ICAPS
International Conference on Applied and Pure Sciences 2023

PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON APPLIED AND PURE SCIENCES

ICAPS 2023

"Sustainable Development through the Advancement of Science and Technology"

13th OCTOBER 2023

Faculty of Science
University of Kelaniya
Sri Lanka

Proceedings of the International Conference on Applied and Pure Sciences (ICAPS 2023-Kelaniya)

Volume 3

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"Sustainable Development through the Advancement of Science and Technology"

ISSN 2815-0112
Editor:
Senior Prof. (Mrs.) B. Jayawardena

Published by
Faculty of Science
University of Kelaniya
Sri Lanka

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Keynote Speaker

Dr. Charith Nanayakkara is currently working as a Principal Scientist for Applied Materials, Massachusetts, USA, where he is developing next generation semiconductor technologies. Dr. Nanayakkara obtained BSc Honours degree in Chemistry from the Department of Chemistry, University of Kelaniya, Sri Lanka and PhD in Chemistry from the Department of Chemistry, University of Iowa, USA. During his doctoral studies he worked on nanotechnology and surface science research. Dr. Nanayakkara was also a postdoctoral research associate at the Department of Materials Science and Engineering, University of Texas at Dallas, USA. His postdoctoral research was focused on developing thin film deposition processes and understanding the film deposition mechanisms for various semiconductor applications. His transition from academia to industrial Research and Development started with the deposition material Research and Development at EMD Electronics, Massachusetts, USA, which is the Semiconductor materials business unit of Merck. During his Research and Development work at EMD Electronics, he worked on developing new Atomic Layer Deposition processes. He also worked as a Senior Process Engineer for ASM, Arizona, USA, where he worked on developing Atomic Layer Deposition process equipment. During his industrial Research and Development work, he had worked on developing new Atomic Layer Deposition process and Chemical Vapor Deposition process and also equipment technology for the next generation semiconductor applications. Dr. Nanayakkara has contributed over 15 Science Citation Indexed journal articles and his citation record is over 1000 with an H index of 11.

Guest Speaker

Prof. Ajith De Alwis is a Senior Professor in Chemical and Process Engineering at the Faculty of Engineering, University of Moratuwa, Sri Lanka and he currently serves as the Dean, Faculty of Graduate studies, University of Moratuwa. Prof. De Alwis obtained BSc in Chemical Engineering from University of Moratuwa and PhD from University of Cambridge, UK. He also has an MBA from Post Graduate Institute of Management of University of Sri Jayewardenepura. Prof. De Alwis was also a post-doctoral research fellow at University of Reading, UK and a visiting scientist at the Indian Institute of Science in Bangalore. He is the Director of the University of Moratuwa-Cargills Food Process Development Incubator and the Project Director of the Coordinating Secretariat for Science, Technology and Innovation. He served as the Chairman of Engineering Research Unit of University of Moratuwa from 2005 to 2007. He was the Science Team Leader of the Sri Lanka Institute of Nanotechnology from its inception in 2008 to 2011, and Chairman of the National nanotechnology committee at NSF from 2011-2012. His research interests include developing environmentally friendly technologies, appropriate technologies for energy efficiency and conservation techniques for process industries, renewable energy systems, process modifications and optimisation techniques to maximize yields and resource usage, solid waste management and waste to energy systems. He is the recipient of numerous awards in recognition of his work. Prof. De Alwis is a member of various local and international professional bodies. He is also the founding President of Sri Lanka Biogas Association of Sri Lanka. He served as a member in the Board of Scientific Counselors of National Institute for Occupational Safety and Health. He is serving in the Intellectual Property Advisory Committee of the National Intellectual Property Office, Sri Lanka. He has contributed about 100 Science Citation Indexed journal articles and his citation record is over 2000 with an H index of 22.

Abstract of the Plenary Speech – Biological Sciences

Dissecting the elusive activation pathway of a pro-apoptotic BCL-2 protein

Dr. Christina Camara
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Cell growth and death exist in a delicate homeostasis. Here, even a minor imbalance can herald the onset of disease. Unregulated growth is generally associated with cancer and autoimmune pathology, while excessive cell death is characteristic of neurodegeneration and immunodeficiency. Elaborate corrective systems have evolved to counterbalance this fragility, including the Bcl-2 family of proteins. Among these is BAK a pro-apoptotic Bcl-2 which can act as a potent mediator of cell-death in hematological malignancies (such as leukemias and lymphomas). While BAK has attracted great interest as a drug target, its instability ex vivo has impeded its biophysical and structural characterization. I will describe how molecular simulation can be combined with different analytical tools to escape these limitations. Notably, the resulting data constrain the physiological dynamics of BAK and indicate conformational targets for rational drug design. These efforts are among the first atomic-scale mappings of pro-apoptotic Bcl-2 dynamics, with lessons that will extend throughout this important protein family.

Abstract of the Plenary Speech – Physical Sciences

Navigating the Drug Development Landscape: A Roadmap of Mathematical and Statistical Approaches

Dr. Janak Wedagedera
Senior Research Consultant
Cytel Statistical Services and Software UK Limited
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The development of therapeutic drugs is a complex and protracted journey that unites the expertise of various disciplines and industries in a collective pursuit of delivering optimal patient care within resource constraints. Within this multifaceted landscape, the pivotal roles of Mathematical/ Statistical Modelling and Computer Simulations are indisputable. These tools empower decision-makers to tackle questions that are otherwise infeasible to address directly in living individuals due to a myriad of constraints. In this presentation, we explore the historical development of mathematical modelling and the challenges of representing the wide variability observed in physiology, demographics, and drug-related parameters. We also discuss how these components are integrated to create mathematical models that explain how drugs move through different tissues and organs in the human body. The resulting mathematical models often involve multi-dimensional parameter spaces. We also cover the tools and methods used to address identifiability issues, allowing for the selection of the most influential and realistic parameters for simulations. An essential aspect of this process is incorporating prior distributions of parameters derived from in-vitro experiments and scaling them up to in-vivo organs. Quantifying inter-individual variability in drug concentration and exposure is crucial for recommending dosing regimens for various sub-populations, such as different sexes, ethnicities, patients with underlying health conditions, and age groups. This requires incorporating prior parameter distributions as "random effects" and addressing any unexplained variability in observations as residual errors resulting in predictions via mathematical models. The unknown, unmeasured and uncertain but model sensitive parameters will be estimated via inference techniques such as Bayesian MCMC simulations by fitting the statistical models to data. Finally, we present a case study illustrating the use of a simple mathematical model in modelling the latest Gene Therapy for Haemophilia A. We demonstrate how this model can be used to compare the efficacy of Gene Therapy with other prophylactic treatments, showcasing the practical application of mathematical modelling and simulation in modern drug development.

Abstract of the Plenary Speech – Software Intensive Systems

Functional Clustering of White Matter Fibers

Professor Jingyong Su
Harbin Institute of Technology at Shenzhen
China

White matter (WM) consists of fibers that transmit information from one brain region to another, and functional fiber clustering that combines diffusion and functional MRI provides a novel perspective for exploring the functional architecture of axonal fibers. However, existing methods only concern functional signals in gray matter (GM), whereas the connecting fibers may not transmit relevant functional signals. There has been growing evidence that neural activity is encoded in WM BOLD signals as well, which provides rich multimodal information for fiber clustering. In this talk, I introduce a comprehensive Riemannian framework for functional fiber clustering using WM BOLD signals along fibers. Specifically, we derive a novel metric that is highly discriminative of different functional classes while reducing the variability within classes and, in the meantime, enables low-dimensional coding of high dimensional data. Our in vivo experiments show that the proposed framework is able to achieve clustering results with inter-subject consistency and functional homogeneity. In addition, we develop an atlas of WM functional architecture for standardisable yet flexible use and exemplify a machine-learning-based application for the classification of autism spectrum disorders, which further demonstrates the great potential of our approach in practical applications.

Abstract of the Plenary Speech – Multidisciplinary Research

Passive Radiative Cooling: A Sustainable Solution for Sri Lanka's Cooling Needs

Dr. Sampath Gamage
Postdoctoral researcher/Instructor
University of Georgia GA, USA

The global demand for cooling is driving a vicious cycle of increased fossil fuel consumption, leading to further heating. Predictions indicate that the energy required for space cooling, primarily in the form of electricity, will triple by 2050. Addressing this issue involves two main approaches: harnessing renewable energy sources and reducing consumption. Passive Radiative Cooling (PRC) offers significant potential in minimizing energy usage. PRC capitalizes on radiative heat exchange, utilizing the temperature difference between Earth's surface (approximately 300 K) and outer space (about 4 K). This natural phenomenon allows PRC systems to cool objects without electricity, reducing energy consumption and greenhouse gas emissions. PRC is founded on the principle that all objects emit and absorb thermal radiation, with emission rates linked to temperature. By selectively directing heat emission towards the coldness of outer space, PRC systems enable objects to reach temperatures well below their surroundings. This presentation provides an overview of PRC technology, encompassing its fundamental principles, diverse PRC materials, and design strategies. It also delves into recent PRC research, emphasizing noteworthy discoveries and contributions. Furthermore, the talk explores the relevance of PRC in the context of Sri Lanka, elucidating how it can mitigate the nation's unique cooling and energy consumption challenges. Additionally, practical applications of PRC in Sri Lanka, such as in buildings, agriculture, and the clothing industry, are presented as examples.

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Physical Sciences

Abstract No: BO-01

A taxonomic survey of fireflies (Coleoptera: Lampyridae) in selected sites of Rammale Forest Reserve, Southern, Sri Lanka

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Fireflies are a group of charismatic insects, and they are important for the sake of tourism and biodiversity. Information on fireflies associating with forest ecosystems in Sri Lanka is still scarce. Hence, the present study was aimed for investigating the firefly faunain Rammale Forest Reserve (RFR), southern, intermediate zone, Sri Lanka. The study was conducted from December 2022 to May 2023. Six visual encounter surveys were conducted once per month using 10 randomly selected sampling points (radius = 3 m) in the RFR. Six sampling points in terrestrial areas and four points in freshwater-associated areas were selected. Fireflies at selected sampling points were observed from 17.30 to 22.00 in each survey. In the study, 13 species of fireflies among 10 genera, namely *Abscondita* (*Abs. perplexa* and *Abs. promelaena*), *Luciola* (*L. candezei* and *L. nicolleri*), *Diaphanes* (*D. lutescens*), *Pygoluciola* (sp1 and sp2), and one from the genus *Asymmetriacta* (*A. humeralis*), *Curtos* (*C. costipennis*), *Lamprigera* (*L. tenebrosus*), *Sclerotia* (*Scl. substriata)*, *Harmatelia* (*H. bilinia*), and *Eugeusis* (*E. palpator*), were recorded. Among them, *H. bilinia,* and *E. palpator* are endemic to Sri Lanka. *Pygoluciola* sp1 (n = 78, 19.5%), *Abs. perplexa* (n = 76, 19%), *Abs. promelaena* (n = 64, 16%), *Pygoluciola* sp2 (n = 53, 13.2%) and *A. humeralis* (n = 45, 11%) were common species in RFR, while the rest of the 8 species were recorded as less abundant fireflies in the forest. Three species, *Scl. substriata, Pygoluciola* sp1 and sp2, were recorded from water-associated areas, and the other 11 species were recorded from terrestrial areas. Terrestrial habitats consisted with moderate canopy of intermediate trees and water associated habitats mainly contained ferns and other riparian vegetation. Both types of habitats are free of human-induced disturbance. This baseline survey is vital as the first taxonomic survey of fireflies in RFR, and its findings will crucially support enhancing the information on firefly biodiversity in Sri Lanka.

Keywords: Lampyrids, Rammale Forest Reserve, Southern-Intermediate zone, Sri Lanka

Acknowledgment
Permission for the study was granted by the Department of Wildlife Conservation and the Department of Forest Conservation, Sri Lanka.

Abstract No: BO-02

Effect of farm management practices on the welfare of dairy cows and microbiological quality of raw milk in Naththandiya area, Sri Lanka

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Animal welfare receives great attention as it is highly important for enhancing milk production and microbiological quality. Literature reveals that the apprehension of dairy cow welfare practices among farmers is at a low level and limited studies have been carried out on dairy cattle welfare, in Sri Lanka. This study focused on investigating the impact of cattle management and welfare practices on the microbiological quality of raw milk. A total of 87 dairy cows from 50 tie-stall dairy farms in the Naththandiya Area in Sri Lanka were randomly selected. Three categories of measurements were collected; protocol-based measurements, facility-based measurements and animal-based measurements based on a questionnaire. The microbiological quality of raw milk samples was determined using Total Colony Count (TCC) of bacteria and count of *Bacillus cereus.* Statistical analyses of data were performed using SPSS 23.0 software. The floor quality was assessed in terms of cleanliness, presence of hoof damageable cracks and the grip. It was found that farmers' attention on quality of flooring remained low. Improper flooring conditions, including presence of dirt (28%), slippage (62%), and hooves being prone to damage (50%), were observed and correlated ($P<0.05$), with the prevalence of lameness (12.5%) and hock wounds (12.8%). Based on the survey, concrete flooring was the most prominent bedding type (80%) followed by the soil type (20%). The type of flooring significantly influenced the slipperiness of the shed ($P<0.001$). A considerable percentage of cows (36.0%) showed signs of wounds, and floor slipperiness significantly ($P<0.05$) affected the prevalence of wounds. Lower attention on the quality of feeders (14%) and water troughs (12 %) was observed. Positive welfare attitude towards cows was observed in 66% of farmers. The average score of farmer attitudes (6.12) and stockperson attitude obtained, significantly ($P<0.001$) affected on the floor quality. According to the microbiological analysis, 48 % of the samples were found to be contaminated with *Bacillus cereus.* The Total Colony Count (TCC) of bacteria and the count of *Bacillus cereus* varied significantly ($P<0.05$) across different farms. TCC is significantly correlated ($P<0.05$) with the floor dirtiness of particular farm. However, there was no significant difference ($P>0.05$) in between the floor type, TCC and Count of *Bacillus cereus.* The current study highlighted the critical welfare issues of dairy cows in Naththandiya area and some of these welfare issues had impact on the quality of raw milk. Therefore, it is essential to improve management practices and increase stockperson awareness to enhance dairy cow welfare and there by the quality of raw milk.

Key Words: Cow welfare, Flooring, Management practices, Milk quality

Acknowledgment
This work was supported by Graduate Institute of Science and Management.

Abstract No: BO-03

Preliminary studies of antioxidant and anti-inflammatory activities in methanol extracts of mistletoe (Pilila) in guava

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Mistletoe has been found to possess antioxidant and anti-inflammatory properties, which are attributed to various bioactive compounds such as phenolic acids, flavonoids, and tannins. These properties make mistletoe a potential candidate for developing natural remedies for various ailments related to oxidative stress and inflammation. In the current study, the antioxidant and anti-inflammatory potential of *Dendrophthoe falcata*, a mistletoe species, parasitic on its host plant, *Psidium guajava* (guava) was evaluated. Cold extraction at lower temperatures was used to obtain a higher yield of bioactive compounds responsible for antioxidant and anti-inflammatory properties as they are sensitive to heat. Methanol was selected as the solvent due to its high-yielding capacity towards the above compounds. Three host guava (*Psidium guajava*) containing mistletoe in species of *Dendrophthoe falcata* were selected and guava host leaf samples (S_1L, S_2L, S_3L) and mistletoe leaf samples (S_1M, S_2M, S_3M) were obtained from each tree. To determine the antioxidant activity of the mistletoe, Total Phenolic Content (TPC), Total Flavonoid Content (TFC), DPPH radical scavenging activity, and Ferric-Reducing Antioxidant Power (FRAP) were analyzed. The highest TPC and TFC were resulted as 169.46 ± 2.06 GAE mg/g and 46.16 ± 1.15 CE mg/g respectively for the mistletoe leaf sample (S_3M) obtained from the host 03. S_3M has shown 0.091 ± 0.001 mg/mL as it's IC_{50} value for DPPH test which is the lowest IC_{50} values from all mistletoe samples, while giving 0.523 ± 0.010 mg/g BHT equivalent value for FRAP assay. The correlation between TPC and TFC was analyzed using the Pearson's correlation analysis, and a robust positive correlation was detected between the TPC, TFC, and antioxidant activities. The study evaluated the anti-inflammatory activity by examining the heat-induced hemolysis. The mistletoe leaf samples demonstrated significant values for the heat-induced hemolysis assay (IC_{50} = 488.302 ± 23.407 µg/mL by S_3M), indicating potential anti-inflammatory activity. Diverse physical properties and growth conditions of mistletoe leaves can contribute to variations in the samples, resulting in inconsistent outcomes. Nonetheless, this limitation did not impede the evaluation of antioxidant and anti-inflammatory properties associated with the presence of mistletoe. As a result, it can be inferred that methanol extracts of mistletoe (*Dendrophthoe falcata*) contain antioxidant and anti-inflammatory activity, which leads for future research endeavors.

Keywords: Anti-inflammatory activity, Antioxidant activity, Cold extraction, Guava, Methanol extract

Acknowledgment
This work was supported by Department of Chemistry, Faculty of Science, University of Kelaniya, Sri Lanka under the research grant RP/03/02/06/06/2021.

