the economic development in Sri Lanka. Illegal, unreported, and unregulated fishing in Palk-bay region has a significant impact on the fishing economy of the country. Sri Lanka and India being two States belonging to the Indian Ocean have a mutually agreed legally binding international mechanism regarding sustainable fishing industry in the region. However, due to various socio-economic factors, conflicts arose between fishermen of both countries regarding fishing activities and they led to many social, economic, and political conflicts. Age-old agreements and legislations are directly impacting the fishing rights, natural resource management, and sustainable fishing in both countries. Unstructured resource allocation has affected this in various ways and it can only be controlled by introducing collective actions taken by both countries. The key objective of this paper is to discuss the limitations of the existing legal framework and to propose an effective conflict resolution mechanism to the existing legal framework enabling to ensure sustainable fishing in the Palk-Bay region. This paper presents a study on how far fisheries agreements and regulation of both countries have effectively contributed to resolve the conflicts among fishing communities of both countries by examining the bilateral agreements reached between the two countries and the commitments of both countries for the proper implementation of those agreements. The study also investigates how far Sri Lanka has committed to cooperate with those agreements through its national legislations. This study is built on a qualitative method of research. Data collection is based on structured interviews and analysis of agreements, statutes and regulations. Findings of the study reveal that further modifications to the existing legal framework that incorporate legal provisions and mutual corporation of both countries would remedy the situation. The study proposes effective modifications to the current legislative framework to ensure sustainable finishing in Sri Lanka.

Keywords: Sustainable fishing, Legal framework, Economic impact, Effective mechanism

A Sociological Study on Trusting Trustworthiness and Behavioural Modification among Young Adults in Sri Lanka

S. Udayanga

Department of Sociology, Faculty of Humanities and Social Sciences,
University of Ruhuna, Matara 81000, Sri Lanka
senithsrisami@gmail.com

Sociologists have miscellaneously characterized the third millennium as the creative age, the digital age, and the age of surveillance capitalism, therein a remarkable behavioural modification among young adults is witnessed. Conscious interventions to behavioural modification are socially justifiable as it aligns with basic human rights. However, arbitrary and unconscious behavioural modification has become one of the prevailing social issues, that is socially unjustifiable. This study thus explored how the behaviour of young adults has been modified with the influence of surveillance capitalism – a mechanism that exploits the most personal behavioural and emotional data to increase profits in the modern-day borderless online society. This study employed a narrative method informed by the subjectivist epistemology, and data were collected through focus group discussions and interviews. Data were analysed thematically, and analysis indicates that the default attitude of 'not trusting others at first' among young adults has been changed and now they are highly likely to trust others/things even without knowing the back-end logic. Because of the belief that the technology supports people for a good move, initially when young adults construct relationships with another party, 'trusting the trustworthiness' has become a generic principle of conduct. Users are provided with free social media services (with targeted adverts), and hence cognitive orientation or the worldview of young adults can be modified due to targeted advertising and so-called personalization of internet platforms such as Facebook, Google Search and other related services, even without their consent. This can decline the quality of relationships while distorting the self-image and their disposition in the place of living. In a time of such constant surveillance (which has unknowingly been allowed by young adults), society/state that facilitates freedom of people is untenable, because the behaviour of people in society has been modified not based on their free will, but because of the indirect-yet-influential instructions given by an unknown person/institution or an invisible/alien mechanical logic.

Keywords: Behavioural data, Behavioural modification, Social media, Surveillance, Trust

An Analysis of Exclusive Maritime Agreement 2020 as a Continuation and Transformation of Foreign Relations between Greece and Egypt

C.T.S.S. Perera

Department of Western Classical Culture and Christian Culture, Faculty of Humanities, University of Kelaniya, Kelaniya 11600, Sri Lanka
sathsi.perera@gmail.com

Over the centuries, world's leading countries have put forth measures to sign agreements under terms favourable to each party. These agreements empower the continuation and transformation of diplomatic relations between the countries. One of the highly discussed recent contracts is the maritime agreement between Greece and Egypt on the delimitation of the exclusive economic zone in the East Mediterranean Sea. Greece and Egypt signed this agreement on the 7th of August 2020 in Cairo which sets the sea boundaries between the two countries. The agreement specifically demarcates an exclusive drilling right for gas and oil, two major energy resources in the East Mediterranean Sea. This recent agreement is reminiscent of the contacts that prevailed between Greece and Egypt. The aim of the research is to examine the present agreement as a continuation and transformation of constant foreign relations between Greece and Egypt. The relations between the two ancient countries run far back to the times of the Second Millennium BCE. Both literary and archaeological evidence from the past illustrates mutually beneficial contacts between the two countries. The establishment of Naukratis, the initial Greek trading port in Egypt, Canopus and Heracleion that also functioned as port cities supporting the trade contacts between the two countries, and Egypt sending grain supplies to support Greece during a famine can be regarded as major instances that support the continuation as well as the transformation of relations between the governments. Few archaeological evidence and several literary evidences support how these ancient countries maintained long-term agreements in foreign relations and contacts over centuries. Accordingly, the present maritime agreement can be recognized as a continuation of long-term socio-economic contacts between Greece and Egypt. The research will follow an analysis on the Agreement comparing it to the pre-Alexandrian trade and social contacts that existed between the two ancient countries in the Western world.

Keywords: Greece, Egypt, Contacts, Continuation, Transformation

Impact of Political Stability and Absence of Violence/Terrorism on Tourism: Empirical Evidence from Sri Lanka

R.M.M. Mayoshi[1]* and J.G. Sri Ranjith[2]

[1]Faculty of Economics Sciences and Business Administration, Transilvania University of Brasov Universitatii Street, No. 1, Building A, 500068 Brasov, Romania
[2]Department of Economics and Statistics, Faculty of Arts, University of Peradeniya, Peradeniya 20400, Sri Lanka
*malshamayoshi@gmail.com

The tourism industry in Sri Lanka has experienced dynamic growth over the past decades. It is considered as one of the largest foreign exchange earning sectors in Sri Lanka. Travelers' decisions to visit a foreign destination depend on many factors. The political stability and absence of violence/terrorism or general internal security condition of the country is one significant factor. The objective of this paper is to examine the long-run and short-run impacts of political stability and absence of violence/ terrorism on tourism in Sri Lanka during the period from 1996 to 2019, adjusting to data available from the World Governance Indicator. The ARDL Bounds test procedure and Granger causality test were adopted to achieve this objective. Throughout this study, international tourism receipts in current US$ are considered as an appropriate proxy variable for tourism. Political stability and absence of violence/terrorism in percentile rank is the main independent variable. Economic growth acts as the control variable for investigating the relationship. The results indicate that political stability, absence of violence/terrorism and economic growth has a strong positive impact on the development of the tourism industry both in the long- and short-run. The findings suggest that the maintaining of political stability and absence of violence/terrorism and economic growth provide the necessary background to develop the tourism industry in Sri Lanka. The result of the Granger causality test also indicate that Sri Lanka has a bidirectional causal relationship between political stability and absence of violence/terrorism and tourism. Therefore, in order to maintain continuous growth in the tourism industry it is necessary to introduce a comprehensive policy framework and to maintain political stability and the absence of violence/ terrorism in the country.

Keywords: Political stability and absence of violence/terrorism, Tourism, Growth

Entrepreneur's Success in Small and Medium Scale Homestay Tourism Business in Southern Coastal Area

S.S.W. Jayasooriya[1]* and U.M. Devadas[2]

[1] 33/7, Galmaduwa Watta, Green Garden Avenue, Kundasale 20168, Sri Lanka
[2]Department of Human Resource Management, Faculty of Commerce and Management Studies, University of Kelaniya, Kelaniya 11600, Sri Lanka
*sachimck2@gmail.com

The impressive growth of the tourism industry has resulted in a lot of business opportunities in developing countries as a homestay tourism business. In the literature, the importance given to homestay tourism is skeletal within the study context of Sri Lanka. Therefore, the researchers intended to explore the nature of homestay entrepreneur as valued by homestay entrepreneurs, factors affecting the entrepreneur's success in the homestay tourism business, and the current challenges of entrepreneurs in the continuation of homestay tourism business in the southern coastal area. This study followed constructivism paradigm, designing the study qualitatively by employing Straussian grounded theory method. A sample was selected using theoretical sampling method to include successful homestay entrepreneurs in the Southern coastal area. The researchers defined homestay entrepreneurs after identifying their nature and a set of personal and impersonal factors that have contributed to determine homestay entrepreneurs' success. The researchers further identified a set of challenges in the areas of government involvement, financial challenges, human resource development, destination development, and competition. The researchers concluded the study by developing a conceptual framework that explains the phenomenon of homestay tourism entrepreneurs' success that can be used for educational and policy-making purposes. The researchers identified the extending facilitation for the development of homestay entrepreneurs and their education while recommending a comprehensive mechanism for the development and empowerment of homestay entrepreneurs, homestay business process and its context, and needed collaborations.

Keywords: Entrepreneur, Homestay tourism, Rural community, Stakeholders, Tourism destination

Could Female Representation in Decision Making be Key to Breaking Hiring Biases?

M.N. Weeraddana

Department of Economics and Statistics, Faculty of Arts, University of Peradeniya, Peradeniya 20400, Sri Lanka
manishaweeraddana@gmail.com

Globally, hiring biases, which affect women's opportunities for career progression, leading to disproportionate unemployment, have been discussed while analysing various aspects of it. However, the existence of these biases in organisations with females present in decision making, especially within the Sri Lankan context, has not been discussed. Therefore, the study adopted a qualitative approach to looking into how female decision-makers act in largely patriarchal workplaces, as it is mostly the case when making hiring decisions. This research aimed to find whether females when on interviewing boards, had a positive impact on recruiting more women to the labour force. For the study, twenty in-depth interviews were carried out with fifteen female participants and five male participants representing recruitment decision-makers in the private sector. They were encouraged to speak about the recruitment process, the differences, as they saw, between female and male workers and recruitment officers, their opinion on the low level of female workforce participation and maternity leave. The interviews were transcribed and studied for recurring themes using thematic analysis within a conceptual framework, combining Economics of Identity and the Social Identity theory. Major findings include the possibility of women in decision making leaving behind a "female trend" regardless of showing no apparent favouritism towards females as opposed to a school-boy-tie bias from male hiring agents and flexible maintenance of stereotypes within females which appears to have made them more progressive than male hiring agents, especially regarding maternity leave. Further analysis of each theme suggests changes at grass root level where the female potential is given equal importance, especially among school children and the importance of paternal leave alongside a good childcare system as a step in recognizing childcare as a parental duty rather than a maternal burden, in tackling hiring biases.

Keywords: Decision-making-females, Sri Lanka, Gender, Hiring, Discriminations

Reasons for Creating Non-Performing Loans (NPLs) in ABC Company – A Case Study

D.G. Gunasekara[1]* and Y.K. Weerakoon Banda[2]

Department of Finance, Faculty of Management Studies and Commerce, University of Sri Jayewardenepura, Gangodavila, Nugegoda 10250, Sri Lanka
*gayashani.ud@gmail.com

Non-Performing loan is a sum of borrowed money upon which the debtor has not made scheduled payments for a specific period of time. Financial institutions consider loans as an asset, while interest generated from loans is considered as revenue. If a loan becomes default, it will fail to generate revenue to a financial institution. The major objective of the case study was to examine the reasons for creating NPLs in ABC company. Minor objectives investigated how NPLs impact on financial performance and what mechanisms could be taken in order to reduce the amount of NPLs of the ABC company. Based on structured interviews with the legal manager, the major reasons to create NPLs were identified. Secondary data were collected from annual reports of ABC company for 30 quarters and analyzed the data using simple regression and correlation. The study has identified most prominent reasons for creating NPLs were due to management practices of the company. The company granted unsecured loans without evaluating the credit worthiness of their customers. Also loans were provided for the uneducated people who were unaware of the interest component. Moreover, loans were provided to people who do not have proper income. Furthermore, based on government promises, loans were granted to start up new businesses. Macroeconomic factors like unemployment and inflation also impacted on the creation of NPLs. Since the *P value* of Regression analysis was 0.053, the NPL ratio has an impact on Return on Assets (ROA). The correlation coefficient was -36.90%, which indicated there was a negative relationship between NPL ratio and ROA. It revealed that NPLs had a negative impact on financial performance. To minimize NPLs the company could adapt risk based strategy, tightening, loan portfolio supervision, hiring qualified debt collectors and evaluating the credit worthiness of customers using the 7 C's Concept. Also loan officers should adapt proper communication mechanisms to communicate with borrowers.