Abstract No: BO-04

Identification of plant based anti-diabetic drug leads: A computer-based drug discovery approach

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Diabetes mellitus is known to be one of the fastest-rising chronic metabolic diseases with multiple etiologies. The disease is characterized by chronic hyperglycemia resulting from defects in insulin secretion, insulin action or both. Available therapeutic agents, come with their fair share of side effects. Plant-derived medications that have been used for centuries in the treatment of diabetes in ayurveda and folk medicine have gained a lot of attention in recent years. Studies have shown that plants consist of many bioactive compounds with anti-diabetic properties. Computer-aided drug discovery is slowly gaining popularity with molecular docking accelerating drug discovery by providing structure-based interactions between ligand and receptor proteins. This study was designed to use computational methods to identify the best anti-diabetic compounds devised from ten selected plants. A total of ten plants and three target receptor proteins were selected for *in silico* screening based on the literature. The selected plants were *Nigella sativa L., Coccinia grandis (L.) Voigt, Cheilocostus speciosus (J.Koenig) C.D.Specht, Momordica charantia L., Strychnos potatorum L.f, Gymnema sylvestre (Retz.) R.Br., Aloe vera (L.) Burm.f., Scoparia dulcis L., Abutilon indicum (L.) Sweet, and Trigonella foenum-graceum L.* A phytochemical compound library with a total of 952 ligands was prepared using IMPPAT database. The main target receptor proteins, include α-glucosidase, α-amylase and dipeptidyl peptidase-IV (DPP-IV), based on their key roles in the maintenance of glucose homeostasis. The 3D protein structures were downloaded from the RCSB Protein Data Bank. Miglitol, sitagliptin and acarbose were selected as reference drugs for each target protein to conduct a comparative study. Biovia Discovery Studio was used to visualize the target protein and prepare the protein for virtual screening. UCSF Chimera and PyRx Autodock were used for the energy minimization of the proteins and the virtual screening respectively. Schrodinger Maestro was used for the dynamic simulation studies with the OPLS-2005 force field and TIP3P Solvent model. The compound library was screened by carrying out flexible docking against each target protein. The search space for virtual screening was defined to include all the critical inhibitor-binding sites based on the literature. All the compounds having binding affinity less than -6 kcal/mol were selected.. Only the compounds with promising binding energy values, depending on each target, were subjected to the target-ligand interaction analysis conducted using Biovia Discovery Studio. The binding affinity and interaction patterns of phytochemical ligands were evaluated against three receptor proteins. The best three molecules for each protein were selected based on the best hydrogen bond interactions since they determine the specific, energetically favorable ligand binding at the target sites. The selected 12 molecules were further analyzed for the best target-ligand binding conformation and subjected to molecular dynamics simulation. Compound 27 and compound 85 in *T. foenum-graceum* with RMSD less than 3Å and hydrogen bond retention above 75% in 100NS simulation were identified as promising therapeutic drug leads for the treatment of diabetes. *In vitro* screening for the antidiabetic activities would be conducted using α-glucosidase, α-amylase and DPP-IV assays to further assess their effectiveness as anti-diabetic drug leads.

Keywords: Anti-diabetic assays, *Cheilocostus speciosus*, *Gymnema sylvestre*, Molecular docking, *Trigonella foenum-graceum*

Abstract No: BO-05

Assessment of level of public knowledge, attitude, and perception towards sustainable mangrove forest conservation: a case study from Negombo region, Sri Lanka

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Mangroves have been an essential vegetative component not only in sustaining the balance of ecosystems but also in providing significant socio-economic benefits to the local communities such as fish, timber, and tourism opportunities to the local communities. Quantifying knowledge, attitudes, and perception (KAP) supports sustainable mangrove conservation by informing conservation efforts to address local needs and priorities and monitoring interventions' effectiveness over time. Thus, this study aims to determine the level of knowledge, attitudes, and perceptions of the public toward sustainable mangrove forest conservation in the Negombo region, Sri Lanka. Prior to data collection, a pilot study was conducted in the study area with 40 respondents and Cronbach's alpha ($\alpha = 0.819$) reliability test was followed to test the reliability of the data. Data were collected via face-to-face interviews with randomly selected 395 respondents living near and around the northern region of the Negombo lagoon, which involved 8 Grama Niladhari Divisions. 51.39% of the individuals were male, while the remaining 48.61% were female, reflecting a commitment to gender equality. A Likert scale and correlation analyses were implemented using SPSS version 26 software to determine the community's knowledge, attitude, and perception (1-lowest and 5-highest). The finding shows that the level of knowledge of the community on the importance of sustaining mangrove forests was high from 3.92 to 4.72, the level of attitude was between 3.2 to 4.88, and the perception components from 4.47 to 4.83. There were significant gender differences in both attitude and perception toward mangrove forest conservation, with the female respondents achieving better scores than the male respondents, although there was no significant difference in their knowledge levels. Also, about 96.2% of respondents agree that the loss of mangroves will have negative impacts on the environment and the economics of the livelihood. Furthermore, most respondents believed that chemical pollution, illegal clearing, and development activities have a significant impact on the degradation of mangroves in the area. The correlation test showed that there was a strong positive correlation between knowledge and attitude ($r = 0.901$, $p < 0.001$), knowledge and perception ($r = 0.795$, $p < 0.001$), and attitude and perception ($r = 0.864$, $p < 0.001$) respectively. They suggest that the most effective approach for preserving this ecosystem's survival is to engage in mangrove replanting through proper scientific monitoring, while also recommending the rectification of policy deficiencies and the execution of comprehensive strategies for mangrove conservation. The findings from this study may provide valuable information for future research, as well as assist government and stakeholders in enhancing the effectiveness of campaigns and programs focused on the sustainable management of mangrove forests.

Keywords: Attitude, Knowledge, Mangroves, Perception, Sustainable Conservation

Abstract No: BO-06

Zinc oxide nanoparticles synthesized using *Camonea bifida* leaf extract as a potential antimicrobial and antibiofilm agent

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Metal nanoparticles have gained much attention in the biomedical field due to excellent biocompatibility and less toxicity. Zinc oxide nanoparticles (ZnO NPs) have exhibited excellent therapeutic value by acting antimicrobial, anti-cancer, anti-diabetic and anti-inflammatory agent. ZnO NPs are also effective in combating biofilm-associated infections. Only a few investigations have been performed on NP synthesis using *C. bifida*. This study was conducted to evaluate the *in vitro* antibiofilm and antimicrobial activity of *Camonea bifida*-derived ZnO NPs. *C. bifida* leaf extract was prepared by boiling 2g of dried leaves powder in 40 ml of distilled water at 60^{o}C for 30 minutes. ZnO nanoparticles were synthesized using ($Zn(CH_3CO_2)_2$) as the reducing agent for Zinc ions. The effect of reaction parameters including zinc acetate ($Zn(CH_3CO_2)_2$) concentration, leaf extract: $Zn(CH_3CO_2)_2$ ratio and reaction temperature were optimized to achieve higher yield using UV-Visible spectroscopy (($Zn(CH_3CO_2)_2$ concentration: 0.1-0.5 M), leaf extract: $Zn(CH_3CO_2)_2$ ratio 1:9, 1:7, 1:5, 1:3, 1:1 and reaction temperature : 0^{o}C, 30^{o}C, 40^{o}C, 60^{o}C, 80^{o}C). Nanoparticles were characterized by Scanning Electron Microscopy and Fourier Transform Infrared Spectroscopy (FT-IR). The antimicrobial activity of ZnO NPs was studied against *Staphylococcus aureus* (ATCC 25923), *Escherichia coli* (ATCC 25922), *Klebsiella pneumoniae* (ATCC 1706), *Pseudomonas aeruginosa* (ATCC 27853), *Candida albicans* (ATCC 10231), *Candida glabrata* (ATCC 90030), *Candida tropicalis* (ATCC 13803). Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC) were studied. Gentamicin (600µg/mL) and Fluconazole (500µg/mL) were the positive controls for bacteria and fungi respectively. Negative control was sterile distilled water. Antibiofilm activity of ZnO NPs was assessed using crystal violet assay for *P. aeruginosa* and *C. glabrata*. The optimum conditions were 0.3M $Zn(CH_3CO_2)_2$, 1:3 ratio and 40°C. UV-Visible peak around 390 nm and precipitate formation confirmed the ZnO NP formation. ZnO NPs were spherical and irregularly shaped and were in the range of 60-70 nm. Functional groups attached on to the surface of NPs such as -OH and -C-H were revealed by FT-IR spectrum. According to UV-Visible spectra, ZnO NPs were stable for 2 months. All selected organisms were susceptible to ZnO NPs. Higher zones of inhibition were given by *P. aeruginosa* (30.7±0.3 mm), *S. aureus* (25.7±0.3 mm) and among fungi, *C. tropicalis* (27.7±0.3 mm). Both the MIC and MBC of ZnO NPs against *S. aureus* and *P. aeruginosa* were 3.6 mg/mL. ZnO NPs inhibited the biofilm formation of *P. aeruginosa* and *C. glabrata* by 68% and 52% respectively at 28.4 mg/mL concentration. *S. aureus*, *P. aeruginosa* and *C. tropicalis* showed higher susceptibility against the NPs. The highest antibiofilm activity of ZnO NPs was reported against *P. aeruginosa*. Results suggest that ZnO NPs are an effective antimicrobial and antibiofilm agent against tested pathogenic microorganisms.

Keywords: Antimicrobial activity, *Camonea bifida*, FT-IR, Zinc oxide nanoparticles

Abstract No: BO-07

Biosynthesis of silver nanoparticles using *Camonea bifida* leaf extract and investigation of antimicrobial properties

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Silver nanoparticles (AgNPs) have been used in nanomedicine as an alternative antimicrobial agent and disinfectant. The biological synthesis of silver nanoparticles has gained much attention due to its eco-friendly and less toxic nature. The present study was focused on the biosynthesis of AgNPs using *Camonea bifida* leaf extract and the investigation of their antimicrobial and antibiofilm properties. Aqueous leaf extract (5 g/100 mL) of *Camonea bifida* was subjected to heat treatment at 60°C. For the optimization of synthesis, parameters including $AgNO_3$ concentration, $AgNO_3$: plant extract ratio, and reaction temperature were studied. The formation of AgNPs was confirmed by the UV-Visible absorption spectrum. Particle characterization was performed using Transmission electron microscopy (TEM), Scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FT-IR), and stability study. Antimicrobial activity was studied using well diffusion method against *Staphylococcus aureus* (ATCC 25923), *Pseudomonas aeruginosa* (ATCC 27853), *Escherichia coli* (ATCC 25922), *Klebsiella pneumoniae* (ATCC 1706), *Candida glabrata* (ATCC 90030), *Candida albicans* (ATCC 10231), and *Candida tropicalis* (ATCC 13803). Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC) were performed for *Staphylococcus aureus* and *Pseudomonas aeruginosa*. Gentamicin (600 µg/mL) and Fluconazole (500 µg/mL) were used as positive controls. The antibiofilm activity of AgNPs against *Pseudomonas aeruginosa* and *Candida glabrata* was performed using crystal violet assay. Color change and UV-Visible peak around 450 nm confirmed the formation of AgNPs. FT-IR spectrum indicated the presence of different functional groups of biomolecules such as O-H, C-H, C=O, C-N on the surface of AgNPs. The phytochemical analysis confirmed the presence of flavonoids, phenols, tannins, terpenoids, and chalcones as reducing and capping agents. TEM and SEM results indicated spherical-shaped AgNPs with an average size of 34 nm. AgNPs were stable for more than 4 weeks under room conditions. *Pseudomonas aeruginosa* (15.0±0.0 mm) and *Staphylococcus aureus* (16.0±0.6 mm) showed the highest sensitivity towards AgNPs while *Escherichia coli* showed moderate results (12.7±0.9 mm). *Klebsiella pneumoniae* and other *Candida* species did not respond except *Candida tropicalis* (10.3±0.3 mm). MIC and MBC of AgNPs against *Staphylococcus aureus* were 20.6 µg/mL and 41.3 µg/mL. MIC and MBC of AgNPs against *Pseudomonas aeruginosa* were 5.2 µg/mL and 10.3 µg/mL respectively. The percentage inhibition of biofilm formation of *Pseudomonas aeruginosa* and *Candida glabrata* was 69% and 61% respectively for 650 µg/mL AgNPs concentration. The overall results indicated the potential of using *Camonea bifida* mediated AgNPs as a promising antimicrobial and antibiofilm agent.

Keywords: Antibiofilm activity, Antimicrobial activity, *Camonea bifida*, Nanomedicine, Silver nanoparticles.

Abstract No: BO-08

Assessment of water quality and pollution state using selected physicochemical parameters and bioindicators in "Modi canal" Galle

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This study was carried out to assess the water quality and pollution status using selected physicochemical and biological parameters in "Modi Canal" at Galle. Water samples were collected from five different sites for assessing selected physicochemical parameters. Sediment samples by Ekman grab and filtered water samples by plankton nets were also collected to assess water quality using macroinvertebrates, zooplanktons, and phytoplanktons. Shannon Wiener Diversity Index (SWDI) and Pollution Tolerant Index (PTI) were calculated for macroinvertebrates, zooplanktons and phytoplanktons according to the standard manual published by the United States Environmental Protection Agency (USEPA). During the study period, range of mean values of physicochemical parameters in the five sampling sites were temperature: 27.5-28.9^{0}C, pH: 6.97-7.29, conductivity: 0.14 - 4.92 mS, salinity: 0.05-1.94 ppt, dissolved oxygen: 1.39-5.98 mg/L, biological oxygen demand: 0.34-1.14 mg/L, chemical oxygen demand 4.89-29.20 mg/L, alkalinity: 0.001- 0.004 mg/L, nitrate: 0.595-1.48 mg/L, phosphate: 0.437-2.867 mg/L. All the selected physicochemical parameters in selected five sites were significantly different from each other ($p<0.05$: One-way ANOVA) during the study period. Considering the biological parameters, most of the macroinvertebrates identified within the canal were pollution-tolerant species such as chironomid larvae and aquatic worms. The calculated SWDI value for macroinvertebrates ranged from 1.30 to 1.87 and the PTI value ranged from 10.7 to 9.2. The SWDI values for zooplanktons ranged from 0.79 to 1.13 among the sites. Group Cladocera was recorded prominently in most sites. Among phytoplanktons, *Spirogyra* sp. and *Cylindrospermum* sp. were recorded as mostly found species and the SWDI value for phytoplanktons ranged from 0.83 to 1.31 among the sites. No significant differences of abundance values were observed among sites for macroinvertebrates, zooplanktons, and phytoplanktons. The present study concludes the "Modi Canal" at Galle as heavily polluted.

Keywords: Physicochemical parameters, Ekman grab, Macroinvertebrates

Abstract No: BO-09

Formulation of novel organic liquid fertilizer for growth enhancement of ornamental cactus: *Opuntia microdasys* (Lehm.) Pfeiff

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The ornamental plant industry is one of the world's most commercially significant plant-based industries. Among the ornamental plants, cacti are popular due to their attractive plant morphology. *Opuntia microdasys* (Lehm.) Pfeiff. is an expensive and popular house plant in Sri Lanka, and it is grown at large scales to fulfill the high market demand. Growers use excessive amounts of phosphorous-rich chemical fertilizers to enhance the growth of cacti, and they may cause both human and environmental health issues either directly or indirectly. This study aimed to formulate an organic liquid fertilizer (OLF) to provide nutrients for *O.microdasys* as an alternative to chemical fertilizers. Hence, the study evaluated the effect of a novel OLF and its optimum concentration for the growth performances of *O. microdasys*. To prepare the OLF, fresh *Tithonia diversifolia* leaves, dried cow dung, coconut husk ash, and powdered rock phosphate (1.5:1.25:1.25:1 ratio) were aerobically digested in well water (6.0 L) for six weeks at 27 °C. Same-sized, *O. microdasys* cladodes were grown in 5 cm diameter plastic pots (one cladode per each) containing cacti growth medium (coarse sand, river sand, and compost in a 4.1.1 ratio). One month after growth, *O. microdasys* plants were treated with 5%, 15%, and 25% of the concentrations of OLF once a week with 15 replicates. Chemical liquid fertilizer (CLF) "Lonzin" was used as the positive control, and well water was the negative control. Treated *O. microdasys* plants were arranged in a randomized block design in a plant house, and the pots were rotated clockwise every two weeks to obtain adequate sunlight. The growth performances of the *O. microdasys* plants were evaluated after six months by measuring the plant height, number of cladodes, cladode's length, width, and root length. All the data were subjected to the One-way ANOVA at $p = 0.05$ followed by Tukey pairwise comparison tests using the R statistical software. The lowest mean height (7.6 ± 1.0 cm), number of daughter cladodes (1.3 ± 0.8), root length (7.8 ± 1.9 cm), cladode's length (4.0 ± 0.8 cm), and cladode's width (2.7 ± 0.3 cm) *of O. microdasys* plants were recorded by the negative control. The growth performances of the *O. microdasys* plants under OLF treatments were significantly higher (One-way ANOVA, $p < 0.05$) than the CLF. Among the concentrations tested, the 5% OLF concentration significantly enhanced the plant height (12.7 ± 1.8 cm), number of daughter cladodes (3.6 ± 1.4), cladode's length (5.0 ± 0.8 cm) and cladode's width (3.6 ± 0.7 cm). Therefore, 5% OLF can be recommended as the optimum OLF concentration for the growth enhancement of *O. microdasys*.

Keywords: Aerobic digestion, Cactus, *Opuntia microdasys*, Organic liquid fertilizer

Acknowledgment
This work was supported by University research grant under the research grant no:RP/03/02/01/03/2020 of the University of Kelaniya, Sri Lanka.

Abstract No: BO-10

Effects of a commercial probiotic incorporated feed on growth performance and nutrient digestibility of fancy guppy, *Poecilia reticulata* (Poecilidae)

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The ornamental fish industry is one of the most thriving industries worldwide. The incorporation of probiotics into the feeds to enhance the production performance of cultured aquatic organisms is a novel implementation of science and technology. The present study was conducted to investigate the effects of a commercial probiotic incorporated feed on the growth performance and nutrient digestibility of *Poecilia reticulata.* Three experimental diets (T1- 1.0 x 10^{-1} cfu/mL, T2- 1.0 x 10^{2} cfu/mL, and T3- 1.0 x 10^{5} cfu/mL of probiotic concentration with four strains of *Bacillus subtilis* and a control diet (without the probiotic) were fed to fish in three replication glass tanks (30 cm x 15 cm x 30 cm) for 75 days. In each tank, ten *P. reticulata* with weight and length of 0.09 ± 0.00 g and 0.9 ± 0.00 cm respectively, were stocked after one week of acclimatization. Fish were fed twice a day at 2% of their body weight. Dissolved oxygen (DO) and pH were measured weekly and the standard length and weight of fish were measured bi-weekly. Fecal matter was collected twice a week from each experimental tank. The nutrient digestibility of *P. reticulata* was determined using chromic oxide as an inert marker. The proximate composition of the diets was analyzed using standard methods. DO and pH were not significantly different between the treatment and the control tanks ($p>0.05$, One-way ANOVA) and were within the optimum ranges for guppy (DO> 6 mg/L, pH 6.8- 7.8). Incorporating the probiotic into the commercial feed positively affected the specific growth rate (SGR), average daily growth (ADG), % body weight increase (% BWI), and % total length gain (% TLG) of *P. reticulata*. T3 had the best growth performance with the highest final weight (3.25± 0.78 g), length (2.6 ± 0.06 cm), %SGR (1.69 ± 0.31), ADG (0.03 ± 0.01 g/day) and % BWI (71.28 ± 6.25). The lowest final weight (2.084 ± 0.22 g), length (1.8 ± 0.15 cm), % SGR (1.15 ± 0.14), ADG (0.02 ± 0.00 g/day), % BWI (56.51 ± 4.30) were recorded in the fish fed the control diet. All the growth parameters were significantly higher in the T1, T2 and T3 than in the control ($p>0.05$, One-way ANOVA). There was no significant difference in the nutrient digestibility of *P. reticulata* between each treatment and the control ($p>0.05$; One-way ANOVA). Further, the proximate analysis showed no significant difference in the crude protein and ash content among the different experimental feeds ($p>0.05$; One-way ANOVA). The commercial probiotic used in the study did not affect the nutrient digestibility of *P. reticulata*, water quality in rearing tanks or proximate composition of experimental feeds. The incorporation of a commercial probiotic into the diet of *P. reticulata* significantly increased its growth performance.

Keywords: Digestibility, Growth, *Poecilia reticulata*, Probiotic

Abstract No: BO-11

Optimizing growth conditions for vegetative propagation of Near Threatened (NT) epiphytic Cactus *Rhipsalis baccifera* sub sp. *Mauritiana* (DC.) Barthlott. (Cactaceae)

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The Cactaceae family exhibits a diverse range of adaptations, making it popular among horticulturists and Cactus growers. *Rhipsalis baccifera* sub sp. *mauritiana* (DC.) Barthlott., an epiphytic cactus, is valued both as an ornamental plant and a medicinal plant. As it is categorized as a "nearly threatened species" (National Red List, 2020) steps must be taken for conservation. Prior studies have not determined the use of commercial growth hormones, the use of naturally available growth media such as compost, soil, and wood, and the effect of shade to increase the successful establishment of stem cuts. We hypothesized that there is an effect of growth hormones, media type and shade level on the growth of the plant. Therefore, this research aimed to determine the optimal shade, growth media, and hormone combination for the vegetative propagation of *R. baccifera* due to the scarcity of information. Freshly plucked twigs of *R. baccifera* were utilized as explants for vegetative propagation experiments. Six soil combinations that include Compost (Co), Brick Powder (BP) + Powdered Roof Tile (RT) (1:1), Soil (S) + Co (1:1), S + Sand (Sa) (1:1), S + Co + Sa + BP (2:1:1:1), and S + Co + BP (3:3:2) were assessed to identify the most suitable growth medium for vegetative propagation. *R. baccifera* planted in each combination was grown in shade net houses with the following shade levels (80%, 60%, and 40%) at room temperature for three months. The successful growth media (Co) and 80% shade level were subsequently employed. It included 16 treatments with 10 replicates randomly for each treatment (160 total), incorporating four types of new growth media that include Co as the base component (Co, Co + S, Co + Wood, and Co + S + Wood) and three types of growth hormones (powder form Rapid Root, Clonex®, a commercial liquid fertilizer). The growth hormone level was 0.3% w/w. The control treatment included no growth hormones. Fresh stem cuttings with a few nodes about 6 cm in length were planted in the above media. Watering was conducted once a week over a three-month period. The length of the plant was recorded at the end of each month as the growth increment parameter. Upon statistical analysis ($p=0.05$), it was found that there was no significant difference between the average growth rate for any growth media type ($p \geq 0.05$), and therefore the inclusion of "compost" in any growth media combination resulted in the best growth. Additionally, the powdered growth hormones "Rapid Root" (5.5±0.4 cm) and "Clonex®" (7.2±0.4 cm), proved to be the most effective, compared to the control (0.9±0.2 cm) for stem cuttings ($p<0.05$). This study successfully identified optimal conditions for the vegetative propagation of *R. baccifera* sub sp. *mauritiana* that includes compost as a growth media and powdered hormone types Rapid Root or Clonex® as the growth hormone, at 80% shade. The findings contribute practical insights for the cultivation of nearly threatened species of *Rhipsalis baccifera*.

Keywords: *Rhipsalis baccifera*, Vegetative propagation, Growth medium, Growth hormones, Cactus

Acknowledgement
This work was supported by the University of Kelaniya under the research grant RP/03/02/01/03/2020.

Abstract No: BO-12

Analyses of biometric growth parameters and feeding habits of *Mugil cephalus* (Flathead mullet): One of the economically important fish species collected from Negombo Lagoon

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Flathead mullet (*Mugil cephalus*) is found to be a potential candidate species in brackish water aquaculture due to its euryhaline nature, and it has ready markets for seeds as well as processed products. However, the lack of data on adult flathead mullets in the natural environment in Sri Lankan waters is the major constraint to study the biology of the species and management practices for fish resources. The present study was conducted to analyze the diet composition, length-weight relationship, and condition factor of *M. cephalus* belonging to the family Mugilidae collected from the Negombo lagoon, Sri Lanka. In fisheries science, the important condition factors are the growth, health state and feeding intensity. The sampling was done from August 2022 to March 2023. A total of 100 specimens were collected from the catches of artisanal fisheries from Negombo lagoon area. The total length and weight of fish were measured and varied in a range of 16.9 cm - 32.0 cm and 55.50 g - 291.70 g respectively. Length frequency distribution showed that the total length class 23 cm - 24 cm had the highest frequency of 100 samples. The FishBase reports length at first maturity as 30.0 cm and the percentage below 30 cm was observed as 97%. Results obtained showed a negative allometric growth pattern for this fish species ($b<3$, t-test, $p< 0.05$) with a significant linear relationship given by the equation; $W = 0.0266TL^{2.690}$ (Log W = - 1.575 + 2.690 log TL ($R^2 = 0.951$, n=100). Fulton's condition factor (K) of males and females of *M. cephalus* was 1.0501 $\pm$ 0.0359, and 1.0048 $\pm$ 0.0123 respectively. Mean Fulton's condition factor for immature mullets was lower than (0.9960 $\pm$ 0.0724) that of the mature ones (1.0373 $\pm$ 0.0735). Relative Gut Length (RGL) and Gastro Somatic Index (Ga.SI) were 1.52 – 3.18 and 2.012 – 3.874 respectively. The recorded mean RGL (2.442 $\pm$ 0.146), confirmed that *M. cephalus* is omnivore species. The stomach content was analyzed using the frequency of occurrence method showed that algae (30.86%), sand particles (25.71%), and detritus (23.43%) as main food items. The food of animal origin consisted of annelids, insect parts and crustaceans. Most of the fish were one-fourth filled (1/4) at the time of capture. The immature individuals recorded from the Negombo lagoon area were 49 %. The present study reported the presence of synthetic debris such as nylon threads in the stomachs of flathead mullets revealing that the area is polluted. Therefore, more research into the effect of synthetic debris on the lagoon area is recommended. Continuous monitoring of fish landings is also recommended as immature individuals recorded were significant in the fish catch.

Keywords: Frequency of occurrence, Mugilidae, Omnivore, Synthetic debris

Abstract No: BO-13

Analysis of groundwater used in areas beyond the National Water Board distribution network in Ratnapura

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Groundwater is the main source of drinking water in selected areas in Ratnapura where municipal water is not accessible. In a majority of households, it is consumed without any treatment. Waterborne diseases such as dysentery and typhoid fever may spread as a result of microbial pathogens. Chemical contaminants may also result in kidney-related issues. The present study was conducted to evaluate the quality of groundwater in three Grama Niladhari divisions around Ratnapura urban area. Amuwala, Kahengama South and Gonakumbura divisions were selected, and twenty wells were sampled from each division for three months as replicates. Measured parameters included total Coliforms, Escherichia coli, color, turbidity, pH, electrical conductivity, chloride, total alkalinity, total hardness, total iron, sulfate and total dissolved solids (TDS). One-sample t-test was performed at a 5% level of significance to assess the deviation of each parameter from Sri Lanka water quality standards. The results revealed that all water sources in the study were microbiologically contaminated throughout the sampling period. All of the physical and chemical water quality parameters were within the limits of Sri Lanka Standards (SLS) 614: 2013 except the pH level which was below the SLS requirement. The turbidity level was statistically significant at the SLS median value in Kahengama and Gonakumbura. Since the presence of *E. coli* bacteria indicates potential fecal contamination in the water, public awareness programmes are needed to educate consumers on the importance of consuming boiled water. The low pH issue can also be resolved by using pH adjusting water filters. The municipal distribution lines have to be extended further permitting access to disinfected potable water to a greater number of consumers.

	Amuwala GND	**Kahengama South GND**	**Gonakumbura GND**	**SLS 614:2013 Limits**
Total Coliforms (per 100 ml)	193.0 ± 71.6	86.4 ± 76.8	214.2 ± 150.1	<10
E. coli (per 100 ml)	112.8 ± 55.3	45.0 ± 44.3	119.0 ± 96.5	NIL
Color (Hazen)	3.8 ± 1.7*	2.9 ± 0.6*	2.7 ± 0.5*	<15
Turbidity (NTU)	1.9 ± 1.6*	0.9 ± 0.6**	1.2 ± 1.0**	0-2
pH	5.6 ± 0.5	5.2 ± 0.3	5.4 ± 0.5	6.5 - 8.5
Electrical conductivity (µS $cm^{-1)}$	62.5 ± 24.3	95.0 ± 86.0	57.0 ± 28.8	Not Specified
Chloride (mg L^{-1})	27.7 ± 5.5**	29.4 ± 4.4**	18.0 ± 6.0**	0-250
Total Alkalinity (mgL^{-1})	22.4 ± 8.6*	39.0 ± 43.4*	29.0 ± 13.8*	0-200
Total Hardness (mg L^{-1})	27.0 ± 7.3*	38.8 ± 40.3*	31.8 ± 12.8*	0-250
Total iron (mg L^{-1})	0.1 ± 0.09*	0.06 ± 0.02*	0.07 ± 0.08*	0-0.3
Sulfate (mg L^{-1})	6.2 ± 2.7*	5.6 ± 2.5*	3.4 ± 0.8*	0-250
TDS (mg L^{-1})	41.2 ± 16.1*	62.6 ± 56.7*	36.2 ± 18.4*	0-500

** statistically significant with the median at 5%
* within the acceptable range

Keywords: Groundwater, Ratnapura, Water quality parameters

Abstract No: BO-14

The vegetation structure and floristic composition of tropical rainforest landscape, at Udakiruwa, Sri Lanka

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The Udakiruwa rainforest fragments in the Uva province, Sri Lanka, represent the last remaining refugia in the Eastern part of the country. Within these forest fragments, populations of endemic plant species thrive, however, many of them are now threatened due to overexploitation of forest products and agricultural expansions. To address the conservation of these endangered species and the maintaining of ecosystem services in Udakiruwa forest fragments, baseline information is crucial. Therefore, this study aimed to examine the species composition and structure of the forests in both old-growth and secondary forest landscapes in Udakiruwa. In this study, we recorded the diameter and species composition of trees in 44 randomly located circular plots, where the tree diameter at breast height (DBH) was greater than 5 cm. The individuals were categorized into five DBH classes (5-9.9 cm, 10-29.9 cm, 30-49.9 cm, 50-69.9 cm, and >70 cm). A total of 1408 individuals, representing 79 species, 38 families, and 62 genera, were recorded from this comprehensive study. Out of the total number of species identified, 25 were endemic. *Mallotus fuscescens* and *Dipterocarpus zeylanicus* emerged as the most abundant species as 70% of the established experimental plots. However, the endemic species such as *Shorea dyeri* (5%), *Euonymus walkeri* (0.1%), *Strombosia ceylanica* (2%), *Palaquium hinmolpedda* (1%), *Diospyros ebenoides* (0.1%), *Mangifera zeylanica* (3%), *Calophyllum tomentosum* (0.1%), and *Garcinia quaesita* (1%) were found to be present in very low numbers. The total basal area of individuals in the site was measured to be 912.615 m^2, and further investigation revealed that 28 out of 44 plots had experienced selective logging. Notably, 87.5% of recorded *Shorea dyeri* in the experimental plots fell under the DBH classes of 5-9.9 cm and 10-29.9 cm, while *Dipterocarpus zeylanicus* was most abundant in the DBH size class >70 cm. The calculated Shannon diversity index and evenness of species were 1.823 and 0.780, respectively, indicating a diverse and relatively balanced ecosystem. However, sites closer to rubber cultivations and those located at the forest edge reported a high disturbance index (7.879), suggesting the impact of human activities on these fragmented lowland forests. The lowland fragmented forest landscapes of Udakiruwa are rich with many endemic species, emphasizing the urgent need for immediate conservation actions to conserve this unique rainforest ecosystem.

Keywords: Diversity indices, Endemic species, Rainforest, Species composition, Udakiruwa

Acknowledgment
This work was supported by Uva Wellassa University of Sri Lanka, Badulla under the research grant Franklinia Foundation.

Abstract No: BO-15

Degradability of biodegradable polymers in freshwater, and sediment under laboratory conditions

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Freshwater rivers, streams, and canals carry waste plastics from inland areas to the sea. These plastics may physically break into smaller fragments and float in the water column, deposit in the sediment, and/or reach the sea causing detrimental impacts on the environment, wildlife, and humans. Biodegradable products were introduced as a green alternative to curb the harmful effects of waste plastic accumulation. The present study evaluated the degradation potential of three commercially available products with "compostable", "oxo-degradable", and/or "biodegradable" labels on them under freshwater (FW), and freshwater sediment (FWS) in an experimental setup. A garbage bag (GB), lunch sheet (LS), and a salad plate (SP) were tested for degradability against a filter paper (FP) as the positive control. FW and FWS were placed in separate glass tanks, and kept near a window allowing the day-night rhythm of the sun. FW was aerated continuously, and FWS was kept wet with freshwater to simulate natural environmental conditions. Prepared samples were placed inside Nylon mesh pockets, and put in the medium in triplicates. Initial dry weights, physical characteristics, RAMAN spectra, and SEM images were obtained. Monthly sampling was carried out. Temperature, salinity, pH, and conductivity readings as well as remaining dry weights, and visual changes of degradation were recorded for 12 months. Degradability was assessed as a percentage of Mean Weight Loss (MWL). Cellulose, polybutylene adipate terephthalate, polylactic acid, and polyethylene were among the major polymers detected in the initial RAMAN spectra of samples. Comparatively, FWS facilitated degradation than FW where the control and SP showed the fastest degradation, 100% in 120 days. LS and GB showed partial degradation, and the percentage of MWL ranged between 2.15%-56.61%, and 0.18%-1.96%, respectively. The percentages of MWL recorded from samples in FW ranked between 2.56% - 61.59%, 4.42% - 36.44%, 1.32% - 6.77%, and 0.21%-7.11%, in the control, SP, LS, and GB respectively. Filter paper, SP, and LS in FWS fragmented and discolored while GB showed slight discoloration only. Filter paper and LS, discolored and torn in FW while SP and GB showed insignificant changes in shape, size, and/or color. Prolonged times taken by the samples to show signs of degradation, alarms the potential of products with "biodegradable", "oxo-degradable", and "compostable" labels, to accumulate in the natural environment as waste plastics.

Keywords: Biodegradability, Polyethylene, Percentage mean weight loss, RAMAN spectroscopy

Acknowledgment
This work was supported by the University of Sri Jayewardenepura, Sri Lanka under the research grant ASP/01/RE/SCI/2021/36.

Abstract No: BO-16

Modeling the urban growth and land use changes in Vavuniya, Sri Lanka, using GIS

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The process of urban growth and its associated land use changes have significant implications for sustainable development and resource management. This research aims to model the urban growth patterns in seven *Grama Niladhari (GN)* divisions *(*i.e., *Koolankulam, Puthukulam, Paranaddakal, Nachimodai, Omanthai, Maruthanamadu, and Echankulam)* in *Vavuniya* between 2001 to 2021 using Geographical Information Systems (GIS). After obtaining Landsat images covering the study area for the years 2001 and 2021, supervised classification based on a maximum likelihood classifier was applied to the imagery to prepare Land use/Land cover (LULC) maps with four land cover classes: forests, water bodies, croplands, and built-up areas. High-resolution Google Earth images were used as ground truth. Land extents for each LULC type were calculated, and the changes in the area between 2021 and 2001 were compared using ArcGIS 10.8. The change of vegetation indices and water indices were analyzed to find the impact of human activities in the study area. The Normalized Difference Water Index (NDWI) and Normalized Difference Vegetation Index (NDVI) were used for water body analysis and to quantify vegetation, respectively. By using ground truth data, the accuracy assessment was done. The supervised classification indicates that forest cover and the cropland areas decreased (6820.92 ha to 5952.01 ha and 4769.1 ha to 2585.34 ha, respectively) while water bodies and built-up areas increased (633.15 ha to 983.97 ha and 2630.83 ha to 5332.68 ha, respectively). So, the vegetation cover and the water bodies have decreased in 2021. The overall accuracy for the 2021 (land use/ land cover change map) is 0.64 (64%). We envision that the findings of this research will contribute to urban planning and policy-making processes by offering a comprehensive understanding of the past and potential future urban growth dynamics in the studied GN divisions. The results can assist local authorities and stakeholders in making informed decisions regarding land management, infrastructure development, and environmental conservation to ensure sustainable urban growth and resource allocation.

Keywords: Change Detection, Land Use Classification, Maximum Likelihood Supervised Classification, Remote Sensing, Sri Lanka

Acknowledgment
This work was supported by University of Kelaniya.