Keywords: NPLs, ROA, Financial performance, 7 C's concept

Pre-Conference Webinar Series

WEBINAR 1

February 24, 2021 | 1000 Hrs (IST)

Transforming Education or Educating Transformation?

Speakers:

Professor Arjuna Parakrama (*Senior Professor of English, University of Peradeniya, Sri Lanka*)

Dr. S.V. Kasynathan (*Former Senior Lecturer, Department of Philosophy and Psychology, University of Peradeniya, Sri Lanka. Currently living in Australia*)

Moderator:

Professor Nelum Udagama (*Professor of Law, University of Peradeniya, Sri Lanka*)

Scope:

The panel will initially focus on interrogating the current buzzword "transformation" to unpack its assumptions and expectations, addressing core questions such as for whom, where, and why such transformation is seen as desirable. There are clear potential dangers from valorising "transformation", especially it if is uncritically tied to market forces or dominant paradigms, and such dangers should be carefully understood. This, broadly speaking, is what we mean by "educating" transformation. We will, therefore, seek to identify who determines the kind of transformation privileged, and whom this transformation includes and excludes, as well as how marginalization will take place as a direct result of its implementation. Moving on from this "deconstruction" of the key terms in the assigned main topic area, we will focus the key component of our presentations on what we consider to be the role and function of education, including in its most important role of nurturing the quality of making "judgments" relating to human affairs and how this may be developed in students and teachers. We believe that the ensuing discussion, including the question and answer session would be the most important component of the panel's outcome.

WEBINAR 2

March 29, 2021 | 1330 Hrs (IST)

A Global University and Engineering Education in 21st Century

Speakers:

Professor (Em.) Torsten H. Fransson (*Prof. Em. [Heat and Power Technology], Royal Institute of Technology [KTH], Sweden*)

A Global University-common Educational Approach for Engineering Education in the 21st Century

University level education is going through a major transformation in various ways. In engineering the transformation is driven by the approach "to the market", directed towards "usefulness for industry" and the "just in time" knowledge and skills, entrepreneurship and various "selling/influencer skills" (under various names like "soft" or "21st century" skills etc) while still trying to keep the academic values which universities are known for. A few years ago it was, although many possibilities existed, almost unheard of "remote education" in the sense of "remote lectures" or "remote laboratories" etc. The Covid-19 pandemic has however given a new perspective on this. The presentation will center around a (controversial?) discussion about how a global educational collaboration can be developed such that "lower ranked" universities might use high-quality educational material from colleagues in other countries to create own courses and programs without having specialists in all areas.

Senior Professor S.B.S. Abayakoon (*Senior Professor of Civil Engineering, Department of Civil Engineering, Faculty of Engineering, University of Peradeniya, Sri Lanka*)

Engineering Education – Sri Lankan Context

Over the last five decades, significant changes have been introduced in the process of producing engineering practitioners at higher educational institutes worldwide. However, as engineering can be and need to be practiced at different levels, all of which are important for the industry, the separation of roles, responsibilities and competencies is a need that has to be addressed, in parallel with curriculum reforms. While this had been a point of discussion in many countries of the world where important strides have been made in the past decade or so, Sri Lanka is yet to develop a nationally accepted system for the same. This presentation is an attempt to describe the current scenarios in this area within Sri Lanka.

Moderator:

Professor J.B. Ekanayake (*Department of Electrical & Electronic Engineering, Faculty of Engineering, University of Peradeniya, Sri Lanka*)

WEBINAR 3

April 6, 2021 | 0900 Hrs (IST)

The Prospects for the Sri Lankan Capital Markets and the Economy in the Aftermath of the Covid-19 Pandemic

Speakers:

Senior Professor D.B.P.H. Dissabandara *(Department of Finance, Faculty of Management Studies and Commerce, University of Sri Jayewardenepura, Sri Lanka*)

Recent Trends and the Status of the Sri Lankan Capital Markets

There is a considerably long history of capital markets in Sri Lanka with the modern stock market dating back 36 years. The regulatory, institutional, trading, clearing and settlement infrastructures are fairly well-established. Although many components of the capital markets are in place, Sri Lanka needs to undertake substantial and challenging structural and policy reforms in order to establish a well-functioning financial system with more broad-based, efficient and stable capital markets and to fully leverage its potential to achieve long-term economic goals. This presentation will provide an overview of the current status and trends of the Sri Lankan capital markets. Further, it will also discuss some of the key contemporary issues and discuss a few important strategies and solutions.

Professor Lalith P. Samarakoon (*Professor of Finance & Former Secretary General and Chief Economist of the National Economic Council of Sri Lanka, Department of Finance Opus College of Business, University of St. Thomas, St. Paul, Minnesota, United States*)

Prospects for the Global economy and Sri Lanka after the Covid-19 Global Recession

The world experienced unprecedented declines in economic activity in due to the Covid-19 pandemic beginning from the first quarter of 2020. This has forced the governments to take extraordinary policy measures to mitigate the economic and financial impact of the crisis. This presentation will focus on the broader fiscal and monetary policy actions implemented and their implications for key macroeconomic conditions such as growth, inflation, interest rates and asset prices. It will also discuss the broader outlook for the Sri Lankan economy in the context of the global dynamics and the particular economic and financial conditions and risks facing Sri Lanka.

Moderator:

Professor Athula Ekanayake (*Professor in Accounting, Dean/ Faculty of Management, University of Peradeniya, Sri Lanka*)

WEBINAR 4

April 28, 2021 | 1030 Hrs (IST)

COVID-19: The Global Pandemic

Speakers:

Professor Sriyal Malik Peiris (*MBBS, FRCPath, D Phil [Oxon], FHKAM [Path], FRCP, FRS*) (*Chair of Virology, School of Public Health, University of Hong-Kong*)

COVID-19: Where Did It Come from and Where Is It Going?

The COVID-19 pandemic is considered the greatest public health challenge of the past one hundred years. Still, there are many controversies regarding the origin, pathogenesis, transmission and treatment of this novel coronavirus infection. An understanding of the origin of the infection is critical in preventing such pandemic in the future. Understanding transmission evidence-based public health interventions. Being RNA viruses that undergo high rates of mutation, SARS-CoV-2 now manifests the emergence of mutants with increased transmissibility and some with the capacity to evade immunity from the previous infection and perhaps some vaccines. This webinar session will present and discuss our present understanding of the COVID-19 pandemic as it progresses from its origins to the present day.

Professor Neelika Malavige (*MBBS [Col.], MRCP [UK], AFHEA, DPhil [Oxon], FRCP [Lond], FRCPath [UK]*) (*Professor and Head Department of Immunology and Molecular Medicine, Faculty of Medical Sciences, University of Sri Jayewardenepura, Sri Lanka*)

Vaccines - The Magic Bullets to End the Pandemic

Vaccines are considered the most effective strategy to control the COVID-19 pandemic. Multiple pharmaceutical industries initiated and manufacture millions of vaccines against COVID-19. The COVID-19 vaccine is one of the vaccines approved for human use within a very short period of time. Hence, many unanswered questions are ahead of us while taking the vaccine. Can vaccine eliminate or successfully control the pandemic despite frequent mutations of the virus? What is the current evidence to prove the effectiveness of the vaccines and their safety? This webinar session will address the science underneath the vaccines against the COVID-19 based on published research evidence.

Moderator:

Professor S.A.M. Kularatne (*MBBS, MD, MRCP [UK], FRCP [Lon.], FCCP*) (*Senior Professor and Professor of Medicine, Department of Medicine, Faculty of Medicine, University of Peradeniya, Sri Lanka*)

WEBINAR 5

June 18, 2021 | 1500 Hrs (IST)

One Health and Nature-Based Solutions

Speakers:

Dr. Ananda Mallawatantri (*Country Representative, IUCN Sri Lanka*)

Mainstreaming Nature-Based Solutions for Sustainable development and Resilience

Nature based solutions (NbS) can be defined as "actions to protect, sustainably manage and restore natural or modified ecosystems to address societal challenges effectively and adaptively also providing human-well-being and biodiversity benefits." During this session a set of selected examples from current global thinking on NbS and traditional local approaches useful for sustainability and resilience in the Sri Lankan context would be discussed.

Professor Suzanne Lenhart (*Chancellor's professor, Department of Mathematics, University of Tennesse, USA*)

One Health: Connecting Humans, Animals and the Environment

'One Health' is a multidisciplinary approach to improving the health of people, animals and the environment. Environmental, wildlife, domestic animal, and human health fall under the One Health concept. Mathematical models of infectious diseases involving animals, environmental features, and humans will be presented. These models can suggest management policies and predict disease spread. Examples including La Crosse virus and Zika virus will be discussed.

Moderator:

Professor Rupika Rajakaruna (*Professor of Applied Zoology, Department of Zoology, Faculty of Science, University of Peradeniya, Sri Lanka*)

WEBINAR 6

June 29, 2021 | 1700 Hrs (IST)

Precision Agriculture: Global Status and Prospects for Developing Countries

Speakers:

Professor John P. Fulton (*Department of Food, Agricultural and Biological Engineering, The Ohio State University, USA*)

Precision Agriculture: Concept, Technologies and Global Status

Nature based solutions (NbS) can be defined as "actions to protect, sustainably manage and restore natural or modified ecosystems to address societal challenges effectively and adaptively also providing human-well-being and biodiversity benefits." During this session a set of selected examples from current global thinking on NbS and traditional local approaches useful for sustainability and resilience in the Sri Lankan context would be discussed.

Professor W.A. Udaya Vitharana (*Department of Soil Science, University of Peradeniya, Sri Lanka*)

Potential Precision Agriculture Technologies for Sri Lanka

Precision agriculture is a modern technology-driven input management approach that relies on the collection, processing and analysis of temporal and spatial data. However, the adoption and popularity of precision agricultural practices are determined by context-specific factors such as the degree of soil/crop spatial variability, farm size and readiness to embrace technology. Prof. Vitharana expects to discuss potential precision agriculture technologies in the context of Sri Lanka and in similar settings.

Moderator:

Professor Buddhi Marambe (*Department of Crop Science, Faculty of Agriculture, University of Peradeniya, Sri Lanka*)

WEBINAR 7

July 26, 2021 | 1700 Hrs (IST)

Emerging Transboundary Animal and Zoonotic Viral Diseases: Impact on Animal and Public Health

Speakers:

Dr. Aruna Ambagala (*Head-Mammalian Diseases Unit, National Centre for Foreign Animal Disease,OIE Reference Laboratory for Classical Swine Fever, Canadian Food Inspection Agency, Winnipeg, Manitoba, Canada*)

Transboundary Animal and Zoonotic Viral Diseases

Emerging transboundary animal diseases present a growing threat to animal and human health and jeopardize the food security. In most of the world, increased demand for animal protein has resulted in the emergence of increasingly complex livestock systems in which the selection of animals is primarily based on production traits rather than disease resistance. The accompanying increase in enhanced biosecurity measures on farms has also increased vulnerability of livestock to disease threats, as the animals in these farms are immunologically naïve and thus at increased risk from pathogen incursions. With the growing demands for intensified farming practices, and increased transportation of livestock for trade purposes, the likelihood of these diseases spreading globally increases reaching epidemic proportions. Approximately 75% of recently emerging animal diseases can be naturally transmitted from animals to humans (zoonotic), and around 60% of all human pathogens are of animal origin. In this session, a selected number of high consequence transboundary animal and zoonotic viral diseases will be discussed.

Dr. Hemali Kothalawala (*Director General, Dept. of Animal Production and Health, Gatambe, Peradeniya, Sri Lanka*)

Socio Economic Impact of Transboundary Animal Diseases

Trans-boundary Animal Diseases (TADs) pose a serious risk to animal production and threaten international trade. Apart from the significant impact to the food security due to production losses, cost on control or eradication programs and trade restrictions are major impacts of these diseases. Also, possibly public health consequences. Sri Lanka has been facing devastating economic losses from outbreaks of trans-boundary viral disease viz. Foot and Mouth Disease (FMD) for years. These diseases impose major economic costs and risks to the country, the neighbours, and trading partners direct and indirect ways. The webinar session will discuss both the direct and indirect impacts of these diseases cause devastating economic losses globally.

Moderator:

Dr. A.W. Kalupahana (*Department of Veterinary Pathobiology, Faculty of Veterinary Medicine and Animal Science, University of Peradeniya, Sri Lanka*)

WEBINAR 8

August 4, 2021 | 1830 Hrs (IST)

COVID-19 - Vaccines and Oral Health

Speakers:

Professor Lakshman Samaranayake (*Professor Emeritus (Microbiomics), and Immediate Past Dean of Dentistry, University of Hong Kong, China and Past Dean of Dentistry, University of Queensland, Australia*)

COVID-19 Vaccines: Vagaries and Vacillations

The pandemic of COVID-19 has been curbed in many countries due to the arrival of a number of efficacious vaccines. Yet, there are many unknowns in the evolving COVID-19 vaccine story, although we now see the emerging true situation in a better light, with reports of their efficacy ranging from 55% to 95 % depending on the vaccine strain. However, this situation is compounded by the reported vagaries of the increasing number of brand-name vaccines, manufactured on both the new and old vaccine platforms. These include their adverse effects, the emergence of possible vaccine-resistant viral variants (e.g. the current delta and lambda strains of SRAS-CoV-2), the efficacy of mixed mode vaccinations, necessity of booster doses and their immunological correlates, as well as reasons for vaccine resistance by a small proportion of the populace. This presentation will provide the details of the foregoing, as well as an outline of the basic mechanisms of vaccines, with a particular emphasis on those available in Sri Lanka.

Professor Ruwan D. Jayasinghe (*Chair Professor in Oral Medicine and Periodontology and Specialist, Department of Oral Medicine and Periodontology, Faculty of Dental Sciences, University of Peradeniya*)

Impact of COVID-19 Pandemic on Dentistry

Coronavirus disease 2019 (CoVID-19) was first reported in Wuhan, China, in December 2019. The disease is caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) and primarily spreads via droplets produced by coughing, sneezing, and talking. When such droplets are large and heavy, they usually fall to the ground or onto surfaces, however the smaller particles, aerosols, are entrained in the air for prolonged periods if the ambient circulation is poor. Most of the dental procedures are aerosol generating and carries a high risk of virus transmission. Therefore, most of the health authorities in the world including Sri Lankan Ministry of Health limit the dental services only to emergency and non-aerosol generating procedures during the peak of pandemic. The emergence of this Covid-19 pandemic has serious impact on the practice of clinical dentistry as well as other branches of dentistry, dental public health, and dental education. In this presentation, impact of CoVID 19 on dentistry including clinical dentistry, dental public health, and dental education, learned lessons, challenges and future directions will be discussed.

Moderator:

Professor J.A.M.S. Jayatilake (*Head, Department of Oral Medicine & Periodontology, Faculty of Dental Sciences, University of Peradeniya, Sri Lanka*)

WEBINAR 9

August 10, 2021 | 0830 Hrs (IST)

Medications without Harm - The Role of Healthcare Workforce

Speakers:

Professor Andrew McLachlan (*Head and Dean of Sydney Pharmacy School, The University of Sydney, Australia*)

Investigating Drug-Herb Interactions

WHO Global Patient Safety Challenge, Medication without Harm highlights the challenge of inappropriate polypharmacy and high risk medicines. Complementary medicines, including herbal products, are widely used in the community and have the potential to interact with medicines a person is taking. Taking a comprehensive medication history and understanding the possible mechanism of herb-drug interactions is essential to guide the safe and appropriate use of complementary medicines in patient care.

Professor Professor Patricia M. Davidson (*Vice-Chancellor, Wollongong University, Australia*)

The Healthcare Workforce Integral to Achieving the WHO Global Patient Challenge (Medication without Harm) and Sustainable Development Goals

Health workers play a crucial role in achieving the health targets in Sustainable Development Goal. An adequate, well-distributed, motivated, and facilitated healthcare workforce is essential for strengthening primary healthcare and efficient universal health coverage that targets detecting and preventing diseases, managing health emergencies, and promoting health and well-being throughout the lifespan. This presentation will discuss key strategies in medication management within a framework of global health.

Dr. A.C.M. Fahim (*Department of Pharmacy, Faculty of Allied Health Sciences, University of Peradeniya*)

Maximizing Optimal Use of Medicines by Implementing Clinical Pharmacy Services: Evidence from Sri Lanka

Clinical pharmacists are a key member of the multidisciplinary team and play a pivotal role in medicines optimization to achieve the third WHO Global Patient Safety Challenge aims to reduce avoidable medication-related harm by 50% by 2023. Although clinical pharmacy services are not part of the Sri Lankan public hospital system studies over the last 10 years in Sri Lanka have demonstrated the impact of clinical pharmacists in medicines optimization and better patient outcomes, reduced drug related problems including hospital re-admission and resulted in reductions in health expenditure.

Moderator:

Dr. M.H.F. Sakeena (*Department of Pharmacy, Faculty of Allied Health Sciences, University of Peradeniya*)

ORGANIZING COMMITTEE – iPURSE 2021

Prof. O.G. Dayaratne Banda (Conference Chairperson)

Prof. Tilak Hewawasam (Co-coordinator)

Prof. Wasantha Athukorala (Co-coordinator)

Dr. Nandaka Maduranga Kalugampitiya (Editor-in-Chief)

Dr. Fazeeha Azmi (Chairperson / Technical Programme Committee)

Prof. T.T.M.S.S.K. Yatigammana Ekanayake (ICT Coordinator / Technical Programme Committee)

Dr. Sudesh Mantillake (Chairperson / Web, Media and Publicity Committee)

Dr. Kumuduni Kumarihamy (Chairperson / Registration Committee)

Dr. Manoj Alawathukotuwa (Chairperson / Ceremonial Committee)

Mrs. P.K. Herath (Chairperson / Logistics Committee)

Mr. M.D.S.M. Rodrigo (Chairperson / Funding Committee)

Mr. W.V.L. Kumara (Chairperson / Food and Refreshments Committee)

CONFERENCE SECRETARIAT – iPURSE 2021

Ms. Udani Amanda Wijerathne – Secretary / iPURSE 2021

Ms. Sewwandi Samadara Hewawasam

Editorial Subcommittee – Faculty of Arts

Dr. Samanmala Dorabawila (Chair)

Ms. H.M. Lecamwasam

Dr. Mahlon Rambukkange

Dr. Kalana Senaratne

[Department Representatives – to facilitate Review process]

Dr. M.Z.M. Nafeel (Dept. of Arabic and Islamic Civilization)

Prof. M.W.C.N.K. Rambukwella (Dept. of Archaeology)

Ven. Dr. J. Dhammaloka (Dept. of Classical Languages)

Ms. M. Dharmasiri (Dept. of Classical Languages)

Prof. W.M.W.G.C.S.M. Wickramasinghe (Dept. of Classical Languages)

Dr. W.M.S.K. Wijesundara (Dept. of Classical Languages)

Dr. A.D.H.K. Kankanamge (Dept. of Economics and Statistics)

Dr. K.M.R. Karunarathne (Dept. of Economics and Statistics)

Prof. T.M.S.S.K. Yatigammana Ekanayake (Dept. of Education)

Dr. P.R.K.A. Vitharana (Dept. of Education)

Dr. K.N. Dharmasiri (Dept. of English)

Ms. A.J.M.N.M. Jayaweera (Dept. of English)

Ms. J.A.K.M. Jayasinghe (Dept. of English Language Teaching)

Ms. K.M.I.W.S.C.H. Kulatunga (Dept. of English Language Teaching)

Mr. W.S.A. Wanniarachchi (Dept. of English Language Teaching)

Mr. S.L.P. Fonseka (Dept. of Fine Arts)

Dr. M.A.S.B. Mantillake (Dept. of Fine Arts)

Ms. S.M.D.N.K. Seneviratne (Dept. of Fine Arts)

Dr. D.M.L. Dissanayake (Department of Geography)

Dr. C.S. Hettiarachchi (Dept. of Geography)

Prof. K.M.R. Dasanayake (Dept. of History)

Ms. B.H.M.R.V. Katugaha (Dept. of Law)

Ms. J.M.P.D. Jayasundara (Dept. of Law)

Dr. H.M.M. Herath (Dept. of Pali and Buddhist Studies)

Dr. M.D.S. Pushpakumara (Dept. of Philosophy)

Dr. R. Ramesh (Dept. of Political Science)

Dr. B.D.A.D.N. Bulathwatta (Dept. of Psychology)

Dr. G.R.K. Dissanayake (Dept. of Psychology)

Dr. R. Usoof (Dept. of Psychology)

Ms. H.M.D.K. Ariyawansa (Dept. of Sinhala)

Mr. K.M.B.N. Konara (Dept. of Sinhala)

Prof. W.A. Liyanage (Dept. of Sinhala)

Ms. M.R.F. Rizmina (Dept. of Sociology)

Dr. P.K. Seelagama (Dept. of Sociology)

Dr. S. Sutharsan (Dept. of Tamil)

[Editorial Assistance]

Ms. O.P. Shani Anuradha

Ms. Pavithra Ekanayake

Ms. J.A.K. Kaushalya M. Jayasinghe

Ms. K.M.I.W. Supoorna C.H. Kulatunga

Prof. Arjuna Parakrama

Mr. W. Sahan Anushka Wanniarachchi

Editorial Subcommittee – Faculty of Dental Sciences

Prof. P.R. Jayasooriya (Chair)

Prof. A.K.S. Arambawatte

Prof. H.R.D. Peiris

Prof. N.S. Soysa

Editorial Subcommittee – Faculty of Engineering

Dr. P.J. Binduhewa (Chair)

Dr. S.K. Navaratnarajah

Dr. L.N. Wickramarathna

[Editorial Assistance]

Ms. Sudakshi De Zoysa

Ms. Nuwanka Eramudugolla

Ms. Uma Karunaratne

Ms. Zafra Razik

Ms. Prabodini Samarakoon

Ms. Shohana Siddique

Ms. Asanthika Upananda

Ms. Ramyadarshanie Vithanage

Ms. Chamika Weerasinghe

Ms. Anushka Wijerathna

Editorial Subcommittee – Faculty of Veterinary Medicine and Animal Science

Dr. A. Arulkanthan (Chair)

Dr. D.R.A. Dissanayake

Dr. N.U.A. Jayasena

Dr. R.A.C. Rabel

Editorial Subcommittee – Faculty of Veterinary Medicine and Animal Science

Dr. A. Arulkanthan (Chair)

Dr. D.R.A. Dissanayake

Dr. N.U.A. Jayasena

Dr. R.A.C. Rabel

COMMITTEES AND SUBCOMMITTEES – iPURSE 2021

TECHNICAL PROGRAMME COMMITTEE – iPURSE 2021

Dr. Fazeeha Azmi (Faculty of Arts) [Chair]

Prof. T.T.M.S.S.K. Yatigammana Ekanayake (Faculty of Arts) (ICT Coordinator)

Dr. Namal Karunaratne – Faculty of Engineering; Director, Network & Communication Services Unit, University of Peradeniya (ICT Consultant)

Dr. Janaka Wijayakulasooriya – Faculty of Engineering; Director, Information Technology Centre, University of Peradeniya (ICT Consultant)

Mr. Prabhath Gunathilake – Faculty of Science; Administrator, Peradeniya Conference Management System (ICT Consultant)

Mr. Dinesh Weerasekara – Webmaster, University of Peradeniya (ICT Consultant)

Mr. Manjula Gunarathne – Electronic Engineer, Information Technology Centre, University of Peradeniya (ICT Consultant)

Prof. H.L.J. Weerahewa (Faculty of Agriculture)

Dr. M.L.C. Menikarachchi (Faculty of Allied Health Sciences)

Prof. G.J. Panagoda (Faculty of Dental Sciences)

Dr. Tharindu Weerakoon (Faculty of Engineering)

Mr. A.M.A.S.M. Bandara (Faculty of Management)

Prof. Kalana Maduwage (Faculty of Medicine)

Prof. W.A.I.P. Karunaratne (Faculty of Science)

Dr. L.G.S. Lokugalappatti (Faculty of Veterinary Medicine and Animal Science)

FACULTY-LEVEL TECHNICAL PROGRAMME SUBCOMMITTEES – iPURSE 2021

Technical Programme Subcommittee – Faculty of Agriculture

Prof. H.L.J. Weerahewa (Chair)

Prof. P.C.G. Bandaranayake

Dr. S.D.S. Hemachandra

Prof. J.K. Vidanarachchi

Technical Programme Subcommittee – Faculty of Allied Health Sciences

Dr. M.L.C. Menikarachchi (Chair)

Dr. B.S. Weerakoon

Technical Programme Subcommittee – Faculty of Arts

Dr. Fazeeha Azmi (Chair)

Prof. T.T.M.S.S.K. Yatigammana Ekanayake (ICT Coordinator)

Mr. Amitha Bandara Andagala

Dr. Muditha Karunaratne

Ms. Uthpala Mudalige

Dr. R. Ramesh

Dr. Shymantha Subhasinghe

Mr. Naveen Thattil

Dr. Kumari Thoradeniya

Dr. T. Vinayagathasan

Technical Programme Subcommittee – Faculty of Dental Sciences

Prof. G.J. Panagoda (Chair)