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Abstract No: BO-17

Morphological and molecular identification of different morphotypes of *Suaeda maritima* from Puttalam district in Sri Lanka

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Suaeda is a genus belonging to the family Amaranthaceae (Chenopodiaceae) and comprises more than 100 species that are distributed all over the world. Members of the genus are mainly used for food, feed, and medicine. Three *Suaeda* species have been reported in Sri Lankan salt marshes among them, *S. maritima* is widely distributed. During a field survey in Seguwanthive in July 2022, two clearly distinct morphotypes of tentatively identified *S. maritima* were found. This tentative identification was done purely based on morphological characteristics. One morphotype had green stems and leaves while the other had reddish-green leaves and brightly red-colored stems. No reproductive parts were found at the time of the survey. Even though, previous reports indicated high phenotypic plasticity among the members of the genus, it was not clear whether both morphotypes belonged to the same species or not. Due to the lack of floral structures throughout the year, accurate species identification was a great challenge for a layperson and for a trained taxonomist. Therefore, the current study was conducted to obtain detailed morpho molecular identification of each morphotype of *Suaeda maritima*, and to confirm their species identity using molecular data as well. Plant samples were collected from Seguwanthive area mainly focusing on two morphotypes and documented. Leaves were succulent, linear in shape, flattened only on one side, and acute in the apex. Plants were 40-65 cm range in height in both morphotypes with a woody base. Flowers were observed only on green plants by the time of sampling, and they were bisexual and contained 5 stamens and 3 stigmas and located axillary in 2 mm diameter clusters and seeds were black, smooth and glossy, and suborbicular to ovoid in shape. Molecular identification was conducted using DNA barcoding approach. Genomic DNA extraction was optimized. The nuclear ribosomal ITS (Internal transcribed spacer) region was PCR (Polymerase chain reaction) amplified using universal primers BLASTn searchers of the sequences confirmed that both morphotypes were identical and 100% similar to previously published records of *S. maritima* (KF866384). This project findings give insights into the plant's phenotypic plasticity under its natural environment and can be used as a future guide.

Keywords: Amaranthaceae, DNA barcoding, DNA extraction, PCR amplification, *Suaeda maritima.*

Acknowledgment
This work was supported by the Science and Technology Human Resource Development Project, Ministry of Education, Sri Lanka, funded by the Asian Development Bank under the research grant no. CRG/R2/RJ1.

Abstract No: BO-18

Low-cost media composition for increased laccase activity of wood decay fungi, *Phlebiopsis flavidoalba* and *Perenniporia tephropora*

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Laccase, a versatile enzyme with broad substrate specificity, has been extensively researched for over 30 years due to its diverse biotechnological applications. Among diverse types of laccases, white-rot fungal laccases are unique in that they have broad substrate specificities and hence have various biotechnological applications such as dye decolorization, lignin degradation, and polyethylene degradation. It is crucial to achieve high yield while utilizing low-cost raw materials to enable the effective utilization of laccases in commercial and industrial applications. The objective of the current study was to optimize a culture media with low-cost carbon sources for high laccase activities of two laccase-producing fungal species, *Phlebiopsis flavidoalba* and *Perenniporia tephropora*. Fungi were cultured in Potato Dextrose Broth (PDB) while systematically varying one factor at a time for a duration of 21 days, and laccase activities were subsequently determined through spectrophotometric analysis. The effect of carbon sources, and varying concentrations of nitrogen source and copper ion concentrations were assessed on laccase activities. Rice husk, coconut coir fibers, peanut shells, and rubber wood chips were used as carbon sources. The amount of yeast varied from 0.5% to 2% (w/v), $CuSO_4$ concentration varied from 1 $mmolL^{-1}$ to 2 $mmolL^{-1}$ as nitrogen and metal ion concentrations respectively. Among different carbon sources tested, rice husks exhibited the highest laccase activity with 5.560±0.023 fold increase compared to the control followed by peanut shells that had 3.624±0.320 fold increase for *P. flavidoalba*. For the same species, 1% yeast (w/v) and 1.5 $mmolL^{-1}$ of $CuSO_4$ demonstrated the maximum laccase activity. However, in *P. tephropora*, neither yeast concentrations nor copper ion concentrations significantly influenced laccase activity compared to the control. Nonetheless, rice husks exhibited the highest laccase activity displaying 2.120±0.012 fold increase compared to the control followed by peanut shells that had 1.074±0.301 fold increase for *P. tephropora*. To the best of our knowledge, this is the first study to explore the optimization of laccase activity using lignocellulosic waste in *P. flavidoalba* and *P. tephropora.* Sri Lanka being an agricultural country, this research sheds light on the effective utilization of one of the main agricultural waste, rice husks in the industrial scale of laccase production.

Key words: Copper, Laccase, Optimization, Rice husks, Yeast

Abstract No: BO-19

Incorporation of pumpkin, *Cucurbita maxima* (Cucurbitaceae) peel as a feed additive for the growth and color enhancement of Guppy, *Poecilia reticulata* (Poeciliidae)

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Ornamental aquaculture relies greatly on the colors of fish and nutrient-rich feed is a major contributing factor. Carotenoid sources are the main ingredients that enhance fish color. Here, as a cost-effective alternative for commercial carotenoid sources we aimed to test the effect of *Cucurbita maxima* peel as a color enhancer for *Poecilia reticulata.* Three diets, incorporating 5% (T1), 10% (T2), 15% (T3) and 0% (control) *C. maxima* peel with respect to total feed weight were fed to fish in three replicate tanks arranged in a completely randomized design. Ten male *P. reticulata* fries with average weight and length of 0.019 ±0.00g and 0.7 ±0.0 cm, respectively, were stocked in each tank. Fish were fed experimental diets of 2% of body weight twice a day for 75 days. Fecal matter was collected semiweekly. DO and pH of water were measured weekly using a multimeter. Fish weight and length were measured fortnightly using an electronic balance and a measuring board. Water quality parameters weren't significantly different among treatments and control and remained within the optimum ranges (DO>6mg/L, pH 6.8-7.8) for *P. reticulata*. Incorporating *C. maxima* peel into the feed positively influenced the growth of *P. reticulata*. Among the treatments, the highest values for final weight (FW); 0.16 ±0.002g, body weight increase (BWI); 0.14 ±0.00g, percent body weight increase (%BWI); 88.12 ±0.15%, specific growth rate (SGR); 1.89 ±0.0, apparent digestibility coefficient (ADC); 59.97 and the lowest feed conversion ratio (FCR) of 1.42 ±0.02 were recorded in T3. In contrast, the minimum growth was recorded from T1 with the lowest FW (0.130 ±0.00g), BWI (0.11 ±0.00g), %BWI (85.38 ±0.11%), SGR (1.879 ±0.0), ADC (14.00), with the highest FCR; (1.80 ±0.02). Adding *C. maxima* peel increased the length parameters and survival rate (SR%) but showed no significant statistical difference with the control (P>0.05). T3 had the maximum SR% (76.67 ±5.77%), while the control had the minimum (70 ±0.00%). The maximum body length was recorded from T3 (3.0 ±0.2cm) while T1 (2.6±0.2cm) and control (2.7±0.3) had the minimum. According to the results, the maximum brightness and carotenoid contents were recorded in T3 (Gray value=50.99 ±4.02, carotenoids=4.05 ±0.27 μg/g wet weight) while lower brightness (and carotenoid levels were in T1 and the control. In conclusion, *C. maxima* can be used to enhance the coloration of *P. reticulata,* but it needs to be in higher concentrations. The incorporation of *C. maxima* exhibits a positive influence on fish growth. Changing the process of *C. maxima* powder or extracting carotenoids from peels is recommended for better results.

Keywords: *Cucurbita maxima*, Color enhancement, Gray value, Growth, *Poecilia reticulata*

Acknowledgment
This work was supported by the University of Kelaniya, Sri Lanka.

Abstract No: BO-20

The effect of egg desiccation period on the hatching success, morphometrics of emerged larvae and F1 generation adults of *Aedes aegypti* and *Aedes albopictus* (Diptera: Culicidae)

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Dengue is a seasonal vector-borne disease that is transmitted by female *Aedes aegypti* and *Aedes albopictus* mosquitoes. One of the most significant challenges in controlling these mosquitoes is the ability of *Aedes* eggs to withstand prolonged desiccation. This study aimed to investigate the effect of egg desiccation on the hatchability, larval and adult morphometrics, and duration of adult emergence of *Ae. aegypti* and *Ae. albopictus*. The *Aedes* eggs were collected from the field using oviposition traps and soaked in larval-rearing trays. Hatched larvae were reared with fish feed. They were differentiated into *Ae. aegypti* and *Ae. albopictus* and transferred to separate pupal-rearing containers. The resulting adult mosquitoes were provided with a sugar solution and a cattle blood meal using a membrane feeding system. They were allowed to lay eggs on cloth strips. Initially, the hatchability of fresh eggs was calculated for two species. The head length and total length of the fourth instar larvae and head, thorax, abdomen, total length, wing length, and wing width of adults of both species that emerged from fresh eggs were measured. The days needed for adult emergence from fresh eggs were counted. Subsequently, other egg sheets were air dried and stored within the insectary (at 27±2°C and 75±5 % humidity), and monthly measurements of the aforementioned parameters were collected for eggs subjected to desiccation over six months. According to the results, the hatchability of both *Ae. aegypti* and *Ae. albopictus* decreased with increasing egg desiccation periods. The hatchability of *Ae. aegypti* and *Ae. albopictus* eggs was highest (75.0±0.6% and 58.3±0.3% respectively) when the eggs were fresh, and lowest (22.0±1.2% and 13.3±0.9% respectively) when they were desiccated for six months. There was a strong negative correlation between hatchability and the desiccation period of both *Ae. aegypti* and *Ae. albopictus* (Pearson's correlation, $p<0.05$, $R^2 = 0.840$ and $R^2 = 0.957$ respectively). Pearson's correlation also indicated a strong negative correlation between egg desiccation period and head length ($p<0.05$, $R^2 = 0.875$ for *Ae. aegypti* and $R^2 = 0.846$ for *Ae. albopictus*), as well as total length ($p<0.05$, $R^2 = 0.812$ for *Ae. aegypti* and $R^2 = 0.888$ for *Ae. albopictus*) of the fourth instar larvae. The adult emergence was delayed with increasing egg desiccation periods, with the longest duration (*Ae. aegypti*; 15.0 ± 0.2 days and *Ae. albopictus*; 26.0 ± 0.2 days) observed when eggs were desiccated for six months. However, no significant differences were found in the morphometrics of adult mosquitoes of both species that emerged from desiccated eggs (one-way ANOVA, $p > 0.05$). In conclusion, the study showed that prolonged egg desiccation reduced hatchability, delayed adult emergence, and negatively affected the morphometrics of fourth instar larvae of *Ae. aegypti* and *Ae. albopictus*. However, the morphometrics of the F1 generation adult mosquitoes were not significantly different from those of fresh eggs, suggesting that the egg desiccation period does not negatively affect the overall morphometrics of adult *Aedes* mosquitoes.

Keywords: *Aedes aegypti*, Egg desiccation, Hatchability, Morphometrics, *Aedes albopictus*

Acknowledgment:
This work was supported by the University of Kelaniya, Sri Lanka.

Abstract No: BO-21

Comparative Effect of Nanoparticles of Sliver, Europium Doped ZnO and CaF_2 on *Aedes aegypti* and *Daphnia magna*

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Aedes aegypti mosquitoes are responsible for transmitting dengue fever. Using nanoparticles is a better suggestion to combat vector mosquito spread. *Daphnia magna* is the keystone species in freshwater food webs. The sensitivity of *Daphnia magna* to low metal concentrations underscores its importance in evaluating the impact of nanoparticles on the ecosystem. This study examined the impact of Silver, ZnO, CaF_2, Europium-doped ZnO, and CaF_2 nanoparticles on *Aedes aegypti* larvae and adult *Daphnia magna*. The batch of 25 third instar larvae of *Aedes aegypti* and the batch of 25 adult *Daphnia magna* were exposed to each nanoparticle in a concentration series for 24 and 48 hours. For *Aedes aegypti*, nanoparticles of ZnO and CaF_2 at 20 mg/L, 40 mg/L, 60 mg/L, 80 mg/L, and 100 mg/L; nanoparticles of Europium-doped ZnO and CaF_2 at 50 mg/L; and Silver nanoparticles at 1 mg/L, 2 mg/L, 3 mg/L, 4 mg/L, and 5 mg/L. For the *Daphnia magna*, ZnO nanoparticles at 0.2 mg/L, 0.4 mg/L, 0.6 mg/L, 0.8 mg/L, and 1 mg/L; Europium-doped ZnO nanoparticles at 0.5 mg/L; CaF_2 nanoparticles at 1 mg/L, 2 mg/L, 3 mg/L, 4 mg/L, and 5 mg/L; Europium-doped CaF_2 nanoparticles at 4 mg/L; and Silver nanoparticles at 2.36 mg/L. The percentage mortality of *Aedes aegypti* larvae and *Daphnia magna* was calculated for each nanoparticle. The study revealed that nanoparticles of ZnO and CaF_2 did not affect *Aedes aegypti* larvae but caused significant mortality in *Daphnia magna*. LC_{50} value at 24 hours for ZnO nanoparticles was 0.51 mg/L, while for CaF_2 nanoparticles, it was 4.44 mg/L. The study also revealed that increasing europium doping in ZnO and CaF_2 nanoparticles led to higher *Daphnia magna* mortality. The study revealed that exposure to silver nanoparticles for 24 hours significantly increased *Aedes aegypti* larvae mortality rates. LC_{50} value was 2.36 mg/L. All *Daphnia magna* were dead within 24 hours of exposure to silver nanoparticles. The study concludes that ZnO and CaF_2 nanoparticles did not affect *Aedes aegypti* larvae. Silver nanoparticles showed lethal effects but cannot be recommended for *Aedes aegypti* control due to being toxic to *Daphnia magna*, a keystone species in aquatic ecosystems.

Keywords: *Aedes aegypti*, *Daphnia magna*, Nanoparticles, LC_{50} value, Europium doping

Acknowledgment
This work was supported by the University of Kelaniya, Sri Lanka under the research grant University of Kelaniya.

Abstract No: BO-22

Abundance and microplastic characterization found in the mud crab *Scylla serrata* inhabiting Negombo Lagoon, Sri Lanka

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Microplastics (MPs) are tiny plastic particles less than 5 mm in size. The danger imposed by MPs continues to rise in the world due to an increase in anthropological pollutants in the environment. The tremendous socioeconomic value and biodiversity of the lagoon have been threatened by a significant accumulation of plastics, particularly MPs. MPs have many negative impacts on the fauna. Herein, the high adsorption capability of MPs increases the toxicity of contaminants as well as oxidative stress that may lead to damaging cell membranes of fauna. Here, we report the investigation on the abundance of MPs in the digestive tract and gills of the mud crab species *Scylla serrata*, which is a prominent edible food source of humans. We collected fifty two (N = 52) individuals of mud crabs from three crab trapping sites in the Negombo Lagoon, Sri Lanka during November 2022 to March 2023. The gills and digestive tract of the crabs were extracted and digested in KOH, and subsequently the putative MPs were separated and imaged using a stereomicroscope (VWR VisiScope 360) for characterization. In the analysis, a total of 455 MP particles were detected in the crabs, out of which, 187 (41.10%) were in the gills and 268 (58.90%) were in the digestive tracts. The average MP abundance in the gills was 0.70 ± 0.52 items per gram, while that in the digestive tracts was 0.71 ± 0.52 items per gram. The most abundant shapes of MP particles were fibers in the gills (54.01%) and in the digestive tracts (85.07%) followed by fragments and films. Further, the prevailing colours of the MPs were blue, transparent, red, black, and purple. Herein, the digestive tract had the highest concentration of MPs in blue (47.38%), whereas the majority of the MPs found in the gills were transparent (51.8%). The range of MP sizes in the crabs was also determined. The most frequent size range in the gills and digestive tracts were 0.002-0.25 mm (39.5%), and 1.0-5.0 mm (48.8%) respectively. Despite the fact that the current study offered details on the presence of MPs in the gills and digestive tract of the mud crab species *Scylla serrata* inhabits in the Negombo Lagoon, it also serves as a benchmark for the quick detection of MPs in mud crabs in the lagoons of Sri Lanka.

Keywords: *Scylla serrata*, Negombo Lagoon, Digestive tract, Gill, Microplastics

Acknowledgment
This work was supported by the Centre for Environment, Fisheries and Aquaculture Science (Cefas) under the research grant Ocean Country Partnership Program (OCCP) of the Blue Planet Fund, UK and the National Aquatic Resource and Development Agency (NARA), Sri Lanka.

Abstract No: BO-23

Assessment of litter and microplastic pollution in the water and sediment of Hirikatuoya stream, within the Walawe River basin, Sri Lanka

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Rapid urbanization and mismanagement have led to a surge in plastic pollution in crucial aquatic ecosystems globally therefore accumulation of debris in aquatic ecosystems is rapidly increasing and they are becoming ultimate sinks for the contaminants. This results in a long-term and widespread threat causing a great challenge for remediation. Poor disposal practices and littering behavior of communities have resulted in considerable quantities of litter in river banks and streams affecting their aesthetic appeal and living beings. This study was conducted to understand the status of litter and microplastic contamination at selected locations in Hirikatuoya stream, a remote stream outside the urban environment in the Rathnapura district, Sri Lanka. The percentage of plastic in litter and the percentages of microplastic particles (based on colour and morphotypes) in water and sediments were estimated, and the corresponding polymer types were also identified. Three samples of water were collected from each of the nine locations along the stream from September to October 2022. In the sampling process, the samples were filtered through a 150 µm mesh. Sediment samples were collected from the shoreline of the stream at each location using a stainless-steel scoop covering 30 cm^2 of surface area and 2-3 cm depth. Low-density particles in the samples were separated by density separation and organic matter in the sample was removed by digestion. Whatman GF/C glass microfiber filter papers of a pore size of 1.2 µm were used for sample filtration. Microscopic imaging was done using a staining method. The ATR-FTIR analysis was performed to identify the polymer type of plastic particle in water samples. The most frequently observed colour for microplastic particles in water and sediments were white (26.87%) and colourless (40.20%), respectively. Based on morphotype, fragments were more abundant in both water (49.62%) and in sediments (59.79%) compared to other morphotypes. The highest microplastic abundance in water (69±22, 60±29, 61±26 items 100 m^{-3}) and highest abundance of microplastics in sediment (15±5.92 items/kg (top), 7±3.28 items/kg (bottom)) were observed in more human and tourist activity locations. According to the ATR-FTIR analysis, polypropylene was the most abundant polymer type in plastic litter (25%). In water polypropylene was the most dominant microplastics (38.10%), followed by low-density polyethylene (14.29%) and polyethylene terephthalate (9.52%). Polypropylene was the dominant microplastics in sediments (32.2%), followed by thermoplastic vulcanizates (22.5%), high-density polyethylene (19.3%). Accordingly, it can be concluded that the Hirikatuoya stream, which is in a remote area, is contaminated with microplastics. There are potential environmental and health risks to the aquatic biota in the stream and the neighboring communities. Further investigations are required to understand the effect on aquatic animals.