Dr. H.M.S.C. Dissanayake

Dr. D. Leuke Bandara

Dr. C. Weerasekera

Technical Programme Subcommittee – Faculty of Engineering

Dr. Tharindu Weerakoon (Chair)

Dr. Subodha Dharmapriya

Dr. Supun Jayasinghe

Dr. I.W. Kularatne

Dr. M.A.S. Preethika

Technical Programme Subcommittee – Faculty of Management

Mr. A.M.A.S.M. Bandara (Chair)

Dr. M.G.P.D. Menike

Ms. M.N.F. Nuskiya

Ms. P.L.W. Priyadarshani

Ms. K.D.M.K. Weerathunge

Technical Programme Subcommittee – Faculty of Medicine

Prof. Kalana Maduwage (Chair)

Dr. Dinesha Ambagaspitiya

Dr. D.N. Athapattu

Dr. W.I.T. Fernando

Dr. Samidi Navarathne

Technical Programme Subcommittee – Faculty of Science

Prof. W.A.I.P. Karunaratne (Chair)

Dr. A.M.C.U.M. Athapattu

Dr. P. K. Perera

Dr. T.P. Ranawaka

Dr. A. Welegedara

Technical Programme Subcommittee – Faculty of Veterinary Medicine and Animal Science

Dr. L.G.S. Lokugalappatti (Chair)

Dr. B.R. Fernando

Dr. H.R.N. Jinadasa

Dr. G.D.R.K. Perera

WEB, MEDIA AND PUBLICITY COMMITTEE – iPURSE 2021

Dr. Sudesh Mantillake (Faculty of Arts) [Chair]

Prof. Rohana Seneviratne (Faculty of Arts) (Conference Webmaster)

Mr. Dinesh Weerasekara (Webmaster, University of Peradeniya)

Dr. J.M.P.N. Anuradha (Faculty of Agriculture)

Mr. Palitha Handunge (Faculty of Agriculture)

Mr. Danushka Kumarathunga (Faculty of Agriculture)

Ms. Sewwandi Daladawattha (Faculty of Arts)

Mr. Priyantha Fonseka (Faculty of Arts)

Mr. Chamila Priyanka (Faculty of Arts)

Mr. Athula Samarakoon (Faculty of Arts)

Mr. Nalin Wijesiri (Faculty of Arts)

Mr. Vinod Viduranga (Faculty of Dental Sciences)

Dr. V.S.N. Vithanaarachchi (Faculty of Dental Sciences)

Dr. M.B. Dissanayake (Faculty of Engineering)

Ms. A.S. Shiromi (Faculty of Management)

Dr. Yasitha Illangasekara (Faculty of Medicine)

Dr. D.A. Satharasinghe (Faculty of Veterinary Medicine and Animal Science)

Dr. H.R.O.E. Dayaratna (Faculty of Science)

Mr. Daminda Rajapaksha (Postgraduate Institute of Humanities and Social Sciences)

REGISTRATION COMMITTEE – iPURSE 2021

Dr. Kumuduni Kumarihamy (Faculty of Arts) [Chair]

Mr. M.M. Alikhan (Faculty of Arts)

Ms. Dilini Ariyawansa (Faculty of Arts)

Dr. Asanka Bulathwatte (Faculty of Arts)

Ms. D. Kawshalya Duraisamy (Faculty of Arts)

CEREMONIAL COMMITTEE – iPURSE 2021

Dr. Manoj Alawathukotuwa (Faculty of Arts) (Chair)

Ms. Sewwandi Daladawattha (Faculty of Arts)

Dr. H.M.M. Herath (Faculty of Arts)

Ms. S.M.D.N.K. Senevirathne (Faculty of Arts)

Dr. Thusari Vidanage (Faculty of Arts)

LOGISTICS COMMITTEE – iPURSE 2021

Ms. P.K. Herath (Senior Assistant Registrar, Faculty of Arts) [Chair]

Mr. J.P. Wesley (Assistant Registrar, Faculty of Agriculture)

Ms. Yasangika Higgoda (Assistant Registrar, Faculty of Allied Health Sciences)

Mrs. Nathasha Ariyaratne (Assistant Registrar, Faculty of Dental Sciences)

Ms. Nilanjanee Rajapakshe (Assistant Registrar, Faculty of Engineering)

Ms. Subodha Panditharathna (Assistant Registrar, Faculty of Management)

Ms. Dilini Herath (Assistant Registrar, Faculty of Medicine)

Mrs. Jeewanthi Dissanayake (Assistant Registrar, Faculty of Science)

Ms. Geethika Ranasinghe (Assistant Registrar, Faculty of Veterinary Medicine and Animal Science)

Ms. Samanthi Herath (Deputy Registrar, Academic Establishments)

Mrs. Jayantha Dharmasiri (Deputy Registrar, General Administration)

Mrs. Sanjeewani Marasinghe (Senior Assistant Registrar, General Administration)

Dr. Chandima Herath (Acting Chief Medical Officer)

Mr. Dinal Rathnayake (Acting Chief Security Officer)

Mr. Pushpika Panditharatne (Works Engineer)

Mr. W.N. Ananda (Curator)

Mr. Mahesh Abeywardhana (Acting Public Relations Officer)

FUNDING COMMITTEE – iPURSE 2021

Mr. M.D.S.M. Rodrigo (Senior Assistant Bursar, Faculty of Arts) [Chair]

Mr. B.M.I.A.K. Basnayake (Senior Assistant Bursar)

Mr. A.I. Samarahewa (Deputy Bursar)

Mr. U.W. Rajmal (Deputy Bursar)

Mr. W.A.G.T.L.G. Weerasekera (Deputy Bursar)

Mr. W.A.N.C. Wijesinghe (Deputy Bursar)

FOOD AND REFRESHMENTS COMMITTEE – iPURSE 2021

Mr. W.V. Lakshman Kumara (Assistant Registrar, Faculty of Arts) [Chair]

Mrs. M.S. Ranasinghe (Deputy Registrar, Central Administration)

Mr. J.P. Wesley (Assistant Registrar, Faculty of Agriculture)

Ms. Nilanjanee Rajapakshe (Assistant Registrar, Faculty of Engineering)

Ms. Subodha Panditharathne (Assistant Registrar, Faculty of Management)

Ms. Geethika Ranasinghe (Assistant Registrar, Faculty of Veterinary Medicine and Animal Science)

Mr. M.N.M Ilham (Management Assistant, Dean's Office, Faculty of Arts)

LIST OF REVIEWERS

Title	First Name(s) / Initials	Surname	Affiliation
Dr.	Isthikar	Aariff	University of Peradeniya, SL
Prof.	C.L.	Abayasekera	University of Peradeniya, SL
Dr.	S.	Abeyagunawardena	University of Peradeniya, SL
Dr.	Rushan	Abeygunawardana	University of Colombo, SL
Dr.	Nilmini	Abeygunawardena	Teaching Hospital Karapitiya, Galle, SL
Dr.	Dhammika	Abeykoon	University of Peradeniya, SL
Dr.	Ashoka	Abeykoonmenike	University of Peradeniya, SL
Mr.	Rasika	Abeyrathna	University of Peradeniya, SL
Dr.	Rajitha	Abeysekara	University of Peradeniya, SL
Dr.	Sumith	Abeysiriwardena	CIC Holdings PLC, SL
Dr.	Hemalika	Abeysundara	University of Peradeniya, SL
Dr.	Sachith	Abeysundara	University of Peradeniya, SL
Ms.	Dinushika Yapa	Abeywardhana	University of Peradeniya, SL
Prof.	Anoma S.P.	Abhayaratne	University of Peradeniya, SL
Dr.	M.	Adikaram	South Eastern University, SL
Prof.	N.K.B.	Adikaram	National Institute of Fundamental Studies, SL
Dr.	I.	Akurugoda	University of Ruhuna, SL
Dr.	C.N.K.	Alahakoon	University of Peradeniya, SL
Dr.	M.	Alawathukotuwa	University of Peradeniya, SL

Mr.	Mohideen	Alikhan	University of Peradeniya, SL
Prof.	C.N.R.A.	Alles	University of Peradeniya, SL
Dr.	B.M.S.	Amarajeewa	Institute of Indigenous Medicine, SL
Prof.	W.A. Liyanage	Amarakeerthi	University of Peradeniya, SL
Prof.	Daya	Amarasekara	University of Peradeniya, SL
Dr.	M.G.T.S.	Amarasekara	Rajarata University of Sri Lanka
Dr.	Thamara	Amarasekara	University of Sri Jayawardenepura, SL
Dr.	H.K.	Amarasinghe	Ministry of Health, SL
Dr.	N.R.	Amarasinghe	University of Peradeniya, SL
Dr.	Eva	Ambos	Heidelberg University, Germany
Dr.	N.M.T.	Anupama	University of Peradeniya, SL
Dr.	J.M.P.N.	Anuradha	University of Peradeniya, SL
Mr.	Sachin	Anushka	Bhiksu University of Sri Lanka, Anuradhapura, SL
Dr.	Nidarshani	Appuhamy	Wayamba University of Sri Lanka
Mr.	P.C.	Arampath	University of Peradeniya, SL
Dr.	H.M.H.S.	Ariyarathna	University of Peradeniya, SL
Dr.	H.A.C.K.	Ariyarathne	University of Peradeniya, SL
Dr.	Mojith	Ariyarathne	University of Peradeniya, SL
Prof.	H.B.S.	Ariyaratne	University of Peradeniya, SL
Dr.	J.A.T.C.	Ariyasena	University of Peradeniya, SL
Dr.	A.S.	Ariyasinghe	University of Peradeniya, SL
Dr.	D.	Ariyasinghe	University of Peradeniya, SL

Dr.	A.	Ariyawansha	Teaching Hospital, Peradeniya, SL
Prof.	A.K.	Arof	The University of Malaya, Malaysia
Mr.	T.	Arudchelvam	Wayamba University of Sri Lanka
Ms.	S.P.	Aryarathne	University of Peradeniya, SL
Dr.	S.	Athambawa	University of Peradeniya, SL
Dr.	A.M.R.G.	Athapaththu	University of Peradeniya, SL
Dr.	A.M.C.U.M.	Athapattu	University of Peradeniya, SL
Dr.	Saman	Athauda	University of Peradeniya, SL
Prof.	P.P.A.W.	Athukorala	University of Peradeniya, SL
Dr.	Sarangi	Athukorala	University of Peradeniya, SL
Dr.	A.M.C.P.K.	Attanayake	University of Peradeniya, SL
Prof.	Manjula	Attygalla	University of Peradeniya, SL
Dr.	Dilhari	Attygalle	University of Colombo, SL
Dr.	Fazeeha	Azmi	University of Peradeniya, SL
Dr.	M.	Balamayuran	University of Peradeniya, SL
Dr.	N.W.B.	Balasooriya	University of Peradeniya, SL
Ms.	Arularasi	Balasubramium	University of Peradeniya, SL
Mr.	Anjana	Bandara	University of Colombo, SL
Dr.	B.M.S.	Bandara	Rajarata University of Sri Lanka
Mr.	A.M.A.S.M.	Bandara	University of Peradeniya, SL
Dr.	N.C.	Bandara	University of Peradeniya, SL
Prof.	T.W.M.T.W.	Bandara	University of Peradeniya, SL
Mr.	J.M.R. Chinthaka	Bandara	Sri Palee Campus, University of Colombo, SL

621

Dr.	Nadeesha Lewke	Bandara	University of Colombo, SL
Dr.	Ruwanthi	Bandara	University of Peradeniya, SL
Prof.	P.C.G.	Bandaranayake	University of Peradeniya, SL
Dr.	Sarath	Bandaranayake	University of Peradeniya, SL
Dr.	N.	Baskaran	University of Peradeniya, SL
Dr.	Chalinda	Beneragama	University of Peradeniya, SL
Dr.	P.J.	Binduhewa	University of Peradeniya, SL
Dr.	Gayan	Bowatte	University of Peradeniya, SL
Prof.	Suyama	Boyagoda	University of Peradeniya, SL
Dr.	H.A.D. Samith	Buddika	University of Peradeniya, SL
Mr.	M.C. Ali	Buhtto	South Eastern University, SL
Dr.	Asanka	Bulathwatta	University of Peradeniya, SL
Ms.	Thejani	Bulathwatta	Open University of Sri Lanka
Prof.	Sarath	Chandrajeewa	University of Visual and Performing Arts, SL
Prof.	R.	Chandrajith	University of Peradeniya, SL
Dr.	Ananda	Chandrasekara	Wayamba University of Sri Lanka
Prof.	Anoma	Chandrasekara	Wayamba University of Sri Lanka
Prof.	W.U.	Chandrasekara	University of Kelaniya, SL
Dr.	W.D.	Chandrasena	University of Peradeniya, SL
Dr.	E.Y.A.	Charles	University of Jaffna, SL
Ms.	S.	Chithra	University of Peradeniya, SL
Dr.	J.T.	Cooray	Uva Wellassa University, SL
Prof.	Domenica	Costantino	DICATECh, Polytechnic of Bari, Italy

Dr.	D.W.P.	Dahanayake	University of Peradeniya, SL
Dr.	U.	Dahanayake	Rajarata University of Sri Lanka
Dr.	Jilushi	Damunupola	University of Peradeniya, SL
Dr.	Ranmalie	Dandeniya	University of Peradeniya, SL
Dr.	Warshi S.	Dandeniya	University of Peradeniya, SL
Prof.	Chandima	Dangalle	University of Colombo, SL
Dr.	Maheshi	Danthurebandara	University of Peradeniya, SL
Dr.	Rohitha	Dasanayaka	University of Peradeniya, SL
Dr.	Damayanthi	Dasanayake	University of Peradeniya, SL
Dr.	B.S.	Dassanayake	University of Peradeniya, SL
Dr.	B.	Dassanayake	University of Peradeniya, SL
Dr.	Suranga	Dassanayake	University of Otago, New Zealand
Prof.	Tharaka	Dassanayake	University of Peradeniya, SL
Prof.	W.B.	Daundasekera	University of Peradeniya, SL
Prof.	W.A.M.	Daundesekara	University of Peradeniya, SL
Prof.	O.G.	Dayarathna-Banda	University of Peradeniya, SL
Dr.	Oshani Erunika	Dayaratne	University of Peradeniya, SL
Prof.	N.D.K.	Dayawansa	University of Peradeniya, SL
Mr.	D.S.	Deegalla	University of Peradeniya, SL
Dr.	A.M.S.	Deepani	University of Peradeniya, SL
Dr.	M.B.	Dehideniya	University of Peradeniya, SL
Prof.	C.M.B.	Dematawewa	University of Peradeniya, SL
Dr.	R.M.C.	Deshapriya	University of Peradeniya, SL
Dr.	Thushari	Devanarayana	Army Hospital, Colombo 5, SL
Dr.	M.T.M.	Dewasurendra	University of Peradeniya, SL

Dr.	S.D.	Dewasurendra	University of Peradeniya, SL
Dr.	N.P.R.	Deyshappriya	Uva Wellassa University, SL
Mr.	R.M.	Dhanapala	Rajarata University of Sri Lanka
Dr.	H.A.	Dharmagunawardane	University of Peradeniya, SL
Dr.	R.S.	Dharmakeerthi	University of Peradeniya, SL
Dr.	Arinda	Dharmapala	University of Peradeniya, SL
Dr.	U.S.S.	Dharmapriya	University of Peradeniya, SL
Dr.	S.	Dharmarathna	University of Peradeniya, SL
Dr.	Samal	Dharmarathna	University of Peradeniya, SL
Prof.	S.D.	Dharmaratne	University of Peradeniya, SL
Dr.	Sisira	Dharmaratne	University of Peradeniya, SL
Prof.	D.A.N.	Dharmasena	University of Peradeniya, SL
Dr.	P.B.	Dharmasena	Department of Agriculture, SL
Dr.	Kanchuka Nayani	Dharmasiri	University of Peradeniya, SL
Prof.	R.K. Sriyani	Dias	University of Kelaniya, SL
Dr.	U.I.	Dissanayaka	University of Peradeniya, SL
Dr.	D.M.D.	Dissanayake	Rajarata University of Sri Lanka
Dr.	D.M. Lalitha	Dissanayake	University of Peradeniya, SL
Prof.	D.P.	Dissanayake	University of Colombo, SL
Dr.	Gunendra	Dissanayake	University of Peradeniya, SL
Dr.	J.	Dissanayake	University of Peradeniya, SL
Mr.	M.	Dissanayake	University of Peradeniya, SL
Dr.	N.	Dissanayake	Respiratory Physician, Teaching Hospital, Ratnapura, SL

Dr.	P.V.	Dissanayake	University of Peradeniya, SL
Prof.	Lakshman	Dissanayake	National Institute of Fundamental Studies, SL
Dr.	M.B.	Dissanayake	University of Peradeniya, SL
Prof.	M.L.M.C.	Dissanayake	Sabaragamuwa University of Sri Lanka
Dr.	P.	Dissanayake	University of Ruhuna, SL
Dr.	P.B.G.	Dissanayake	University of Peradeniya, SL
Prof.	Ranjith	Dissanayake	University of Peradeniya, SL
Dr.	Ratnakumara	Dissanayake	Sirimavo Bandaranaike Children's Hospital, SL
Mr.	S.M.	Dissanayake	University of Peradeniya, SL
Dr.	S.	Diyabalanage	University of Sri Jayewardenepura, SL
Dr.	S.S.K.B.M.	Dorabawila	University of Peradeniya, SL
Ms.	Kowsalya	Duraisamy	University of Peradeniya, SL
Dr.	A.G.H.J.	Edirisinghe	University of Peradeniya, SL
Dr.	Varunadatta	Edirisinghe	University of Peradeniya, SL
Prof.	Udeni	Edirisinghe	University of Peradeniya, SL
Ms.	Waruni	Edirisooriya	University of Peradeniya, SL
Prof.	S.	Ediriweera	Uva Wellassa University SL
Prof.	Janakie	Eeswara	University of Peradeniya, SL
Dr.	Rasika	Ekanayaka	Teaching Hospital, Karapitiya, Galle, SL
Dr.	J.	Ekanayake	University of Peradeniya, SL
Ms.	Pavithra	Ekanayake	University of Peradeniya, SL
Dr.	Hiran	Ekanayake	University of Colombo School of Computing, SL

Prof.	Lilani	Ekanayake	University of Peradeniya, SL
Dr.	R.A.	Ekanayake	University of Peradeniya, SL
Dr.	D.	Elkaduwe	University of Peradeniya, SL
Dr.	Susila	Embekke	University of Peradeniya, SL
Dr.	B.A.N.	Eranda	University of Peradeniya, SL
Dr.	A.C.M.	Fahim	University of Peradeniya, SL
Dr.	Indika	Ferdinando	University of Visual and Performing Arts, SL
Dr.	I.R.	Fernando	University of Sri Jayawardenepura, SL
Dr.	N.	Fernando	University of Colombo, SL
Prof.	P.H.P.	Fernando	University of Peradeniya, SL
Mr.	T.S.S.	Fernando	University of Peradeniya, SL
Dr.	Ruchika	Fernando	University of Peradeniya, SL
Dr.	W.I.T.	Fernando	University of Peradeniya, SL
Dr.	S.	Fonseka	University of Peradeniya, SL
Dr.	Manil	Fonseka	University of Peradeniya, SL
Mr.	S.L.P.	Fonseka	University of Peradeniya, SL
Dr.	M.N.M.	Fouzi	University of Peradeniya, SL
Dr.	Maurizio	Furlani	Chamers University of Technology, Sweden
Prof.	Chandika	Gamage	University of Peradeniya, SL
Dr.	Gayani	Gamage	Open University of Sri Lanka
Ms.	I.	Gamage	University of Ruhuna, SL
Dr.	S.K.N.	Gamage	Rajarata University of Sri Lanka
Dr.	Piumnil	Gamagedara	University of Peradeniya, SL

Prof.	M.Y.U.	Ganehenage	University of Peradeniya, SL
Prof.	G.A.S.M.	Ganehiarachchi	University of Kelaniya, SL
Prof.	I.	Gawarammana	University of Peradeniya, SL
Dr.	P. Korale	Gedara	University of Peradeniya, SL
Dr. (Mrs.)	Sudarshanee	Geekiyange	University of Ruhuna, SL
Dr.	M.C.	Gihan	University of Peradeniya, SL
Prof.(Rev.)	M.	Gnanananda	University of Peradeniya, SL
Mr.	A.K.A.S.	Gnanaratne	University of Peradeniya, SL
Dr.	G.M.R.I.	Godaliyadda	University of Peradeniya, SL
Mr.	G.C.I.	Gunarathna	University of Peradeniya, SL
Ms.	Ishari	Gunarathna	National Institute of Social Development, SL
Prof.	M.H.J.P.	Gunarathna	Rajarata University of Sri Lanka
Dr.	M.S.	Gunarathne	University of Peradeniya, SL
Dr.	Thilanka	Gunarathne	University of Peradeniya, SL
Prof.	L.H.P.	Gunaratne	University of Peradeniya, SL
Dr.	Janith	Gunasekera	Private Veterinary Practitioner, Nugegoda, SL
Prof.	P.A.D.H. Nayana	Gunathilaka	University of Kelaniya, SL
Mr.	Prabath	Gunathilaka	University of Peradeniya, SL
Dr.	D.	Gunathilake	University of Peradeniya, SL
Dr.	W.S.S.	Gunathilake	University of Peradeniya, SL
Dr.	Janitha	Gunatilake	University of Peradeniya, SL
Prof.	S.K.	Gunatilake	Sabaragamuwa University of Sri Lanka
Ms.	H.H.A.J.	Gunatissa	University of Peradeniya, SL

Dr.	G.A.	Gunawardana	Veterinary Research Institute, Gannoruwa, Peradeniya, SL
Dr.	Kasun	Gunawardana	University of Colombo School of Computing, SL
Dr.	Niluka	Gunawardana	University of Peradeniya, SL
Dr.	T.A.	Gunawardana	University of Peradeniya, SL
Dr.	A.U.A.W.	Gunawardena	University of Peradeniya, SL
Dr.	N.	Gunawardena	University of Peradeniya, SL
Dr.	Lasith	Gunawardena	University of Sri Jayawardenepura, SL
Prof.	D.N.B.	Gunewardena	University of Peradeniya, SL
Dr.	Thilina	Halloluwa	University of Colombo School of Computing, SL
Dr.	Namali	Handegama	University of Peradeniya, SL
Mr.	P.	Handunge	University of Peradeniya, SL
Dr.	I.N.	Harischandra	University of Sri Jayawardenepura, SL
Dr.	W.A.N.I.	Harischandra	University of Peradeniya, SL
Prof.	K.S.	Hemachandra	University of Peradeniya, SL
Dr.	S.D.S.	Hemachandra	University of Peradeniya, SL
Dr.	K.K.U.G.	Hemamali	University of Ruhuna, SL
Prof.	Chandra	Herath	University of Peradeniya, SL
Dr.	Damayanthi	Herath	University of Peradeniya, SL
Dr.	Dhammika	Herath	University of Peradeniya, SL
Dr.	G.B.B.	Herath	University of Peradeniya, SL
Dr.	H.M.W.A.	Herath	University of Peradeniya, SL
Dr.	H.M.M.	Herath	University of Peradeniya, SL

Dr.	H.M.D.R.	Herath	University of Sri Jayewardenepura, SL
Prof.	H.M.T.U.	Herath	University of Peradeniya, SL
Prof.	A.C.	Herath	Rajarata University of Sri Lanka
Dr.	Chulani	Herath	Open University of Sri Lanka
Dr.	H.M.V.G.	Herath	University of Peradeniya, SL
Ms.	Subhashini	Herath	SL International Buddhist Academy (SIBA)
Dr.	S.R.	Herath	University of Peradeniya, SL
Dr.	Vijitha	Herath	University of Peradeniya, SL
Dr.	S.	Hettiarachchi	University of Peradeniya, SL
Prof.	C.V.	Hettiarachchi	University of Peradeniya, SL
Dr.	G.	Hettiarachchi	Kansas State University, USA
Dr.	Inosha	Hettiarachchi	University of Colombo School of Computing, SL
Prof.	S.	Hettiarachchi	Rajarata University of Sri Lanka
Dr.	Kalani	Hettiarachchi	University of Peradeniya, SL
Ms.	B.S.	Hettiarachchy	University of Peradeniya, SL
Dr.	Kanthi	Hettigoda	University of Peradeniya, SL
Dr.	I.G.N.	Hewajulige	Industrial Technology Institute of SL
Prof.	P.B.	Hewavithana	University of Peradeniya, SL
Prof.	T.	Hewawasam	University of Peradeniya, SL
Dr.	S.M.C.	Himali	University of Peradeniya, SL
Dr.	B.M.M.C.B.	Hindagolla	University of Peradeniya, SL
Prof.	Devika	Iddawala	University of Peradeniya, SL