Keywords: Aquatic ecosystems, FTIR, Microplastics, Water and sediments

Acknowledgment

This work was supported by the Centre for Environment, Fisheries and Aquaculture Science (Cefas) under the Ocean Country Partnership Programme (OCPP) of the Blue Planet Fund, UK, and the National Aquatic Resource Research and Development Agency (NARA), Sri Lanka.

Abstract No: BO-24

Microplastic contamination in selected commercial fish species in Negombo Lagoon, Sri Lanka

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Microplastics (MPs) act as physical anthropogenic pollutants and their ability to act as contaminant vectors in biological matrices has become a serious ecosystem and human health concern. The present study, for the first time, has screened and detected MPs in the gastrointestinal tract and gill of a select group of commonly consumed fish species from Negombo lagoon, Sri Lanka. Negombo lagoon is one of the most productive ecosystems in Sri Lanka. A total of 60 fish samples were investigated for the microplastic presence, abundance, and morphological types within the guts and gills of commercial fish consisting of seven (7) species: *Siganus javus* (SJ: n=5), *Leiognathus splendens* (LS: n=8), *Leiognathus blochii* (LB: n=5), *Mugil cephalus* (MC: n=19), *Strongylura leiura* (SL: n=10), *Stolephorus indicus* (SI: n=10), and *Caranx heberi* (CH: n=3) with different feeding habits and habitats. Samples were collected between July–December 2022. Fish gut content was screened for the presence of MPs using the alkaline digestion and density gradient separation technique (NaCl hypersaline solution) and examined using a stereomicroscope and micro-Fourier transform infrared spectrometer (m-FTIR). Microplastics, ranging from 0.05 to 4.80 mm, were found in the investigated fish species. Remarkably, this study revealed that 51.67% and 32.00 % of the fish samples contained microplastic in their guts and gills respectively. A total number of 67 MP particles (size < 5 mm) were found in the excised fish guts of the seven species. The most common morphology of microplastics discovered in fish guts was fragments, which accounted for 87.5% of all MPs present. The MP content in guts differed between species. Of that *Mugil cephalus* recorded the greatest amount of MP ingestion, with an average MP count of 2.68±0.23 items per individual in fish gut corresponding to an average abundance of 0.22±0.26 particles/g and 0.84 ±0.46 items per individual in gills corresponding to an average abundance of 0.41±0.68 particles/g. The majority of ingested particles were fragments (40.3%), followed by fibers (34.33%), films (19.40%), microbeads (4.48%), filament (2.29%), and no pellets were observed. In terms of colour, the most abundant were blue (58.20%), followed by green (13.43%), transparent particles (8.96%), yellow (7.46%), red (5.97%), black (2.98%), white, brown, pink (1.49%) were found in low number. The majority of MPs presented were identified by m-FTIR as particles of polypropylene and polyethylene (HDPE), rayon. The results are evident in the growing threat of MPs on biological matrices and ingested MPs in edible fish species present in the Negombo lagoon.

Keywords: Fish species, Gill & guts, Microplastics, Negombo lagoon, m-FTIR

Acknowledgment
This work was supported by the Centre for Environment, Fisheries and Aquaculture Science (Cefas) under the Ocean Country Partnership Programme (OCPP) of the Blue Planet Fund, UK, and University of Kelaniya Research Grant (RP/03/02/06/02/2021) and the National Aquatic Resource Research and Development Agency (NARA), Sri Lanka.

Abstract No: BO-25

Analysis of the spatial relationship between land surface temperature and vegetation cover in Gampaha District, Sri Lanka

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Land Surface Temperature (LST) provides important information about the land surface's physical properties and climate. Natural phenomena and anthropogenic activities, particularly urbanization, can alter LST. Besides, population increase, and urbanization are among the most widely reported drivers of vegetation cover change. As such, it is essential to investigate vegetation cover changes to identify vulnerable areas and implement sustainable management strategies to protect the environment. The present study evaluated the relationship between LST on vegetation change in the Gampaha district. Landsat 8 OLI /TIRS data of the study area from 2013 to 2015 were utilized to prepare vegetation maps and investigate LST. The thermal infrared bands of Landsat 8 were used to calculate the LST. Normalized Difference Vegetation Index (NDVI) was used to explore the vegetation change of the study areas. The result revealed that LST increased from 2013 to 2015. The maximum LST was reported from areas surrounding the Gampaha city (i.e., the maximum temperatures for 2013 and 2015 were 30.63°C and 35.02°C, respectively). The highest NDVI values reported for 2013 and 2015 were 0.62 and 0.52, respectively. Vegetation cover types of Gampaha district were classified into three categories based on the NDVI values (i.e., -0.1 to 0.2 non-vegetation, 0.2 to 0.3 sparse vegetation and 0.3 to 0.6 moderate vegetation). Interestingly, the current study revealed considerable changes in areas of vegetation cover classes over the study period. In 2013, the study area was found to be dominated by moderate vegetation (67.16 %) followed by sparse vegetation (27.92 %) and non-vegetation (4.92 %). However, between 2013 to 2015, the extent of moderate vegetation significantly declined from 67.16 % to 61.67 %, whereas sparse vegetation increased significantly from 27.92 % to 32.03 % ($p < 0.01$). Correlation analysis revealed a negative correlation between NDVI and LST, suggesting an increase in LST resulting in the decline of the vegetation cover change in Gampaha district. The results of this study may support urban planners, and respective authorities in making appropriate decisions to mitigate the environmental impacts of urban development activities in Gampaha district.

Keywords: Gampaha District, Landsat-8, LST, Vegetation Cover, NDVI

Abstract No: BO-26

Valorization of diaper waste into sustainable production of commercially grown *Pleurotus* spp. in Sri Lanka

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Oyster mushrooms (*Pleurotus* spp.) are commercially grown and consumed for their taste, high nutritional value, and medicinal properties. In Sri Lanka, oyster mushroom cultivation is practiced on a small scale as a self-employment cottage industry. With the scarcity as well as increased cost of conventional substrate materials, the use of an efficient, cost-effective, and sustainable alternative substrate is a key factor in promoting the oyster mushroom industry within the country. Disposable diapers representing about 4% of solid waste, which is the third largest consumer item discarded after a single use, pose a great burden on landfill sites causing adverse impacts on the environment. Therefore, this study aimed to develop a sustainable cultivation protocol using diaper waste to effectively cultivate oyster mushrooms. For this purpose, sterilized diaper cores (1%, 2%, 4%, and 6%) containing liquid waste, were mixed with commercial growth substrate. The treatments were statistically analyzed using One-way ANOVA for their mycelium running rate at 10 days intervals until complete colonization of the substrate blocks and the total yield of mushrooms for a duration of 2 months from the first fruiting date of the four commercially cultivated oyster mushroom species in Sri Lanka; *Pleurotus djamor, Pleurotus eous, Pleurotus ostreatus,* and *Pleurotus cystidiosus* in comparison with the control treatment containing 100% commercial growth substrate. According to the statistical analysis, the mycelium spreading rate of all the treatments with diaper core incorporation was comparatively higher than the control in *P. ostreatus, P. djamor,* and *P. eous* except for *P. cystidiosus,* in which 1% diaper core incorporation was reported the lowest mycelium spreading rate. In all four *Pleurotus* species, 2% and 4% diaper core incorporation led to the fastest running rate and was significantly higher than the control treatments and other treatments. According to statistical analysis, the means of the total yield of treatments and control of the four *Pleurotus* species were not significantly different. However the highest production yield was obtained from 4% of diaper core incorporation for *P. ostreatus* (990 g), *P. eous,* (855 g) *and P. cystidiosus* (820 g) *except* for *P. djamor* (670 g) *for* which the highest yield was observed at 2 % diaper core incorporation. With the results obtained, we could confirm that the high lignocellulose content, high N, P, and K content as well as the water retention abilities of used diaper cores suggest a potential for mushroom cultivation through lignocellulose enzymatic reactions. Therefore, our study proposed a potential resource management towards the zero-waste concepts, where diaper waste is no longer a debit entry but a valuable resource for today's circular economy that can be used as a cultivation medium for sustainable mushroom cultivation.

Keywords: Mycelium running rate, Oyster mushrooms, Total yield, Used diapers

Acknowledgment
This work is supported by the Research council, University of Kelaniya internal research grant.

Abstract No: BO-27

Soil erosion and sediment yield estimation using GIS-based RUSLE model in Attanagalu Oya watershed, Sri Lanka

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Soil erosion is considered a significant cause of land degradation that negatively impacts natural resources and socioeconomic activities across the globe. Hence, estimating the spatial distribution of soil erosion is essential for making successful policies and implementing proper land conservation and management practices. The present study was designed to estimate the soil erosion and sediment yield in the Attanagalu Oya Watershed, one of the major watersheds located in the low-country wet zone in Sri Lanka, which acts as an important natural ecological zone and a source of surface water for the area. The Revised Universal Soil Loss Equation (RUSLE) model integrated with the Geographic Information System and Remote Sensing was used to quantify soil erosion and map the spatial variation of the soil erosion hazard over a 20-year period. The Sediment Delivery Ratio (SDR) was utilized to estimate the sediment yield generated in the Attanagalu Oya watershed. Land use land cover derived from Landsat 7 ETM and Landsat 8 OLI imagery and Digital Elevation Model (DEM) were integrated into the model. The results indicated that the average annual soil erosion in the Attanagalu Oya watershed has substantially increased from 1.58 t ha^{-1} yr^{-1} in 2001 to 2.3 t ha^{-1} yr^{-1} in 2020, an increment of about 45.6%. The spatial distribution of soil erosion reflected that the moderate to extremely high erosion levels increased from 2001 to 2020, and the extremely erosion-prone areas (>60 t ha-1 yr-1) were distributed in the eastern part of the watershed. Furthermore, the average annual sediment yield in the Attanagalu Oya watershed was estimated as 0.39 t ha^{-1} yr^{-1} with a range of 0 to 124.4 t ha^{-1} yr^{-1} in 2001 and 0.57 t ha^{-1} yr^{-1} with a range of 0 to 87.4 t ha^{-1} yr^{-1} in 2020. The spatial distribution of sediment yield revealed that the high sediment yield was also generated in the eastern part of the watershed as soil erosion. The spatial analysis further revealed that steep slopes (>10.41%), high mean annual rainfall levels (>2500mm), erosion-prone soil types and land use land cover changes, contributed to the high soil erosion and sediment yield in the Attanagalu Oya watershed. The soil erosion hazard information obtained through this study on the Attanagalu Oya watershed can be utilized to design proper erosion conservation and land management practices for improving the sustainability of the watershed.

Keywords: GIS, RUSLE, Sediment yield, Soil erosion, Tropical watershed

Abstract No: BO-28

Effects of paddy cultivation on the water and sediment quality of drainage canals of an anicut scheme, Sri Lanka

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Paddy cultivation is a major and widespread agricultural practice in Sri Lanka. During the paddy cultivation, the water and sediment quality of nearby waterbodies can significantly change due to irrigation of paddy fields and agronomical practices. This research was conducted in a section of Morenna Anicut Scheme, Gampaha, Sri Lanka to assess the changes of water quality, sediment quality and flow aspects of the drainage canals with reference to a selected major irrigation canal during different agronomical practices of Maha cultivation season. Water and sediment samples were collected from four sampling sites from September (2022) to February (2023) selected based on a judgmental sampling method. Different physico-chemical parameters of water samples (temperature, pH, DO, salinity, EC, TDS, TSS, transparency, NO_3^- and PO_4^{3-} concentrations), sediment samples (particle sizes and heavy metal concentrations) and flow aspects (water depth and flow velocity) were analyzed employing standard procedures. Significant spatial and temporal variations of water and sediment quality parameters were observed ($p<0.05$, ANOVA) during the study period. The highest mean pH (6.61 ± 0.50), salinity (0.046 ± 0.004 ‰), EC (95.21 ± 6.95µS/cm), TDS (41.67 ± 3.74 mg/L), TSS (484.0 ± 220.0 mg/L), water depth (73.61 ± 4.38 cm), flow velocity (1.96 ± 1.81 m/s), PO_4^{3-} concentration (1.865 ± 0.750 mg/L), Cd^{2+} concentration (0.626 ± 0.293 ppm), total Cr concentration (5.62 ± 3.46 ppm), Zn^{2+} concentration (0.130 ± 0.130 ppm) and Ni^{2+} concentration (0.203 ± 0.203 ppm) were recorded at sampling site 04 (end point of the major drainage canal). In spatial Principal Component Analysis, sampling site 04 was characterized by temperature, pH, salinity, EC, TDS, TSS, transparency, water depth, flow velocity, NO_3^- and PO_4^{3-} concentrations and heavy metal concentrations (Cd^{2+}, total Cr, Ni^{2+} and Zn^{2+}). In Cluster Analysis, sampling site 04 was significantly different from all the other sites based on the water and sediment quality parameters and flow aspects. Therefore, among all sampling sites, site 04 was heavily degraded. In temporal Principal Component Analysis, February (After harvesting paddy) was characterized by temperature, pH, salinity, EC, TDS and TSS and October – 2 (Just after sowing and first major fertilization) and December (After the second major fertilization) were characterized by NO_3^- and PO_4^{3-} concentrations and heavy metal concentrations (Cd^{2+}, total Cr, Ni^{2+} and Zn^{2+}). Therefore, except in September (prior to land preparation), the water and sediment quality were heavily degraded in all other sampling occasions. This study reveals that physico-chemical water and sediment quality parameters and flow aspects of drainage canals in the selected paddy-cultivation area are affected by irrigation and agronomical practices in the paddy fields. Water and sediment quality of the selected major drainage canal and minor drainage canal were degraded when compared to the selected major irrigation canal of the Morenna anicut scheme.

Keywords: Agronomical practices, Anicut scheme, Drainage canal, Paddy irrigation, Water and sediment quality

Abstract No: BO-29

Impact of extrusion cooking on nutrient composition of a composite flour mixture developed using local grain varieties

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Extrusion cooking is preferred over conventional cooking in the food industry because it yields high production and retains significant nutrient values in a minimum processing time. This study presents the impact of extrusion cooking on nutrient components of composite flour mixtures developed using locally available grain varieties in Sri Lanka. Formulations were developed fitting to two factor factorial design using kalu heenati (WF 13272) rice flour as the major ingredient. Further, green gram flour, black gram flour, meneri flour were composited with black seeds, sesame seeds and cinnamon in developing the final product. The flour formulations were mixed with water to produce dough of suitable consistency. These dough mixtures were extruded at 95-100 ^{0}C using a single screw extruder for a specific time. The proximate composition of samples before and after the extrusion process including carbohydrate, crude protein, crude fat, dietary fiber and ash were analyzed according to the AOAC official methods of analysis. The results showed that the extruded samples had 0.72-5.56% carbohydrates, 0.25-0.89% protein, 0.01-0.04% ash, 0.03-0.14% dietary fiber more than that of samples prior to extrusion process. Further, the extruded samples had 0.19-0.36% crude fat less than that of sample prior to extrusion process. The highest percent difference during extrusion cooking is of carbohydrate content and the lowest percent difference is of ash content. In conclusion, extrusion technology is identified as a beneficial technique in improving the nutritional composition of food products. The potential to increase nutrient availability highlights the significant impact of extrusion on the nutritional quality of foods. As this technology is of increasing concern in the food industry, further research is suggested to optimize the extrusion process and develop nutrients rich food items that meet consumer expectations for taste and sensory appeal as well.

Keywords: Extrusion technology, Nutrient components, Composite flour mixtures, Grains

Acknowledgment
This work was supported by the university of Sri Jayewardenepura under the research grant ASP/01/RE/SCI/2021/93.

Abstract No: BO-30

Microplastics in selected offshore pelagic fish in Indian Ocean

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Microplastics (MPs) pollution in marine environment is an emerging threat to marine biota. Marine pelagic fish species such as tuna and tuna-like species caught during offshore fisheries in open seas, are known to be more commercially important and could be contaminated by MPs. As such, MPs could pose a risk to fish by themselves and to human health due to consumption of contaminated seafood. The present study was planned to investigate the MPs contamination of commercially important three pelagic fish species (*Thunnus albacares, Katsuwonus pelamis, and Elagatis bipinnulata*) caught from offshore fisheries using multi-day boats from several locations of the Indian Ocean to fill the knowledge gap on MPs contamination of pelagic fish, especially in the Indian Ocean. Fish samples were collected from Beruwala, Galle, Panadura and Negombo fishery harbors in Sri Lanka, and the gastro-intestinal tract (GIT) and gills were examined for possible MP contamination. A total of 40 samples belonging to three fish species were used for the study. The abundance and morphology (i.e. color, shape) of the MPs were assessed, and the polymer type of the MPs was investigated by using ATR-FTIR. Descriptive analysis was done by using IBM SPSS statistical version 26 and MS excel was used to calculate the percentages of MPs by color, shape and polymer type. There was a contamination of MPs in all three fish species. Nevertheless, 12.5% of *E. bipinnulata* and 21.7% of *K. pelamis* did not show MPs in analyzed tissues. *T. albacares* was found to have the greatest number of MPs (15±6 items individual^{-1}). The morphology of the MPs found from the GIT and gills of all the three fish species were fibers (51%), followed by fragments (37%) and films (12%). In GIT, the most prominent color was blue in all the fish species. Moreover, the polymer types found belonged to three categories *viz*, thermoplastic elastomers (TPE), phenol formaldehyde resin (PF), and polyethylene copolymer (PE-Copolymer). Among them, the most prominent type of polymer was PF. PE-copolymer was found only in *T. albacares*. Therefore, continuous monitoring of marine environment and implementing stringent regulations are recommended to minimize plastic pollution in the Indian Ocean to protect both the marine ecosystem and humans.