Prof.	O.A.	Ileperuma	University of Peradeniya, SL
Dr.	Prasanna	Illankoon	University of Peradeniya, SL
Prof.	D.C.K.	Illeperuma	University of Peradeniya, SL
Rev.	W.	Indananda	University of Peradeniya, SL
Dr.	M.I.M.	Ishak	University of Peradeniya, SL
Ms.	M.	Jansz	Open University of Sri Lanka
Ms.	V.	Jayakumar	University of Peradeniya, SL
Mr.	Shantha	Jayakumara	University of Peradeniya, SL
Dr.	C.P.	Jayalath	University of Peradeniya, SL
Dr.	Laleen	Jayamanne	University of Sydney, Australia
Dr.	L.	Jayaratne	National Institute of Fundamental Studies, Kandy, SL
Dr.	N.B.	Jayaratne	Rajarata University of Sri Lanka
Dr.	Kithsiri	Jayasekara	Kotelawala Defense University, SL
Dr.	N.K.	Jayasekera	University of Peradeniya, SL
Prof.	Dinesh	Jayasena	Uwa Wellassa University of SL
Prof.	H.A.H.	Jayasena	University of Peradeniya, SL
Prof.	C.V.L.	Jayasinghe	Wayamba University of Sri Lanka
Dr.	J.M.J.K.	Jayasinghe	Sri Jayawardenepura University of SL
Dr.	J.M.S.	Jayasinghe	University of Peradeniya, SL
Ms.	Kaushalya	Jayasinghe	University of Peradeniya, SL

Prof.	Lalith	Jayasinghe	National Institute of Fundamental Studies, SL
Dr.	M.G.C.M.	Jayasinghe	University of Peradeniya, SL
Prof.	R.D.	Jayasinghe	University of Peradeniya, SL
Dr.	U.J.M.A.L.	Jayasinghe	University of Peradeniya, SL
Prof.	Udith K.	Jayasinghe-Mudalige	Wayamba University of Sri Lanka
Dr.	Kumari Priyanka	Jayasooriya	University of Kelaniya, SL
Dr.	L.J.P.A.P.	Jayasooriya	University of Peradeniya, SL
Prof.	Primali	Jayasooriya	University of Peradeniya, SL
Dr.	A.C.A.	Jayasundera	University of Peradeniya, SL
Dr.	K.B.	Jayasundera	University of Ruhuna, SL
Prof.	K.M.G.G.	Jayasuriya	University of Peradeniya, SL
Dr.	Sunethra	Jayathilake	University of Sri Jayawardenepura, SL
Dr.	Mohan	Jayatilake	University of Peradeniya, SL
Prof.	J.A.M.S.	Jayatilake	University of Peradeniya, SL
Prof.	Barana	Jayawardana	University of Peradeniya, SL
Dr.	Chandana	Jayawardena	University of Peradeniya, SL
Prof.	J.A.C.K.	Jayawardena	University of Peradeniya, SL
Dr.	D.	Jayawardena	University of Jayewardenepura, SL
Dr.	P.	Jayawardena	University of Colombo, SL
Dr.	N.U.	Jayawardena	University of Peradeniya, SL
Dr.	K.L.T.D.	Jayawardene	University of Peradeniya, SL
Dr.	A.A.K.K.	Jayawardhana	Uwa Wellassa University, SL
Dr.	A.	Jayaweera	University of Peradeniya, SL

Prof.	A.H.H.M.	Jayaweera	University of Peradeniya, SL
Ms.	Nishani	Jayaweera	University of Peradeniya, SL
Dr.	R.	Jayaweera	University of Kelaniya, SL
Dr.	T.S.P.	Jayaweera	Sabaragamuwa University of Sri Lanka
Ms.	Erandathi	Jayawickrama	University of Peradeniya, SL
Prof.	J.M. Ananda	Jayawickrama	University of Peradeniya, SL
Dr.	K.B.S.N.	Jinadasa	University of Peradeniya, SL
Dr.	H.R.N.	Jinadasa	University of Peradeniya, SL
Dr.	Z.A.M.S.	Juman	University of Peradeniya, SL
Dr.	H.K.	Kadupitiya	Natural Resources Management Centre (NRMC), SL.
Dr.	C.S.	Kalpage	University of Peradeniya, SL
Dr.	N.M.	Kalugampitiya	University of Peradeniya, SL
Dr.	A.W.	Kalupahana	University of Peradeniya, SL
Prof.	N.S.	Kalupahana	University of Peradeniya, SL
Prof.	R.S.	Kalupahana	University of Peradeniya, SL
Dr.	A.	Kalyanaratne	University of Sri Jayewardenepura, SL
Dr.	D.	Kanatiwela	Institute of Health Sciences, SL
Dr.	S.	Kandegedara	Consultant Oncologist, National Hospital, Kandy, SL
Dr.	A.D.H.K.	Kankanamge	University of Peradeniya, SL
Dr.	N.	Kannan	University of Jaffna, SL
Mr.	C.	Karaliyadda	Rajarata University of Sri Lanka
Dr.	Anula	Kariyawasam	University of Peradeniya, SL

Dr.	Danesh	Karunanayake	University of Peradeniya, SL
Dr.	Kasun	Karunanayake	University of Colombo School of Computing, SL
Dr.	K.O.L.C.	Karunanayake	Open University of Sri Lanka
Dr.	K.M.R.	Karunarathna	University of Peradeniya, SL
Dr.	Suneth Namal	Karunarathna	University of Peradeniya, SL
Prof.	D.G.G.P.	Karunarathne	University of Peradeniya, SL
Dr.	A.K.	Karunarathne	University of Peradeniya, SL
Ms.	A.	Karunaratne	Bandaranaike Centre for International Studies, SL
Prof.	D.N.	Karunaratne	University of Peradeniya, SL
Prof.	Inoka	Karunaratne	University of Peradeniya, SL
Prof.	P.M.A.S.	Karunaratne	Sabaragamuwa University of Sri Lanka
Dr.	D.S.K.	Karunasinghe	University of Peradeniya, SL
Dr.	Thabotharan	Kathirawelu	University of Jaffna, SL
Dr.	H.S.	Kathriarachchi	University of Colombo, SL
Ms.	Ruvini	Katugaha	University of Peradeniya, SL
Dr.	W.K.D.	Keerthirathne	Rajarata University of Sri Lanka
Dr.	Chamath	Keppetiyagama	University of Colombo, SL
Dr.	Vasana	Kiridana	University of Peradeniya, SL
Dr.	G.	Kodithuwakku	Department of Research & Development, National Institute of Education, Maharagama, SL
Ms.	S.	Kodithuwakku	University of Peradeniya, SL
Prof.	S.S.	Kodithuwakku	University of Peradeniya, SL
Prof.	K.K.S.P.	Kodituwakku	University of Peradeniya, SL

Prof.	Saluka	Kodituwakku	University of Peradeniya, SL
Ms.	Ursula	Koduthore	Allianz Mission, Kandy, SL
Ms.	A.	Kolongahapitiya	University of Peradeniya, SL
Dr. (Ms).	K.P.P.	Kopiyawattage	Rajarata University of Sri Lanka
Dr.	W.	Kosgallana	University of Peradeniya, SL
Dr.	Thushara	Kudagammana	University of Peradeniya, SL
Dr.	Wasana	Kudagammana	University of Peradeniya, SL
Ms.	K.M.I.W.S.C.H.	Kulathunga	University of Peradeniya, SL
Dr.	K.M.A.K.	Kulatunga	University of Peradeniya, SL
Ms.	Ruwantha	Kulatunga	University of Peradeniya, SL
Dr.	Sunil	Kulatunga	University of Peradeniya, SL
Prof.	Shamala	Kumar	University of Peradeniya, SL
Dr.	A.K. Jeewaka Saman	Kumara	University of Peradeniya, SL
Dr.	G.D.K.	Kumara	Sabaragamuwa University of Sri Lanka
Dr.	Hemantha	Kumara	University of Ruhuna, SL
Dr.	J.R.S.S.	Kumara	University of Peradeniya, SL
Prof.	G.R.A.	Kumara	National Institute of Fundamental Studies, Kandy, SL
Dr.	P.H.T.	Kumara	Uva Wellassa University of SL
Mr.	R.M.S.	Kumara	University of Peradeniya, SL
Mr.	S.	Kumara	Rajarata University of Sri Lanka
Dr.	Prabhash	Kumarasinghe	University of Colombo School of Computing, SL
Dr.	Shriyani	Kumarasinghe	Open University of Sri Lanka

Dr.	Kumuduni	Kumarihamy	University of Peradeniya, SL
Dr.	L.C.	Kurukulasuriya	University of Peradeniya, SL
Dr.	R.H.	Kuruppuge	University of Peradeniya, SL
Prof.(Mrs.)	W.G.D.	Lakmini	University of Ruhuna, SL
Ms.	Hasini	Lecamwasam	University of Peradeniya, SL
Prof.	Xue-Cong	Liu	University of Chinese Academy of Sciences, China
Dr.	L.C.P.T.	Liyanaarachchie	University of Peradeniya, SL
Dr.	Esther	Liyanage	University of Peradeniya, SL
Prof.	J.A.	Liyanage	University of Kelaniya, SL
Dr.	R.	Liyanage	National Institute of Fundamental Studies, SL
Dr.	Pemith	Liyanage	National Dental Hospital, Colombo, SL
Prof.	Saumya	Liyanage	University of Visual and Performing Arts, SL
Dr.	Veranja	Liyanapathirana	University of Peradeniya, SL
Dr.	L.G. Sampath	Lokugalappatti	University of Peradeniya, SL
Dr.	Wei	Ma	Heilongjiang University of Chinese Medicine, Harbin, China
Prof.	H.M.S.P.	Madawala	University of Peradeniya, SL
Prof.	C.M.	Maddumabandara	University of Peradeniya, SL
Dr.	Panagiotis	Madesis	The Institute of Applied Biosciences, Centre for Research and Technology Hellas, Thessaloniki, Greece
Prof.	W.M.T.	Madhujith	University of Peradeniya, SL
Prof.	Wasanthi	Madurapperuma	University of Kelaniya, SL
Prof.	K.P.	Maduwage	University of Peradeniya, SL

Prof.	D.	Magana-Arachchi	National Institute of Fundamental Studies, SL
Prof.	G.D.K.	Mahanama	University of Ruhuna, SL
Dr.	Anuradha	Mahasinghe	University of Colombo, SL
Mr.	R.	Maheswaran	University of Peradeniya, SL
Dr.	S.	Maheswaran	University of Peradeniya, SL
Dr.	P.	Malavi-Arachchi	University of Sri Jayawardenepura, SL
Ms.	Kanchana	Manikdiwela	SL International Buddhist Academy (SIBA)
Dr.	Aruna	Manipura	University of Peradeniya, SL
Dr.	P.G.	Manthilake	University of Peradeniya, SL
Dr.	S.B.	Mantillake	University of Peradeniya, SL
Mr.	Ziyan	Maraikar	University of Peradeniya, SL
Prof.	B.	Marambe	University of Peradeniya, SL
Prof.	Kosala	Marambe	University of Peradeniya, SL
Dr.	M.A.J.C.	Marasinghe	University of Peradeniya, SL
Prof.	Nazrim	Marikkar	National Institute of Fundamental Studies, Kandy, SL
Ms.	Kosalai	Mathan	University of Jaffna, SL
Dr.	Chinthaka	Meddegoda	University of Visual and Performing Arts, SL
Dr.	M.K.D.L.	Meegoda	University of Sri Jayawardenepura, SL
Prof.	S.J.S. de	Mel	University of Peradeniya, SL
Dr.	B.C.G.	Mendis	University of Peradeniya, SL
Dr.	Eresha	Mendis	University of Peradeniya, SL
Dr.	L.C.	Menikarachchi	University of Peradeniya, SL

636

Dr.	M.G.P.D.	Menike	University of Peradeniya, SL
Dr.	A.J.	Mohotti	University of Peradeniya, SL
Prof.	M.I.M.	Mowjood	University of Peradeniya, SL
Dr.	M.P.S.	Mudalige	University of Peradeniya, SL
Dr.	D.M.S.	Munasinghe	University of Peradeniya, SL
Mr.	Tharupathi	Munasinghe	University of Kelaniya, SL
Dr.	S.P.	Munasinghe-Arachchige	University of Peradeniya, SL
Dr.	I.	Munaweera	University of Sri Jayawardenepura, SL
Ms.	H.R.K.	Nagahamulla	Wayamba University of Sri Lanka
Prof.	Charmalie	Nahallage	University of Sri Jayewardenepura, SL
Prof.	Deepthi	Nanayakkara	University of Peradeniya, SL
Dr.	K.G.N.	Nanayakkara	University of Peradeniya, SL
Dr.	B.S.	Nanayakkara	University of Peradeniya, SL
Prof.	C.M.	Nanayakkara	University of Colombo, SL
Dr.	I.	Nanayakkara	University of Peradeniya, SL
Prof.	K.D.W.	Nandalal	University of Peradeniya, SL
Dr. (Mrs.)	N.M.N.K.	Narayana	University of Ruhuna, SL
Dr.	M.C.M.	Nasvi	University of Peradeniya, SL
Dr.	S.K.	Navaratnarajah	University of Peradeniya, SL
Prof.	A.N.	Navaratne	University of Peradeniya, SL
Dr.	M.A.U.S.	Navaratne	University of Peradeniya, SL
Dr.	Lakshika	Nawarathna	University of Peradeniya, SL
Dr.	Ruwan	Nawarathne	University of Peradeniya, SL