Keywords: Indian Ocean, Microplastics, Offshore Fisheries, Pelagic Fish

Acknowledgment
This work was supported by the Centre for Environment, Fisheries and Aquaculture Science (Cefas) under the Ocean Country Partnership Programme (OCPP) of the Blue Planet Fund, UK and the National Aquatic Resource Research and Development Agency (NARA), Sri Lanka.

Abstract No: BO-31

Effectiveness of banana leaves and coconut coir as substrates for *Pleurotus ostreatus* cultivation: A perspective of nutritional and antioxidant properties

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Pleurotus ostreatus (PO) is an edible oyster mushroom capable of degrading a wide variety of lignocellulosic substrates. Moreover, many of the *Pleurotus* species have been shown to have medicinal properties and contain bioactive compounds. Furthermore, they have high nutritional value as they are rich in fiber, proteins, carbohydrates, vitamins, and minerals. In Sri Lanka, sawdust is predominantly used as the substrate for oyster mushroom cultivation. Other substrates utilized in Sri Lanka include paddy straw, banana leaves and shredded paper. The purpose of this study was to evaluate which substrate or substrate combinations of dried banana leaves (BL) and coconut coir (CC) would produce PO mushrooms with high antioxidant activity and nutritional value. The different substrates used to grow the mushrooms were 100% BL, 100% CC, 50% BL + 50% CC, 75% BL + 25% CC and 75% CC + 25% BL. The PO spawn packets were purchased from the Mushroom Development and Training Center in Ratmalana, Sri Lanka. Polypropylene media bags were prepared by adding an appropriate weight of each substrate (BL and CC) along with white rice bran, red rice bran, chemical mix, and water. Each bag was autoclaved and inoculated under aseptic conditions. The bags were then transferred to a dark incubation room with a temperature of 25 °C. Once the spawn run had reached the bottom of each bag, the bags were cut open from the top and watered 3-4 times a day. Aqueous mushroom extracts were prepared using the mushrooms harvested from each substrate. Qualitative tests were conducted to determine the presence of bioactive compounds such as saponins, flavonoids, polyphenols, terpenoids, tannins, steroids and anthraquinones. Moreover, quantitative assays such as Lowry assay to determine the total protein content, Phenol-sulfuric acid assay to determine the total carbohydrate content, DPPH assay to evaluate the antioxidant activity, Phosphomolybdenum assay to determine the total antioxidant capacity and Folin-Ciocalteu assay to determine the total phenolic content of the mushrooms were performed. The 100% CC substrate had the highest water-holding capacity but was the least suitable substrate for mushroom growth as very little mycelial growth was observed in the media bags. All the mushroom extracts tested positive for polyphenols, saponins, terpenoids and steroids. 100% BL produced mushrooms with the highest total antioxidant capacity (1.13 mg/ml), moisture content (85.10%) and lowest IC50 value (1.25 mg/ml). Furthermore, these mushrooms had the highest number of fruiting bodies (13) and yield (18.75g). The 50% BL and 50% CC substrate produced mushrooms with the highest carbohydrate content (51.11 g/100g of sample). Based on the results it can be concluded that the 100% BL substrate is best suited to produce mushrooms with a high yield and antioxidant activity. In addition, the substrate ideal for producing mushrooms with a high nutritional value was 50% BL and 50% CC. Therefore, these substrates can be considered as suitable alternatives to the commonly used substrates by mushroom cultivators in Sri Lanka. Moreover, due to the presence of bioactive compounds identified in this study, further research can be conducted to determine the antibacterial and antifungal properties of the mushrooms grown on these substrates.

Keywords: Oyster mushrooms, Carbohydrates, Proteins, Polyphenols

Abstract No: BO-32

Levels of Naphthalene and Phenanthrene in seawater along the coastal belt from Colombo to Mirissa in Sri Lanka

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Polycyclic Aromatic Hydrocarbons (PAHs) are pervasive pollutants in marine and coastal settings. Naphthalene (NAP) and Phenanthrene (PHE) are among the sixteen PAHs recognized as priority pollutants by the United States Environmental Protection Agency. Due to their persistence, bioaccumulative capacity, and probable carcinogenicity, PAHs pose a serious threat to the health and wellbeing of humans when ingested. The present study was carried out to evaluate the levels of NAP and PHE in seawater along the coastal belt from Colombo to Mirissa, where coastal water pollution is considered to be high. Seawater samples collected from 19 distinct locations (n=3 each) along the selected area underwent HPLC analysis, followed by organic solvent extraction. Each of these locations provided three replicates, facilitating a reliable evaluation of the concentrations of NAP and PHE. The NAP concentration along the coastal belt was from 1.70 to 15.05 mg/L. The highest NAP concentration was recorded in Mirissa (15.05 ± 0.14 mg/L), followed by Galle Face, Bentota, Rathgama, Wellawatta, Gintota, Galle, Ambalangoda, Weligama, Kalutara, Unawatuna, Ratmalana, Moratuwa, Koggala, Hikkaduwa, Mount Lavinia, Panadura, and Wadduwa. In comparison, the lowest NAP concentration was detected in Dehiwala (1.70 ± 0.00 mg/L). The highest PHE concentration was recorded in Ambalangoda (5.36 ± 0.55 mg/L) followed by Mirissa, Galleface, Weligama, Rathgama, Gintota, Bentota, Galle, Koggala, Unawatuna, Hikkaduwa, Wellawatta, Dehiwala, Ratmalana, Wadduwa, Mount Lavinia, Panadura, and Moratuwa. However, PHE was not detected in Kalutara. Mirissa was heavily polluted, having the highest NAP concentration and the second highest concentration of PHE (5.25 ± 0.03 mg/L). The concentrations of NAP and PHE in all coastal water samples except Kalutara exceeded the maximum permissible concentration ($\sum$PAHs = 0.030 μg/L) stated by the Environmental Quality Criteria for the United States. The high concentrations of PAHs might be due to high oil and grease content caused by engine oil leaks from fishing boats and boat repair stations, infrequent oil and sludge spills from nearby industries, unintentional oil spills when refueling, and tributary inflows. Since NAP has a higher solubility in water, the concentration of NAP in seawater is higher than that of PHE. This study provides valuable information for EIA programs and contributes to developing effective strategies to mitigate PAH pollution in coastal waters. Broader studies are recommended to pinpoint the sources of PAHs and explore strategies for reducing environmental emissions.

Keywords: Coastal water, HPLC, Naphthalene, Phenanthrene, Polycyclic aromatic hydrocarbons.

Acknowledgment
This work was supported by Center for Water quality and Algae Research, Department of Zoology.

Abstract No: BO-33

Impact of different biochar and urea fertilizer ratios on soil microbial activity, growth and physiological performances of rice (*Oryza sativa* L.)

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This study investigated the interplay between biochar, urea, soil microbes, and rice growth. Biochar, a carbon-rich material, and urea, a nitrogen-containing compound, were investigated for their potential to enhance soil health, microbial activity, and rice crop physiological performance. The experiment evaluated the outcomes of varying urea levels (0, 30, 70, and 100 %) along with different biochar levels (0, 1, 2 and 3 t/ha) including a control with 0.62 t/ha partially burned paddy husk in accordance with a split-plot design. Data were collected 6 weeks after the experiment was established reveling significant interactions among urea, biochar and soil microbial activities. Soil microbial activity was measured by using carbon mineralization process, which involves the respiration of microorganisms. CO_2 emitted due to microbial respiration on soil substrate was trapped by 0.1M NaOH solution and titrated with 0.1M HCl solution to determine soil microbial activity. Data were analyzed using STAR for windows version 2.0.1. It was observed that microbial activity (23.53 mg/kg) was increased with higher biochar levels (2 t/ha) especially when combined with 70 % urea. Biochar nurtures microbial communities, which then enhance nutrient cycling, organic matter decomposition and improvement of soil matrix, potentially contributing to the significant water holding capacity (64.53 %) observed at 2 t/ha biochar rate. Rice growth parameters including tiller count (717.39 m^2), plant height (70.55 cm), total chlorophyll content (4.66 mg/g) and carotenoid concentration (0.77 mg/g) were also significantly improved with the combined application of 70 % urea and 2 t/ha biochar. The improvements compared to the control were 3.77, 7.20, 7.08, 2.59 % respectively. Therefore, it can be concluded that the synergistic effect of the combination of urea and biochar significantly effects microbial activity and rice growth 6 weeks after treatment application. These results highlighted the potential for biochar-urea interactions to optimize, rice crop performance after 6 weeks, offering a roadmap for sustainable agricultural practices that influence environmental conservation.

Keywords: Biochar, Physiology, Rice, Soil microbes, Urea

Abstract No: BO-34

Fluorescence-activated cell sorting analysis of yEGFP expression in transgenic *Pichia pastoris* with reconstituted RNAi

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Pichia pastoris lacks an RNA interference (RNAi) mechanism, which is a way of post-transcriptional gene regulation present in almost all eukaryotes including humans. The absence of RNAi makes *P. pastoris* a model organism that can be used to study foreign RNAi mechanisms by introducing the essential genes involved in the RNAi pathway of a particular organism. Yeast-enhanced green fluorescence protein (yEGFP) can be used as a reporter protein to study the reconstituted RNAi in *P. pastoris*. The objective of this study was to analyze yEGFP expression in transgenic *P. pastoris* with reconstituted human RNAi. yEGFP expressing *P. pastoris* reporter strain was produced by integrating yEGFP gene into *Pichia* genome at the alcohol oxidase (*AOX*) locus with the aid of pPICZ A vector. RNAi was reconstituted by transforming human Argonaute, Dicer, and TRBP genes (RNAi genes) to yEGFP expressing *P. pastoris* reporter strain to create the ADT strain. Human RNAi genes were cloned with Gateway cloning. Galactose induction was carried out to activate RNAi genes followed by methanol induction to express yEGFP. After both inductions, the expression of yEGFP was analyzed by fluorescence-activated cell sorting (FACS). The FACS results were further analyzed with Flowjo™ software. Wild-type *P. pastoris* (WT) was used as the no-fluorescence control. WT strain showed 134 median FITC-A signal, ADT strain had 833 median FITC-A signal, and yEGFP expressing reporter strain elicited 153 median FITC-A signal. The genes were cloned under the control of *Gal1* promoter in Gateway cloning. When galactose induction was carried out first, the Gateway vectors will be activated and RNAi genes will be expressed. Now, the *Pichia* cells have Argonaute, Dicer, and TRBP proteins in their cells. Secondly, the methanol induction induces the yEGFP gene which was cloned under the influence of *AOX1* promoter. The reporter strain had a higher median fluorescence value indicating the amount of fluorescence produced by yEGFP in *Pichia*. However, the ADT strain having yEGFP, and also RNAi genes, showed a fluorescence value similar to the wild-type that did not have yEGFP. This is evidence for the inhibition of yEGFP expression by reconstituted human RNAi in *P. pastoris*. In conclusion, the reconstituted human RNAi in *P. pastoris* successfully ceases the yEGFP expression. This model system can be used to study the effect of RNAi for another gene by replacing the yEGFP.

Keywords: FACS, RNAi, *Pichia pastoris*

Acknowledgment
This work was supported by the Arturo Falaschi fellowship (Fellowship number F/LKA21-01) awarded by International Centre for Genetic Engineering and Biotechnology (ICGEB).

Abstract No: BO-35

Studying the associations between myeloperoxidase levels in neutrophils and mean cell haemoglobin concentration in varying haemoglobin concentrations of patients attending haematology clinic, Colombo North teaching hospital, Ragama, Sri Lanka

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Myeloperoxidase (MPO), a heme-containing peroxidase mostly found in the lysosomal azurophilic granules in neutrophils. Since the MPO directly associates with the neutrophil phagocytic system, diseases that associate with bacterial infection or inflammation may directly link with its levels in neutrophils. Since serum iron levels regulate the levels of MPO in neutrophils, it may directly or indirectly be correlated with the plasma hemoglobin (HB) and intra-red cell HB concentration;MCHC, especially in anemic conditions. In such a situation, finding associations between MCHC, HB with MPO would facilitate MPO to be used as a new diagnostic tool for anemia. Present study was focused on understanding the correlations between MPO in peripheral blood neutrophils and Mean Cell Hemoglobin Concentration (MCHC) in varying hemoglobin concentrations. Total of 180 patients with varying hemoglobin concentrations who attended Haematology Clinic at Colombo North Teaching Hospital, Ragama, Sri Lanka were selected and peripheral blood smears of them were stained and quantified according to Mahjoub et al. (2015) with a few modifications. Mean Cell Hemoglobin Concentration (MCHC) was measured using a Hematology analyzer (Mindray BC-6800). Results were further categorized according to the subgroups of HB; Group1: 8.0 g/dL<HB; Group2: 8.0 g/dL=<HB<10.0 g/dL, Group3: 10.0 g/dL=<HB<12.0 g/dL, Group4: Hb>= 12.0 g/dL. The statistical analysis was performed using IBM SPSS_V26. First, the data was tested for normalization, followed by the Mann-Whitney Test. The total study population was 180 that included females (70%) and males (30%). The mean values of HB, Total MPO score, MCHC are 9.77 ±3.21, 50.85±30.29, 32.98±3.59 g/dL respectively. None of the parameters followed a normal distribution. In the Spearman's correlation bivariate analysis, the MCHC showed significant weak negative correlation ($p=0.025$; $r=.167$) with the MPO. However, there was no reliable correlation between MPO and HB. MPO did not show any significant differences between HB subgroups. However, MPO and MCHC separately showed a significant ($p<0.01$) increase in their mean difference among all the HB subgroups. Our results revealed that the MCHC possesses a moderate to weak correlation with MPO in neutrophils. Further, the MPO did not provide reliable correlations with HB in the whole group or in subgroups. However, MCHC values tend to decrease with the increasing levels of MPO in the mild anemic group (10.0 g/dL=<HB<12.0g/dL). The initial results provoked to study the behavior of MCHC and MPO in neutrophils in varying HB concentrations. By performing future research with a larger sample size, the initial findings could be validated.

Key Words: Iron deficiency, Iron deficiency anemia, Haemoglobin, Myeloperoxidase, Mean Cell hemoglobin concentration.

Abstract No: BO-36

Evaluation of *in vitro* antioxidant, anti-inflammatory activities and photoprotective properties of methanolic extracts of fruits, leaves and bark of *Flacourtia indica*

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Many plant-derived compounds are used medicinally as therapeutic measures against various disorders. *Flacourtia indica* commonly known as "Uguressa" or "Katulovi" is a medicinal plant used in ayurvedic medicine in Sri Lanka for treatment of various diseases. Therefore, this study focused on evaluating the antioxidant, anti-inflammatory activities and photoprotective properties of methanolic extracts of fruits, leaves and bark of *Flacourtia indica*. Phytochemicals in leaves, fruits and bark of *Flacourtia indica* were extracted into methanol by Soxhlet extraction. The presence of bioactive compounds was qualitatively identified by phytochemical screening of methanolic extracts. The total phenolic content (TPC) of each extract was determined by Folin-Ciocalteu (F-C) method. The antioxidant activity of each extract was determined by 2,2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging assay and the anti-inflammatory activity of each extract was assessed by protein denaturation assay. Photoprotective properties of the extracts of leaves, fruits and bark of *Flacourtia indica* were evaluated by determining the sun protection factor (SPF) of each extract using a UV-visible spectrophotometric method and applying the Mansur equation. The results of phytochemical screening revealed the presence of steroids, tannins, saponins, alkaloids, proteins and phenols in three tested plant parts. The DPPH free radical scavenging activity, anti-inflammatory activity and photoprotective properties of tested extracts were in the order of leaf>bark>fruit. The highest DPPH radical scavenging activity (IC_{50} = 27.02 ± 0.25 µg/mL), anti-inflammatory activity (IC_{50}=186.08±0.80 µg/mL) and photoprotective property (SPF = 40.57 ± 0.11 at 2.0 mg/mL) were shown in the leaf extract. According to the results, extract of leaves of *Flacourtia indica* has high sunburn protection as sunscreens with SPF> 30 are considered as products with high sun protection and recommended by the most dermatologists. Among the three extracts, the methanolic leaf extract was rich in phenolics with TPC of 39.97±4.18 mg GAE/g of dry weight of plant material. According to the Pearson correlation, a strong positive correlation was observed between the TPC and antioxidant activity ($r=0.9730$, $p<0.05$) indicating a strong contribution of phenolics for antioxidant activity of leaves, fruits and bark of the plant. The results of this study revealed that the leaves of *Flacourtia indica* could be used as natural source rich in plant-derived antioxidant, anti-inflammatory and photoprotective agents, which can be used in the pharmaceutical industry and as additives in sunscreen formulations.

Keywords: Anti-inflammatory, Antioxidant, DPPH, SPF, *Flacourtia indica*

Acknowledgment
This work was supported by the University of Kelaniya under the research grant number RP/03/02/06/01/2018 and the National Science Foundation of Sri Lanka under the research grant number RG/2013/EQ/01.