Dr.	Samidi	Nawaratna	University of Peradeniya, SL
Dr.	E. Sulochana	Neranjani	University of Colombo, SL
Prof.	K.W.G. Rekha	Nianthi	University of Peradeniya, SL
Dr.	S.A.A.	Nishantha	University of Peradeniya, SL
Prof.	S.P.	Nissanka	University of Peradeniya, SL
Prof.	F.	Noordeen	University of Peradeniya, SL
Ms.	M.N.F.	Nuskiya	University of Peradeniya, SL
Dr.	N.P.D.	Padmakanthi	University of Kelaniya, SL
Dr.	Vijitha	Paheerathan	Trincomalee Campus, Eastern University of SL
Dr.	K.	Pakeerthan	University of Jaffna, SL
Dr.	G.W.R.M.R.	Palamakumbura	University of Peradeniya, SL
Dr.	Achala	Pallegedara	University of Peradeniya, SL
Prof.	Nirmalie	Pallewatte	University of Colombo, SL
Dr.	Chamari	Palliyaguru	Veterinary Research Institute, Gannoruwa, Peradeniya, SL
Dr.	K.M.G.K.	Pamunuwa	Wayamba University of Sri Lanka
Prof.	Gehan	Panagoda	University of Peradeniya, SL
Prof.	Arjuna	Parakrama	University of Peradeniya, SL
Dr.	Madhavi	Paranagama	University of Peradeniya, SL
Dr.(Mrs.)	P.M.H.D.	Pathiraje	Wayamba University of Sri Lanka
Dr.	C.K.	Pathirana	University of Peradeniya, SL
Prof.	K.P.P.	Pathirana	University of Peradeniya, SL
Mr.	H.	Pathirana	University of Kelaniya, SL
Dr.	L.	Pathirana	University of Peradeniya, SL

Dr.	M.L.	Pathirathna	University of Peradeniya, SL
Dr.	Eshantha	Peiris	'Music matters', Colombo 02, SL
Dr.	H.	Peiris	University of Peradeniya, SL
Prof.	L.D.C.	Peiris	University of Sri Jayewardenepura, SL
Dr.	P.	Peiris	University of Colombo, SL
Dr.	B.M.K.	Pemasiri	University of Peradeniya, SL
Prof.	Anoma	Perera	University of Peradeniya, SL
Dr.	B.M.A. Oswin	Perera	Retired Professor, University of Peradeniya, SL
Dr.	Chandrika	Perera	University of Peradeniya, SL
Prof.	H.K.I.	Perera	University of Peradeniya, SL
Dr.	K.	Perera	University of Peradeniya, SL
Dr.	Muditha	Perera	University of Peradeniya, SL
Prof.	A.D.L.C.	Perera	University of Peradeniya, SL
Dr.	H.C.S.	Perera	University of Peradeniya, SL
Dr.	K.K.K.R.	Perera	University of Kelaniya, SL
Dr.	M.S.J.	Perera	Sabaragamuwa University of Sri Lanka
Prof.	P.P.R.	Perera	University of Sri Jayewardenepura, SL
Dr.	S.	Perera	University of Peradeniya, SL
Dr.	Piyumali	Perera	University of Peradeniya, SL
Dr.	Prasadini	Perera	University of Peradeniya, SL
Dr.	Rangeeka	Perera	University of Peradeniya, SL
Dr.	Shalika	Perera	Veterinary Research Institute, Gannoruwa, Peradeniya, SL

639

Ms.	Venuri	Perera	Rockbund Art Museum, Shanghai, China
Dr.	K.K.V.S.	Peshala	Institute of Indigenous Medicine, SL
Dr.	Kalyani	Pethiyagoda	University of Peradeniya, SL
Prof.	A.U.B.	Pethiyagoda	University of Peradeniya, SL
Dr.	Amalka	Pinidiyaarachchi	University of Peradeniya, SL
Prof.	Mallika	Pinnawala	University of Peradeniya, SL
Prof.	H.M.T.G.A.	Pitawala	University of Peradeniya, SL
Prof.	J.C.	Pitawala	Uva Wellassa University of SL
Dr.	S.A.	Pradeep	University of Ruhuna, SL
Dr.(Mrs.)	L.	Pradheeban	University of Jaffna, SL
Dr.	D.V.P.	Prasada	University of Peradeniya, SL
Dr.	K.D.	Prasangika	University of Ruhuna, SL
Mr.	A.L.I.	Prasanna	University of Peradeniya, SL
Dr.	P.H.P.	Prasanna	University of Peradeniya, SL
Dr.	R.P.I.R.	Prasanna	Rajarata University of Sri Lanka
Dr.	B.D.R.	Prasantha	University of Peradeniya, SL
Dr.	R.	Prasanthan	University of Jaffna, SL
Mr.	L.	Premakumara	Buddhasravaka University of SL
Dr.	Lakraj	Premanatha	University of Colombo, SL
Mr.	Saminda	Premarathna	University of Moratuwa, SL
Prof.	P.D.	Premasiri	University of Peradeniya, SL
Dr.	Sunanda	Premasiri	University of Peradeniya, SL
Dr.	Ruwan	Premathilake	University of Peradeniya, SL

Dr.	M.M.S.N.	Prematilake	Uwa Wellassa University of SL
Prof.	Neelakshi	Premawardhena	University of Kelaniya, SL
Mr.	Chamila	Priyanka	University of Peradeniya, SL
Prof.	P.A.N.	Punyasiri	University of Colombo, SL
Dr.	Saman	Pushpakumara	University of Peradeniya, SL
Dr.	B.H.R.	Pushpananda	University of Colombo School of Computing, SL
Prof.	Roshan	Ragel	University of Peradeniya, SL
Prof. (Rev.)	K.	Rahula	University of Peradeniya, SL
Prof.	Rupika	Rajakaruna	University of Peradeniya, SL
Prof.	Gamini	Rajapakse	University of Peradeniya, SL
Prof.	R.P.V.J.	Rajapakse	University of Peradeniya, SL
Dr.	R.P.N.P.	Rajapakse	University of Peradeniya, SL
Dr.	A.U.	Rajapakse	University of Sri Jayawardenepura, SL
Prof.	R.G.S.C.	Rajapakse	University of Peradeniya, SL
Prof.	R.M.C.P.	Rajapaksha	University of Peradeniya, SL
Prof.	T.	Rajapaksha	University of Peradeniya, SL
Ms.	S.	Rajendran	University of Peradeniya, SL
Dr.	Udaya	Ralapanawa	University of Peradeniya, SL
Dr.	A.	Ramanan	University of Jaffna, SL
Dr.	Ramesh	Ramaswamy	University of Peradeniya, SL
Ms.	S.	Ranaraja	University of Peradeniya, SL
Dr.	Rajitha	Ranasinghe	University of Peradeniya, SL
Dr.	S.W.	Ranasinghe	National Botanical Garden, Peradeniya, SL

Prof.	Shirani	Ranasinghe	University of Peradeniya, SL
Prof.	M.B.	Ranathilaka	University of Peradeniya, SL
Dr.	R.J.K.U.	Ranatunga	University of Peradeniya, SL
Prof.	K.B.	Ranawana	University of Peradeniya, SL
Dr.	R.D.	Ranaweera	University of Peradeniya, SL
Mr.	Asela	Rangadeva	University of Visual and Performing Arts, SL
Dr.	R.H.G.	Ranil	University of Peradeniya, SL
Prof.	J.G.Sri	Ranjith	University of Peradeniya, SL
Dr.	Lalith	Rankoth	University of Peradeniya, SL
Mr.	R.M.S.	Rasnayake	University of Peradeniya, SL
Dr.	R.	Rasool	University of Kelaniya, SL
Dr.	H.S.K.	Rathnathilake	University of Peradeniya, SL
Prof.	N.	Rathnayaka	University of Moratuwa, SL
Ms.	R.M.U.R.K.	Rathnayaka	University of Peradeniya, SL
Dr.	L.	Rathnayake	University of Peradeniya, SL
Dr.	N.	Rathnayake	Institute of Oral Health, Maharagama, SL
Ms.	R.M.H.	Rathnayake	University of Peradeniya, SL
Dr.	I.V.N.	Rathnayake	University of Kelaniya, SL
Dr.	A.	Rathnayake	Uva Wellassa University of SL
Dr.	J.	Rathnayake	University of Peradeniya, SL
Prof.	R.	Rathnayake	National Institute of Fundamental Studies, SL
Dr.	R.M.C.S.	Rathnayake	University of Kelaniya, SL
Dr.	Sarath	Rathnayake	University of Peradeniya, SL
Mr.	M.S.M.	Razik	University of Peradeniya, SL

Ms.	R.	Rilwan	University of Peradeniya, SL
Dr.	S.K.	Rodrigo	Open University of Sri Lanka
Dr.	S.	Rosairo	University of Peradeniya, SL
Dr.	Sumudu	Rubasinghe	University of Peradeniya, SL
Dr.	M.H.F.	Sakeena	University of Peradeniya, SL
Mr.	A.	Samarakoon	University of Peradeniya, SL
Dr.	E.R.J.	Samarakoon	University of Peradeniya, SL
Dr.	S.M.A.K.	Samarakoon	Open University of Sri Lanka
Dr.	Lilantha	Samaranayake	University of Peradeniya, SL
Mr.	D.I.J.	Samaranayake	University of Peradeniya, SL
Dr.	D.	Samararatne	University of Colombo, SL
Prof.	Pubudu	Samarasekara	University of Peradeniya, SL
Dr.	A.K.B.B.T.B.	Samarasinghe	University of Peradeniya, SL
Prof.	P.S.	Samaraweera	University of Peradeniya, SL
Dr.	P.E.	Samarawickrama	University of Colombo, SL
Prof.	S.	Samita	University of Peradeniya, SL
Prof.	Fatima	Samreen	University of Karachi, Pakistan
Dr.	M.	Sandirigama	University of Peradeniya, SL
Ms.	Anne Yalini	Satheeswaran	University of Peradeniya, SL
Dr.	Asanka	Sayakkara	University of Colombo School of Computing, SL
Mr.	Andi	Schubert	Open University of Sri Lanka
Dr.	P.K.	Seelagama	University of Peradeniya, SL
Prof.	G.K. Rohan	Senadeera	National Institute of Fundamental Studies, SL
Dr.	C.D.	Senanayake	University of Peradeniya, SL

Dr.	D.M.J.B.	Senanayake	Rice Research & Development Institute, SL
Dr.	Lalith	Senarathne	Rajarata University of Sri Lanka
Dr.	Jagath	Senarathne	University of Peradeniya, SL
Prof. (Mrs)	D.	Senaratna	University of Ruhuna, SL
Dr.	Kalana	Senaratne	University of Peradeniya, SL
Dr.	K.G.C.	Senaratne	Uva Wellassa University of SL
Dr.	Leena	Seneheweera	University of Peradeniya, SL
Prof.	H. Sunil	Senevi	Sabaragamuwa University of Sri Lanka
Dr.	D.V.K.P.	Senevirathne	University of Colombo, SL
Dr.	K.S.H.M.V.W.W.	Senevirathne	University of Peradeniya, SL
Ms.	Niroshi	Senevirathne	University of Peradeniya, SL
Prof.	Gamini	Seneviratne	National Institute of Fundamental Studies, SL
Dr.	S.A.	Seneviratne	Rajarata University of Sri Lanka
Ms.	Sumudu	Seneviratne	University of Peradeniya, SL
Dr.	Varuni	Seneviratne	University of Peradeniya, SL
Prof.	Prasad	Sethunga	University of Peradeniya, SL
Dr.	D.D. Niranjala De	Silva	University of Peradeniya, SL
Prof.	D.A.M. De	Silva	Sabaragamuwa University of Sri Lanka
Dr.	H.I.C. De	Silva	University of Colombo, SL
Dr.	Lasanthi De	Silva	University Colombo School of Computing, SL
Prof.	M.P.K.S.K. De	Silva	University of Ruhuna, SL