Abstract No: BO-37

Spatial variations of macrobenthic assemblage structure along paddy-based run-of-river irrigation system: A case study from Colombo, Sri Lanka

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In a paddy-based run-of-river irrigation system, quality of water varies spatially along the river, which influences the biodiversity present in an aquatic ecosystem. With the spatial variations, macrobenthic fauna living along a run-of-river system also vary. The major objective of this study was to analyze the spatial variation of macrobenthos along a run-of-river irrigation system. The selected study area is located in Uduwana near Homagama in Colombo District. The study paddy field is mainly irrigated using two natural streams which are named Kalu Ganga athu ela and Thel Ela and irrigated water is drained to a natural stream named Kunu Ela. Four sampling sites were taken judgmentally as covering different areas of the run-of-river irrigation system. A random sampling technique was employed, and two bottom sediment samples were collected using a Peterson grab sampler on monthly basis from each sampling site between September 2022 to February 2023 (Maha cultivation season). Sediments were wet sieved through 0.5 mm mesh and collected macrobenthos were identified using standard keys. Total abundance, species richness, species evenness, and species heterogeneity were determined separately for the four sites. The spatial variation of total abundance between the four sites was analyzed using one-way ANOVA in MINITAB version 17.0. Similarities of macrobenthos community assemblages were assessed using Bray-Curtis similarity clustering method using PRIMER. A total of 8 macrobenthic taxa (*Pila globosa*, *Lymnaea pinguis*, *Gyraulus saigonensis*, *Melanoides turberculata*, *Hirudo* sp., *Glyphidrilus* sp., *Paratelphusa* sp., and Chironomidae sp.) were observed from sampling sites. *Lymnaea pinguis* and Chironomidae sp. dominated in sediment samples and accounted for more than 70% of the total macrobenthic abundance. Sampling site 2 recorded the highest total abundance (N=350) and site 1 recorded the lowest total abundance (N=115) throughout the sampling period. The species richness of the macrobenthic communities was similar in sites 1, 3, and 4 (S=6) while the species richness was 5 in site 2. Since the benthic community was mainly dominated by *Lymnaea pinguis*, the lowest species heterogeneity (H') and species evenness (J) values were observed in sampling site 2 ($H' = 0.11$; $J = 0.79$). According to the results of ANOVA, the abundance of *Pila globosa*, *Lymnaea pinguis*, and *Gyraulus saigonesis* showed spatial variations. The cluster analysis separated site 2 from other sites, indicating that the macrobenthic taxa in site 2 are varied compared to the other three sites. Thus, the results revealed that there were spatial variations in the distribution pattern of macrobenthos along a paddy-based run-of-river irrigation system. It is recommended to extend the sampling period to include both Yala and Maha cultivation seasons with more sampling sites to get a better understanding of the spatial variations in the distribution patterns of macrobenthos along the paddy-based run-of-river irrigation system.

Keywords: *Lymnaea pinguis*, Macrobenthic, Paddy, Run-of-river, Water quality

Abstract No: BO-38

Changes in the composition and diversity of standing vegetation and soil seed bank in a lowland wet evergreen forest

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The lowland wet evergreen forests in Sri Lanka hold significant ecological and socio-economic value, making it a crucial ecosystem worthy of conservation efforts. Salgala forest reserve (FR) in the Kegalle district is one of the small, isolated forest reserves and home to many endemic plant species. Like many other forest reserves in the country, Salgala FR is also under anthropogenic and natural threats such as habitat degradation, erosion, and invasive species. In order to take protection measures, it is important to assess the amount and trends in biodiversity on the site. This study was carried out to assess the species diversity and composition of vegetation and soil seed bank (SSB) in the Salgala FR along an elevational gradient. Vegetation and soil sampling were conducted at three different elevations: above 300 m elevation, between 250 m- 300 m and between 250 m and 200 m. The stratified random sampling method was carried out due to the heterogeneity of the terrain and vegetation and seven main sampling plots of 10 m x 10 m were laid to assess the overstory vegetation with the individuals higher than 1.5 m and circumference of tree trunks at breast height is greater or equal to 30 cm. Five subplots of 2 m x 2 m and another two 1 m x 1 m sub-sub plots were laid within each main sampling plot to assess the diversity of understory vegetation in two strata. During this study, 70 soil samples (35 kg) were collected from 7 sampling plots and under greenhouse conditions, soil samples were incubated for SSB analysis. Hutcheson's t-test was used to analyze diversity variation in standing vegetation and SSB along the elevational clusters in FR with Shannon Weiner index values. The results indicate a decreasing trend in the Shannon diversity index (H`) with increasing elevation for SSB, while the vegetation has shown a different pattern. However, the higher diversity was recorded in mid-elevation for the standing vegetation (H'=3.5390), while the higher elevation for both standing vegetation (H`= 2.7659) and SSB (H`= 1.4809) has recorded the least diversity values. Higher slopes and soil erosion in higher elevations in the sampling sites and several slope-related factors can have an impact on the differences of diversity in vegetation. And, these differences are due to the amount of sunlight received, lack of water, and nutrient depletion brought on by soil erosion. *Stemonurus apicalis* was identified as the dominant plant species in the standing vegetation. However, *Clidemia hirta* was the dominant species in the soil seed bank in Salgala FR. Hence, variations in the composition of the existing vegetation in these seven sampling locations may be attributed to disparities in germination prerequisites, competitive forces, anthropogenic disruptions, and soil erosion processes.

Keywords: Hutcheson's t-test, Shannon diversity index, Slope effect, Soil seed bank, Overstory

Abstract No: BO-39

Imposex in the gastropod, *Thais clavigera* as a sensitive biomarker for tibutyltin (TBT) pollution

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Imposex occurs when certain invertebrates are exposed to organotin antifouling paints, resulting in the formation of morphological traits such as the penis and vas deferens in female gastropod mollusks or the superimposition of male morphological features onto females. Imposex is a morphological biomarker that can be used to detect organotin contamination in marine habitats. Among the various butyltin compounds, TBT accumulates the most and is the most common cause of imposex. TBT-induced imposex may be responsible for a significant amount of the loss of certain coastal marine invertebrates. The gastropod, *Thais clavigera* was used for imposex studies considering its high TBT sensitivity. *T. clavigera* species were collected from both commercial and fishery harbors in Western and Southern coastal stretches (n=30). Imposex response in the populations was evaluated by using the Relative Percentage Penis Length Index (RPLI) and Vas Deferens Length Index (VDLI), and Imposex development was assessed by calculating the indices of imposex incidence or Frequency (I %) given as a percentage of imposex-affected females in the sample. Statistical analyses were done by using Anova, 2016. Results revealed that the highest imposex frequency and TBT concentration were detected in Colombo harbor (TBT= 303± 7.4 ng/L; I= 38%), where the highest TBT concentration was recorded in Sri Lanka. Dikkowita (97± 4.3 ng/L; I= 36%), Galle (110± 4.1 ng/L; I=8%), Mirissa (54± 3.6 ng/L; I= 5%) and Kirinda (2. 2± 0.3 ng/L; I= 2%) followed with varying TBT concentrations and I%. No imposex frequency was recorded in samples collected from Dewundara and Hambanthota harbors, showing the relationship between contamination levels of TBT and imposex development in mollusks. RPLI in *T. clavigera* was found from 14.63% to 24.77%. Further, it was found that the imposex severity was high in females of *T. clavigera* collected from the Colombo and Dikkowita harbors. A positive correlation between the frequency of imposex incidence and TBT concentrations found at different locations ($p<0.05$ & $r^2= 0.64$) suggests that imposex-affected females in the population of *T. clavigera* augment with increasing TBT concentrations in the marine environment. It could be concluded that TBT is a potential xenobiotic chemical that acts as an environmental hormone that adversely affects mollusks causing reproductive impairment and leading to imposex incidences.

Keywords: Biomarker, Imposex, *Thais clavigera*, Tributyltin (TBT), Xenobiotic

Acknowledgment
This work was supported by the University of Sri Jayewardenepura under the research grant ASP/01/RE/SCI/2017/11.

Abstract No: BO-40

Antimicrobial activity of poly-herbal formula "Dasapanguwa" against several Gram positive bacteria and Gram negative bacteria

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The resistance of bacteria against available antibiotics has become a rising problem worldwide. Therefore, the discovery of alternatives using medicinal plants is widely studied. Although medicinal plants have been studied individually, the impact of herbal formulas was studied rarely. "*Dasapanguwa*" is a poly-herbal formula prepared as a decoction of 10 different plant parts to use in Ayurvedic medicine in Sri Lanka for colds, fever, and infectious diseases. Although the formula is used as a treatment for infectious diseases in Ayurvedic medicine in Sri Lanka, the antimicrobial action of this preparation was not scientifically assessed. The objective of the research was the determination of the antibacterial activity of the *Dasapanguwa* formula against Gram positive and Gram negative bacteria. Plant parts of *Mollugo cerviana* (L.) Ser., *Solanum virginianum* L., *Solanum melongena* L., *Justicia adhatoda* L., *Rotheca serrata* (L.) Steane & Mabb., *Glycyrrhiza glabra* L., *Zingiber Officinale*, *Coscinium fenestratum* (Gaertn.) Colebr., *Piper nigrum* L., and *Coriandrum sativum* L. were collected in dried form. Water extracts of decoction 1 (D1) (plant part: 5.0 g) and Decoction 2 (D2) (plants parts: 5.0 g ground into fine powder) were prepared by refluxing in 500.0 ml of water for two hours at 100 °C followed by freeze-drying. The antibacterial susceptibility test was performed by the Kirby-Bauer disc diffusion method against Gram positive bacteria (*Staphylococcus aureus*, *Bacillus subtilis*, and *Enterococcus faecalis*), and Gram negative bacteria (*Pseudomonas aeruginosa*, *Escherichia coli*, and *Klebsiella pneumoniae*). Antibiotic discs were prepared for each concentration of two decoctions (1.0 to 15.0 mg ml^{-1}). Commercially available tetracycline (30 µg) and ceftriaxone (30 µg) were used as positive controls against Gram's positive and Gram's negative bacteria respectively according to the CLSI guideline. The diameter of the clear zones was measured. There were no inhibition zones against all the bacteria for tested concentrations of both decoctions compared to positive controls. Previous studies showed that the antibacterial activity of an herbal extract could depend on the plant, solvent, test pathogens, and concentrations. Furthermore, the activity could depend on the plant itself or the formula of poly-herbal. Therefore, it is recommended to further study the antibacterial activity of both decoctions for higher concentrations from 15 mg ml^{-1} against selected bacteria. Furthermore, the antibacterial activity could be studied for extracts prepared by different solvents including methanol and ethanol.

Keywords: Antibacterial activity, Poly-herbal formula, Dasapanguwa, Gram positive bacteria, Gram negative bacteria

Abstract No: BO-41

Effects of climate change on early life history stages of selected montane forest species in Sri Lanka

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Global climate change has become a significant challenge for ecosystems across the world, as it alters the global temperature, and rainfall patterns and creates extreme weather events. It influences different components such as environmental, ecological, and socio-economic stability. Among the climatic factors, temperature and rainfall play a critical role in determining vegetation distribution and abundance. Montane and alpine forests located at higher altitudes are the most vulnerable terrestrial ecosystems to the current climate change. Surpassing the various life stages of plants, seed germination, and seedling establishment are the phases highly affected by climate change. The main objective of this research was to determine the effect of predicted high temperatures and drought stress on the early life history stages of plants in the montane forests of Sri Lanka. Seeds from *Eurya ceylanica* and *Hortonia floribunda* were obtained from the Knuckles Forest whereas *Exacum trinervium* and *Maesa indica* were collected from the Loolkandura estate. Then the effect of temperature and water potential were measured by their germination percentages and shoot-root lengths under different temperatures. Seeds collected from Knuckles Forest were incubated at different temperatures, such as 17^{o}C, 25^{o}C, and 30^{o}C on filter papers saturated with water, in Petri dishes. Seeds collected from Loolkandura were subjected to different temperatures (17^{o}C, 25^{o}C, and 30^{o}C) and an osmotic potential gradient (0 MPa, -0.25 MPa, -0.50 MPa, and -0.75 MPa) by dissolving different amounts of polyethylene glycol in distilled water. According to the results, except *M. indica* other species did not show germination until 30 days, but germinated upon the scarification and gibberellic acid treatment depicting they have seed dormancy. Although *E. ceylanica* germinated at all 3 temperatures, the highest shoot and root growth were observed at 25^{o}C showing that it can be adapted to the current warmer climate with moderate temperature increments. *H. floribunda* showed germination only at 25^{o}C with remarkable seedling growth revealing that high temperatures promote its seed germination and seedling establishment. *E. trinervium* showed poor germination only at 17^{o}C under -0.25MPa. Thus, other high temperatures are unfavorable for its germination. However, further studies are required to determine the precise climate effect on *E. trinervium*. *M. indica* had remarkable germination along with higher shoot and root growth at 17^{o}C. Hence, global warming demotes the *M. indica* seed germination and establishment. However, it had the potential to survive under moderate temperature increments up to 25^{o}C and water deficit conditions up to -0.25 MPa. *M. indica* seedlings can tolerate extended drought periods within their existing local range. But it is unable to survive in severe osmotic stress at -0.75 MPa and high-temperature conditions like 30^{o}C when its range shifts to other locations. Since *M. indica* is a pioneer species in Knuckles Forest and has adaptability for climatic warming in local regions, it can be used to promote ecological succession in fragmented areas of montane forests and improve its biodiversity.

Keywords: Extended drought, High temperature, *Maesa indica*, Water potential gradient

Abstract No: BO-42

Bioremediation potential of wood-associated fungi in Rajawaka forest reserve, Balangoda

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Sri Lanka consists of a high diversity of fungal species, especially wood-associated fungi. These fungi play a vital ecological role in wood decomposition and have potential applications in environmental remediation due to their unique enzyme systems. Currently, the accumulation of polycyclic aromatic hydrocarbons (PAHs), mainly from vehicular emissions has become a significant environmental concern. Therefore, the present study aimed to identify the wood-associated macro and micro fungi in the Rajawaka forest reserve which is a lowland secondary forest located in the Balangoda area in the Rathnapura district, and to assess their ability to degrade specific PAHs, including phenanthrene, naphthalene, pyrene, and anthracene. Identification keys followed by morphological characteristics and image-based methods were used to identify the macrofungi. Microfungi were isolated following surface sterilization and culturing on potato dextrose agar (PDA) plates. Most frequently isolated fungal strains were subjected to plate assay to assess the fungal growth in PAHs by using 8 replicates. Control plates were prepared without inoculating fungi for each PAH-incorporated media. Spectrophotometric analysis was done to determine their PAH degradation abilities using 3 replicates. Controls were prepared without inoculating fungi. Obtained data were analyzed using ANOVA and Tukey's pairwise comparison by using Minitab 17 statistical software. The macrofungi collected from the Rajawaka forest reserve were mainly in the phylum Basidiomycota; *Ganoderma* sp., *Pycnoporus* sp., *Phellinus* sp., *Hexagonia* sp., *Trametes* sp., *Earliella* sp., *Schizophyllum* sp., *Lentinus* sp., *Calocera* sp., *Stereum* sp., *Microporus* sp., and *Pleurotus* sp. Frequently isolated microfungi included *Trichoderma* sp. 1, *Trichoderma* sp. 5, *Trichoderma* sp. 6, Grey sterile sp., *Mortierella* sp. 2, Brown sporulating sp., *Humicola* sp., and *Aspergillus* sp. 1. *Mortierella* sp. 2 and Grey sterile sp. were significantly effective in degrading phenanthrene (42.51%, and 34.16% respectively) and naphthalene (41.27%, and 33.48% respectively), while *Humicola* sp. and Grey sterile sp. showed a high degradation capacity for anthracene (33.73%, and 23.72% respectively) and pyrene (30.62%, and 19.32% respectively). All the PAHs studied were efficiently degraded by Grey sterile sp. This investigation serves as a preliminary exploration of the wood-associated macro and microfungal diversity in the Rajawaka forest reserve, and their potential in remediating PAH pollutants. It also opens the avenue for future research in finding environmental solutions for bioremediation of PAH deposition in Sri Lanka.

Keywords: Bioremediation, PAH degradation, Rajawaka forest reserve Balangoda, Wood-associated fungi

Abstract No: BO-43

Evaluation of antioxidant and anti-inflammatory properties of leaves of *Impatiens repens*

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Impatiens repens, a plant species highly valued for its medicinal properties, has been used in traditional medicine to treat various ailments, such as epilepsy, insanity, hemorrhoids, and gonorrhea. This species contains phytochemicals such as tannins, flavonoids, and phenols that are believed to possess antioxidant and anti-inflammatory properties, making it a potential source for developing novel anti-inflammatory drugs. This study aimed to investigate the medicinal properties of *I. repens* and evaluate its potential as a valuable source of natural anti-inflammatory compounds. The research focused on exploring the antioxidant and anti-inflammatory activities of *I. repens* leaf extracts. Phytochemicals of *I. repens* leaves, first extracted into hexane by cold extraction were sequentially extracted into ethyl acetate and methanol, respectively. The antioxidant potential of three solvent extracts (hexane, ethyl acetate, and methanol) was evaluated using the ferric reducing antioxidant power (FRAP) and 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assay. The methanol extract demonstrated the highest radical scavenging activity, with an IC_{50} value of 407.63 ± 12.24 µg/mL, indicating its ability to effectively act as an antioxidant. Similarly, in the FRAP assay the methanol extract exhibited the highest reducing power, with a FRAP value of 661.56 ± 16.69 µg (Fe^{2+})/g extract. Furthermore, the total phenolic content (TPC) and total flavonoid content (TFC) of the extracts were determined. The methanol extract exhibited the highest TPC (120.52 ± 4.47 mg GAE/g extract) and TFC (17.77 ± 4.47 mg CE/g extract) among the solvent extracts. In addition, the radical scavenging properties of all solvent fractions were investigated using DPPH scavenging assay and their correlations with phenolics and flavonoids were analyzed using Pearson's correlation. Strong and positive correlation coefficients of 0.99 and 0.99 were observed respectively. These results reflected that both phenolics and flavonoids contributed to elicit antioxidant properties of *I. repens* leaves. To assess the anti-inflammatory potential of *I. repens*, two assays were performed: the egg albumin denaturation assay and the Human red blood cell (HRBC) membrane stabilization assay. In the egg albumin denaturation assay, the methanol extract exhibited marked and concentration-dependent anti-inflammatory activity, with an IC_{50} value of 346.58 ± 26.93 µg/mL. I In the HRBC membrane stabilization assay, the hexane extract demonstrated significant inhibition of protein denaturation with an IC_{50} value of 387.73 ± 4.42 µg/mL, comparable to the standard drug used, o-acetylsalicylic acid. These results suggest that leaves of *I. repens* possesses potent anti-inflammatory properties, making it a promising candidate for the development of new anti-inflammatory drugs. The findings of this study validate the use of *I. repens* in traditional medicine for various ailments and highlight its potential as a valuable medicinal plant. The rich content of phenolic compounds and flavonoids in the methanol extract further supports its antioxidant activities. Given the increasing demand for effective and safe anti-inflammatory drugs, *I. repens* holds promise as a natural alternative to conventional treatments.