Dr.	Dileep De	Silva	Ministry of Health, SL
Dr.	Dushmanthi	Silva	University of Ruhuna, SL
Prof.	G.L.L.P.	Silva	University of Peradeniya, SL
Ms.	H.L.M. De	Silva	University of Peradeniya, SL
Prof.	Kalinga Tudor	Silva	Emeritus Professor, University of Peradeniya, SL
Dr.	Priyanka De	Silva	University of Peradeniya, SL
Dr.	R.M.	Silva	University of Sri Jayawardenepura, SL
Dr.	Rekha De	Silva	University of Peradeniya, SL
Prof.	T.D.	Silva	University of Colombo, SL
Dr.	Susil	Silva	Veterinary Research Institute, Gannoruwa, Peradeniya, SL
Mr.	A.P.	Sirisena	University of Peradeniya, SL
Prof.	B.S.M.S.	Siriwardena	University of Peradeniya, SL
Dr.	M.A.M.	Sitheeque	Emeritus Professor, University of Peradeniya, SL
Dr.	F.	Sitheeque	University of Peradeniya, SL
Mr.	Mayooran	Sithravelayuthan	University of Peradeniya, SL
Prof.	R.	Sivakanesan	Emeritus Professor, University of Peradeniya, SL
Dr.	V.	Sivakumar	University of Peradeniya, SL
Prof.	Sumathy	Sivamohan	University of Peradeniya, SL
Prof.	S.	Sivarajasingham	University of Peradeniya, SL
Prof.	C.	Sivayoganathan	University of Peradeniya, SL
Dr.	Ruwanthini	Siyabalapitiya	University of Peradeniya, SL
Dr. (Rev.)	Madurawala	Sobhitha	University of Peradeniya, SL
Dr.	G.M.	Somaratne	University of Peradeniya, SL

Prof.	Mahinda	Somathilake	University of Peradeniya, SL
Prof.	M.R.	Sooriarachchi	University of Colombo, SL
Prof.	S.D.S.S.	Sooriyapathirana	University of Peradeniya, SL
Prof.	N.S.	Soysa	University of Peradeniya, SL
Mr.	Sriharan	Sriranganathan	Sabaragamuwa University of Sri Lanka
Dr.	Shyamantha	Subasinghe	University of Peradeniya, SL
Dr.	S.M.U.T.S.	Subasinghe	University of Peradeniya, SL
Dr.	Chandana	Suraj	Sabaragamuwa University of Sri Lanka
Dr.	H.A.K.N.	Surangi	University of Kelaniya, SL
Dr.	Namali	Suraweera	University of Kelaniya, SL
Dr.	S.A.H.A.	Suraweera	University of Peradeniya, SL
Prof.	L.D.B.	Suriyagoda	University of Peradeniya, SL
Dr.	S.	Sutharsan	University of Peradeniya, SL
Dr.	Imalka	Tennakoon	University of Peradeniya, SL
Prof.	Sampath	Tennakoon	University of Peradeniya, SL
Dr.	C.	Thalagala	University of Peradeniya, SL
Dr.	H.	Thampoe	Visiting Lecturer, University of Peradeniya, SL
Mr.	Chaminda	Thilakarathna	University of Kelaniya, SL
Ms.	S.	Thilakarathne	University of Peradeniya, SL
Ms.	Sitharie	Thilakaratne	University of Colombo, SL
Dr.	Kumari	Thoradeniya	University of Peradeniya, SL
Mr.	W.	Thyagaraja	University of Colombo, SL
Dr.	B.K.G.	Tilakarathne	University of Peradeniya, SL

Prof.	W.M.	Tilakaratne	University of Malaya, Malaysia
Dr.	Dilshani	Tissera	University of Colombo, SL
Dr.	U.G.I.G.K.	Udagedara	University of Peradeniya, SL
Dr.	D. De S.	Udakara	University of Peradeniya, SL
Prof.	K.G.A.	Udayakumara	Rajarata University of Sri Lanka
Dr.	J.J.K.H.	Udupihille	University of Peradeniya, SL
Prof.	D.N.	Uduwawala	University of Peradeniya, SL
Dr.	Dimanthi	Uduwela	University of Peradeniya, SL
Dr.	Kanishka	Ukuwela	Rajarata University of Sri Lanka
Dr.	Udaya	Usgodaarachchi	Ministry of Health, SL
Dr.	Ramila	Usoof	University of Peradeniya, SL
Dr.	R.	Vandercone	Rajarata University of Sri Lanka
Dr.	T.N.	Vidanage	University of Peradeniya, SL
Prof.	K.P.	Vidanapathirana	Wayamba University of Sri Lanka
Prof.	J.K.	Vidanarachchi	University of Peradeniya, SL
Dr.	Kandasamy	Vignarooban	University of Jaffna, SL
Dr.	Thanabalasingam	Vinayagathasan	University of Peradeniya, SL
Dr.	Sameera	Vishvakula	University of Colombo, SL
Prof.	M.	Vithanage	University of Sri Jayewardenepura, SL
Dr.	P.R.K.A.	Vitharana	University of Peradeniya, SL
Prof.	Udaya	Vitharana	University of Peradeniya, SL
Dr.	S.	Wadugodapitiya	University of Peradeniya, SL

Dr.	Saminda	Wadusinghearachchi	National Dental Hospital, Colombo, SL
Dr.	Sampath Bandara	Wahala	Sabaragamuwa University of Sri Lanka
Prof.	K.S.	Walgama	University of Peradeniya, SL
Dr.	C.K.	Walgampaya	University of Peradeniya, SL
Dr.	W.M.S.	Wanasinghe	Open University of Sri Lanka
Prof.	W.A.D.P.	Wanigasundera	University of Peradeniya, SL
Dr.	Thusangi	Wannige	University of Ruhuna, SL
Dr.	H.M.K.S.	Wanninayake	University of Peradeniya, SL
Ms.	Rasika	Warnasooriya	Rajarata University of Sri Lanka
Dr.	Samanthi	Wasala	Plant Genetic Resources Center (PGRC) Gannoruwa, SL
Prof.	Jeevika	Weerahewa	University of Peradeniya, SL
Prof.	H.L.D.	Weerahewa	Open University of Sri Lanka
Prof.	Palitha	Weerakkody	University of Peradeniya, SL
Dr.	B.S.	Weerakoon	University of Peradeniya, SL
Dr.	G.M.P.R.	Weerakoon	University of Peradeniya, SL
Dr.	Tharindu	Weerakoon	University of Peradeniya, SL
Dr.	U.	Weerakoon	University of Peradeniya, SL
Ms.	Subashini	Weerakotuwa	University of Peradeniya, SL
Dr.	T.C.	Weeraratne	University of Peradeniya, SL
Dr.	Ishanka	Weerasekara	University of Peradeniya, SL
Prof.	Jagathpriya	Weerasena	University of Colombo, SL
Dr.	G.S.	Weerasinghe	University of Peradeniya, SL
Dr.	L.K.	Weerasinghe	University of Peradeniya, SL

Prof.	M.S. Samantha	Weerasinghe	University of Colombo, SL
Dr.	Shalanee	Weerasinghe	University of New England, Australia
Dr.	Ruvan	Weerasinghe	University of Colombo School of Computing, SL
Dr.	Thushari	Weerasinghe	University of Colombo School of Computing, SL
Prof.	V.	Weerasinghe	University of Peradeniya, SL
Dr.	S.A.	Weerasooriya	University of Peradeniya, SL
Prof.	R.	Weerasooriya	National Institute of Fundamental Studies, Kandy, SL
Dr.	Wei	Wei	Northwest Normal University,Gansu, China
Dr.	A.P.	Welagedara	University of Peradeniya, SL
Dr.	Ashoka	Welitota	University of Kelaniya, SL
Prof.	D.B.M.	Wickamarathne	University of Peradeniya, SL
Prof.	Carmen S.	Wickramagamage	University of Peradeniya, SL
Prof.	P.	Wickramagamage	Emeritus Professor, University of Peradeniya, SL
Dr.	Chitraka	Wickramarachchi	University of Sri Jayawardenepura, SL
Dr.	J.	Wickramaratne	Attorney-at-Law, SL
Dr.	Richard	Wickramaratne	University of Peradeniya, SL
Dr.	A.M.	Wickramasinghe	University of Colombo School of Computing, SL
Prof.	Chandima	Wickramasinghe	University of Peradeniya, SL
Dr.	Manori	Wickramasinghe	Wayamba University of Sri Lanka
Dr.	S.	Wickramasinghe	University of Peradeniya, SL

Prof.	Susiji	Wickramasinghe	University of Peradeniya, SL
Dr.	W.M.V.S.K.	Wickramasinghe	University of Peradeniya, SL
Prof.	A.	Wickramasinghe	University of Peradeniya, SL
Prof.	Deepthi	Wickramasinghe	University of Colombo, SL
Prof.	Sriyani	Wickramasinghe	Rajarata University of Sri Lanka
Mr.	Ashvin	Wickramasooriya	University of Peradeniya, SL
Dr.	Kapila Bandara	Wijayaratne	University of Peradeniya, SL
Dr.	Nayana	Wijayathilaka	University of Sri Jayewardenepura, SL
Dr.	Nayana	Wijayawardhane	University of Peradeniya, SL
Prof.	Pushpa	Wijekoon	University of Peradeniya, SL
Dr.	S.B.	Wijekoon	University of Peradeniya, SL
Dr.	C.	Wijekoon	Consultant Dermatologist, SL
Ms.	R.M.S.	Wijerathna	University of Peradeniya, SL
Prof.	K.M.	Wijerathne	University of Peradeniya, SL
Dr.	Sheevani	Wijeratne	Private Dental Practitioner (Orthodontist), SL
Dr.	R.G.S.	Wijesekara	Wayamba University of Sri Lanka
Dr.	D.P.H.	Wijesekera	University of Peradeniya, SL
Dr.	H.D.	Wijesekera	Open University of Sri Lanka
Prof.	D.G.N.G.	Wijesinghe	University of Peradeniya, SL
Dr.	Ganga	Wijesinghe	Department of Animal Production and Health, Getambe, Peradeniya, SL
Prof.	W.A.S.N.	Wijesinghe	University of Peradeniya, SL
Dr.	M.	Wijesinghe	University of Peradeniya, SL

Dr.	S.	Wijesinghe	Sri Lanka Institute of Nanotechnology (SLINTEC)
Dr.	W.R.P.	Wijesinghe	University of Peradeniya, SL
Dr.	Vipula	Wijesiri	University of Peradeniya, SL
Mr.	N.	Wijesiri	University of Peradeniya, SL
Dr.	Chaman	Wijesiriwardhana	University of Moratuwa, SL
Dr.	Udeni	Wijesooriya	University of Peradeniya, SL
Mr.	Chaminda	Wijesundara	University of Peradeniya, SL
Dr.	K.K.	Wijesundara	University of Peradeniya, SL
Dr.	S.D.K.	Wijesundara	University of Peradeniya, SL
Dr.	W.M.S.K.	Wijesundara	University of Peradeniya, SL
Dr.	G.	Wijesundera	University of Ruhuna, SL
Dr.	Kavindra	Wijesundera	University of Peradeniya, SL
Ms.	W.M.H.U.	Wijethunga	University of Peradeniya, SL
Dr.	S.	Wijetunge	University of Peradeniya, SL
Prof.(Rev.)	M.	Wimalagnana	University of Kelaniya, SL
Prof.	Swarna	Wimalasiri	University of Peradeniya, SL
Prof.	Deepthi	Yakandawala	University of Peradeniya, SL
Dr.	H.D.	Yapa	University of Peradeniya, SL
Dr.	Hiran	Yapa	University of Peradeniya, SL
Prof.	P.I.	Yapa	Sabaragamuwa University of Sri Lanka
Prof.	Dharshana	Yapa	University of Peradeniya, SL
Dr.	Duminda	Yasaratne	University of Peradeniya, SL
Prof.	Lalani	Yatawara	University of Peradeniya, SL
Dr.	Kaushalya	Yatigammana	University of Kelaniya, SL

Prof.	Sakunthala	Yatigammana-Ekanayake	University of Peradeniya, SL
Dr.	S.	Young	University of Colombo, SL
Prof.	Asoka De	Zoysa	University of Kelaniya, SL
Mr.	Indrajee De	Zoysa	University of Peradeniya, SL
Dr.	Kasun De	Zoysa	University of Colombo, SL

AUTHOR INDEX

Covid-19: Issues and Solutions
Education for Transformation
Environment and Natural Resources
Food, Nutrition and Livestock
Health and Society
Language, Culture and Thought
Science, Technology and Industry
Socioeconomic Progress and Governance

iPURSE 2021
PERADENIYA UNIVERSITY INTERNATIONAL RESEARCH SESSIONS
Research and Innovation for an Inclusive Society