Keywords: Anti-inflammatory, Antioxidants, Egg albumin denaturation, HRBC membrane, *Impatiens repens*

Abstract No: BO-44

Assessment of heavy metals in oysters (*Crassostrea cucullata*), sediments, and water in selected locations of Negombo estuary

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Heavy metal contamination in aquatic environments is a matter of great concern due to its negative effects on both humans and other organisms. The present study was planned to evaluate the concentrations of selected heavy metals, cadmium (Cd), copper (Cu), lead (Pb), selenium (Se), and zinc (Zn), in oysters (*Crassostrea cucullata*), sediment (~1.4 m depth), and water (~0.5 cm depth). The samples were collected from four sites in the Negombo estuary in the dry season (March - April) of the year 2022. The selection of sampling locations was determined based on the presence of oysters. For each site, 20 oyster samples, 3 water samples, and 3 sediment samples were collected. The analysis was conducted following the protocols outlined in EPA (Environmental Protection Agency) methods 3052 for oysters and 3051A for sediments. This involved the use of microwave-assisted digestion and subsequently analyzing the samples with an inductively coupled plasma-mass spectrometer. A comparison was made between the average metal concentrations obtained from four study sites. The concentrations of heavy metals found in oysters were higher than the concentrations found in sediments and water at selected sites. Lead concentrations in oysters were safe for human consumption (21.52 ppb – 151.1 ppb), but zinc levels were higher than the (4834 ppb – 11538 ppb) WHO guidelines. The measured levels of copper (Cu), cadmium (Cd), and selenium (Se) were found to be within permissible limits. Metal concentrations in water were significantly lower than in sediments and oysters for all metals studied. There was no direct correlation observed between the metal levels in nearby sediments and water (The correlation coefficients for the metals are as follows: Cu (-0.466), Zn (0.180), Se (-0.174), Cd (0.036), and Pb (-0.445)). Metal distribution in water inlets of the estuary did not show a clear pattern. Water consistently had lower metal concentrations compared to sediments and oysters. The present study suggests several avenues for future research. Long-term monitoring may reveal temporal variations in metal concentrations, while source identification studies can trace the origin of pollutants. Investigating bioaccumulation factors in oysters and their ecological impacts on the ecosystem is crucial. Developing remediation strategies and conducting human health risk assessments are necessary for mitigating contamination effects. Pursuing these research directions can lead to improved understanding and protection of the estuarine environment and human health.

Keywords: Estuary, Heavy metals, Oysters, Sediment, Water

Abstract No: BO-45

Assessment of the antioxidant, anti-diabetic, and anti-obesity activities of a Sri Lankan "spice" mixture at different storage conditions used for treating obesity

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Obesity, diabetes, and hypertension have become prevalent health issues in Asian countries, affecting individuals at young age. Systemic oxidative stress and adipose tissue contribute significantly to the development of insulin resistance associated with obesity and type II diabetes. Due to the possible toxicity and carcinogenicity of synthetic antioxidants, there is a global need to discover safe antioxidants to use as food additives. To address these concerns, clinical trials were conducted in Sri Lanka using a spice mixture consisting of commonly used spices in Sri Lankan cuisine: *Cinnamomum zeylanicum*, *Cuminum cyminum*, *Piper nigrum*, *Murraya koenigii*, and *Allium sativum*. This study aimed to evaluate the antioxidant, anti-obesity, and anti-diabetic potential of a methanol extract derived from this Sri Lankan spice mixture, as well as to evaluate the above activity properties of five glass bottle samples stored at different storage conditions: the positive control (STD), the initial spice mixture sample (INT), the sample after three months at room temperature (RT), the sample after three months in a dark environment (BLK), and the sample after three months in a refrigerator (COOL). The IC_{50} value of the methanol extract of INT demonstrated significant antioxidant activity ($0.08 \pm 0.03x10^{-2}$ mg/mL, $p < 0.05$) in the DPPH assay compared to the positive control, BHT ($0.07 \pm 0.05x10^{-2}$ mg/mL). Similarly, the lower IC_{50} value of INT indicated higher antioxidant activity ($0.17 \pm 0.14x10^{-1}$ mg/mL) in the ABTS assay when compared to the positive control BHT ($0.36 \pm 0.15x10^{-1}$ mg/mL). In both assays, the IC_{50} values followed the order of INT < COOL < BLK < RT, signifying decreasing antioxidant activity in the same order. The methanol extract samples (1.0 mg/mL) in the FRAP assay showed increasing relative % reducing power in the order of RT < BLK < COOL < INT, with values of 30.37%, 32.14%, 32.74%, and 37.05%, respectively, which was lower compared to the positive control (BHT). The α-amylase inhibition assay revealed that the IC_{50} of the methanol extract of the INT was $0.29 \pm 0.21x10^{-1}$ mg/mL compared to the positive control Acarbose (IC_{50}, $0.06 \pm 0.02x10^{-1}$ mg/ml). The IC_{50} of the methanol extract of INT in the anti-lipase assay was $0.14 \pm 0.05x10^{-1}$ mg/mL, while the positive control (Orlistat) had an IC_{50} of $0.09 \pm 0.01x10^{-1}$ mg/mL. These results revealed that the IC_{50} value increased in the order of INT < COOL < BLK < RT, when each glass bottle sample was stored after three months according to their distinct conditions, suggesting a negative correlation between assay activity with light intensity, temperature, and storage time. Overall, the study concluded that the spice mixture used for reducing obesity exhibits significant antioxidant potential. Additionally, the results from the anti-lipase and α-amylase inhibition assays suggest that the bioactive constituents present in the methanol extract have the potential to inhibit lipase and α-amylase enzymes, providing anti-obesity and anti-diabetic benefits.

Keywords: Anti-diabetic, Anti-obesity, Antioxidant, Spice mixture

Abstract No: BO-46

A preliminary assessment of odonate (Insecta: Odonata) diversity and abundance in Mihintale lake and Kaludiyapokuna in Mihintale, Anuradhapura

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The odonates of Sri Lanka comprise with 129 known species, including 67 species belongs to 12 families where 56 species (43%) are known to be endemic to the country. These organisms are currently threatened due to increase in human population and activities, climatic change, intensive agricultural practices and pollution and in need of conservation. Having less diversity, richness, abundance and distribution surveys is one of the key obstacles in conservation. There have been less surveys of odonates in dry zone areas. This study intended to prepare an inventory of odonates that inhabit two lotic ecosystems in dry zone. Four sample sites were selected from each lotic habitat. Visual observations of adult odonates were conducted by walking along belt transect of 100 x 3m that are adjacent to the water bodies in all four sample sites in the selected two lotic ecosystems. Observations were taken from 0900 h to 1100 h in the morning and 1500 h to 1600 h in the evening for six months from Kaludiya pokuna and Mihintale lake visiting three times per month to each site. The observed individuals were photographed. A total of 3,343 of individual odonates were recorded. A total of 22 species identified using standard field guides, belong to three families, Coenagrionidae (25.90%), Gomphidae (3.26%) and Libellulidae (70.83%), two vulnerable species *Aciagrion occidentale* and *Ceriagrion cerinorubellum,* two endemic species *Cyclogomphus gynostylus* and *Pseudagrion rubriceps ceylonicum* where one was considered as critically endangered and three nearly threatened species *Orthetrum glaucum, Hydrobasileus croceus* and *Rhodothemis rufa* were recorded. The diversity of odonates and abundance was higher in Mihintale lake because Shannon – Weiner diversity index (2.267) and Simpson's diversity index (0.854) and Eveness (0.817) were high for Mihintale lake. The highest number of individuals that observed was *Brachythemis contaminata* in both study sites as a total but in Kaludiya pokuna number of individuals that was observed from this species was higher than Mihintale lake. This study shows odonate diversity is high in both lotic habitats that were studied and in Mihintale lake it is higher than Kaludiya pokuna. This study needs to be further expanded taking microhabitat parameters, water quality parameters and expanding it over time and area. Further, both lotic and lentic habitats can be considered with and without/less anthropogenic activities.

Keywords: dragonfly, damselfly, abundance, endemic, conservation

Abstract No: BO-47

Effect of dietary supplementation of probiotics and ascorbic acid on the growth, survival and haematological parameters, and enhancement of resistance to bacterial infections in Nile Tilapia (*Oreochromis niloticus*)

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This study was conducted to evaluate the effects of dietary administration of probiotic (PROFS POWER®) and ascorbic acid in Nile tilapia fingerlings (*Oreochromis niloticus*) diets. A total of 90 Nile tilapia fingerlings were distributed into three triplicate treatments. The first treatment, T_1 was fed a balanced diet supplemented with probiotics (5 g/kg), whereas T_2 received the same basal diet supplemented with ascorbic acid (500 mg/kg). Fish of the third treatment, T_3 were served a control diet free from both probiotics and ascorbic acid. After three months of the experiment, survival and growth performances were evaluated and blood samples were collected from the experimental fish of different treatments. The protective effect of the two compounds was evaluated via a challenge infection test, using *Aeromonas hydrophila.* For the histopathological study, tissue specimens of the gills, liver, and intestine were excised from the tested fish. The specific growth rate (%) was significantly higher (p<0.05) in T_1 (1.89 $\pm$ 0.04) followed by T_2 (1.88 $\pm$ 0.04) compared to the control (1.62$\pm$ 0.04). The survival (%) was significantly higher (p<0.05) in T_1 (93.33 $\pm$ 3.33) and T_2 (90.00 $\pm$ 0.00) compared to the control (63.33$\pm$ 6.67) at the end of the feeding trials. Significant improvements (p<0.05) in hematological parameters of fish such as the mean erythrocyte count (RBC), white blood cell count (WBC), haemoglobin content (Hb) and haematocrit (Hct) were found with experimental groups, fed with probiotics and ascorbic acid compared to the control group. Haemoglobin content and RBC were significantly (p< 0.05) reduced in T_3 after bacterial challenge, but fish in T_1 and T_2 were not significantly affected. The challenge infection showed an improved level of protection in fish fed with two supplemented treatments compared to the control. Gill hyperplasia was observed in the control treatment while almost normal gill structure was observed in fish fed with supplements. Melano-macrophage centers were observed in liver sections of fish in T_1 and T_2. Necrotic areas were observed in the gut sections of fish in the control treatment. The shown protection in fish in T_1 and T_2 may be due to the protective effect of supplemented diets. The results revealed a positive growth enhancement and improved level of protection of *O. niloticus* with the incorporation of both ascorbic acid and probiotics as growth promoters in their diet with respect to its growth, haematology, innate immunity, and disease resistance. Following the experimental design, adding 500 mg of ascorbic into one kilo of diet was cheaper than adding 5 g of probiotics. Therefore, it is suggested that the incorporation of ascorbic at a dose of 500 mg per one kilo of diet could be a potential, less expensive, and promising dietary supplementation than incorporating probiotics for Nile tilapia (*O. niloticus*) fingerlings aquaculture.

Keywords: Challenge, *Oreochromis niloticus*, Probiotic, Resistance, Vitamin C

Acknowledgment
This work was supported by the University of Kelaniya, Sri Lanka.

Abstract No: BO-48

Effect of almond-based diet, on the growth performance and selected hematological parameters of Nile tilapia (*Oreochromis niloticus*) fingerlings

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The inconsistency in supply, and high prices pose constraints on the utilization of fish meal, as the protein source, in the process of fish feed preparation. Therefore, it is crucial to identify cost-effective alternative protein sources for fish feed formulation in aquaculture to overcome these limitations. To address this issue, tropical almond kernel meal has been identified as one of the alternative protein sources for replacing fish meal in the process. In the current investigation, four experimental meals i.e., Diet 1: prepared feed with 0% tropical almond kernel meal (TAM) (control feed), Diet 2, 3, and 4 replaced fish meal with TAM at 10%, 30%, and 50%, respectively, were used. Additionally, Diet 5 which was purchased commercially was also used as the second control feed. Effects of these replacements of fish meal with TAM were assessed by feeding these five experimental feeds separately to five treatments of all male Nile tilapia (*Oreochromis niloticus*) fingerlings, each with three replicates, and evaluated the growth performances, survival, and selected haematological parameters; total erythrocyte count, haemoglobin count, differential leucocyte count, and haematocrit calculation under laboratory conditions. Experimental feeds processed with TAM diets (Diet 2, Diet 3, Diet 4) contributed to the growth performances, survival, and haematological parameters of Nile tilapia fingerlings, and the results were significantly different (One-way ANOVA, $P<0.05$) from those of two control feeds (Diet 1 and Diet 5). The highest mean percentage weight gain (316.8±35.0), mean specific growth rate (2.036±0.12), and mean average daily growth (4.526±0.49), was achieved by the Diet 3 (30% TAM) when compared to other treatments. However, there was no significant difference in the mean percentage survival rate for five experimental diets. When considering feed conversion ratio, the lowest feed conversion ratio (FCR) (1.210±0.05) and the highest mean feed efficiency ratio (FER) values (0.827±0.03) were obtained from Diet 3 feed fed treatment. The highest FCR (2.675±0.04) value was obtained from the Diet 5 feed fed treatment. Among the various dietary options, Diet 3 fed fish displayed the highest values for red blood cells (RBCs) at 3.173×10^{6} mm^{-3} and hemoglobin (Hb) at 11.225 g/dL. These values were significantly different ($P<0.05$) from those values observed for the other experimental diets tested. The findings suggest that incorporating 30% tropical almond kernel meal into the fish feed as their diet can have a positive impact on both RBC count and Hb levels in *O. niloticus* fingerlings. The outcome of this study suggests that there is a definite potential for tropical almond kernel meal as a beneficial dietary component for enhancing blood parameters as well as growth parameters in *O. niloticus*. Further exploration is highly motivated due to the positive impact of the results.

Keywords: Haematology, Growth rate, *Oreochromis niloticus*, Replacement, *Terminalia catappa*

Acknowledgment
This work was supported by University of Kelaniya, Sri Lanka.

Abstract No: BO-49

A comparative study of the nutritional, pharmaceutical and photoprotective properties of almond (*Prunus dulcis*) and tropical almond (*Terminalia catappa*) nuts

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This study focuses on the comparison of nutritional, pharmaceutical and photoprotective properties of methanolic extracts of *Terminalia catappa* (TC) commonly known as tropical almond or 'kottamba' and *Prunus dulcis* (PD) nuts (almond). *TC* is a popular folk medicine and has several proven biological properties. The objective of this research work was to evaluate *in vitro* antioxidant, α-amylase inhibitory, anti-lipase activities, and photoprotective properties of TC and *PD* nuts. First, the proximate composition of powdered nuts was determined by standard methods. Next, the phytochemicals in powdered nuts were extracted to methanol by cold extraction and phytochemical screening was conducted using standard biochemical tests. Further, 2,2-Diphenyl-1-picrylhydrazyl (DPPH), 2,2'-Azino-bis(3-ethylbenzthiazoline-6-sulfonic acid) diammonium salt (ABTS), and the ferric reducing power assays were used to determine the antioxidant activity of methanolic extracts of nuts. The α-amylase inhibitory activity and anti-lipase activity of extracts were determined by α-amylase inhibitory assay and anti-lipase assay respectively. Finally, the photoprotective property of the extracts was determined by a UV-Visible spectrophotometric method. Results showed that TC was significantly high in moisture (11.8%) with p value (0.00000097) less than 0.05 and low lipid content (32.16%) with p value (0.0000016) less than 0.05. There was no significant difference ($p > 0.05$) recorded in crude fiber (15.66% and 14.33%) (p value = 0.2000), protein (36.15% and 33.85) (p value = 0.2298), and carbohydrate (11.85% and 12.23%) (p value = 0.2690) for *TC* and PD, respectively. The present study revealed that both nuts are rich in phenols, alkaloids, flavonoids, steroids, terpenoids, glycerides, saponin, cardiac glycosides and triterpenes. *PD* extract showed significantly higher DPPH radical scavenging activity with an IC_{50} value of 78.55 ± 5.10 μg/mL while *TC* extract showed an IC_{50} of 89.22 ± 4.40 μg/mL. The ABTS radical scavenging activity of PD, with a value of IC_{50} 57.19 ± 0.32 μg/mL is significantly higher than that of TC, (IC_{50} 74.36±3.34 μg/mL). The ferric reducing power of TC *(FRAP values of 41.6±0.23* mg potassium ferricyanide equivalents per gram (PFE/g) *of dried extracts)* is significantly lower than that of PD (39.15±0.21 mg PFE/g of dried extracts). The α-amylase inhibitory experiment demonstrated that the extracts of TC with an IC_{50} 113.4±1.56 μg/mL and *PD* with IC_{50} 128.3±1.12 μg/mL have inhibitory effects on the enzyme. In the anti-lipase assay, both samples showed anti-lipase activity (TC - 190.4 ± 5.22 μg/mL, and PD, 167.33 ± 6.35 μg/mL) indicating their potential to block the lipase enzyme, which aids in weight reduction. Compared to a commercially available sunscreen, both extracts exhibited moderate UV protection with SPF values of 14.52 ± 2.34 (TC) and 12.92 ± 1.78 (PD). These results suggested that not only *PD*, but also *TC* nuts are a great source of antioxidants, anti-diabetics, and anti-obesity compounds despite not being commercially utilized. Therefore, *Terminalia catappa* can be used as an alternative to *Prunus dulcis* in food and pharmaceuticals.

Keywords: Antioxidant, Anti-diabetic, Anti-lipase, Photoprotective

Acknowledgment
This work was supported by the University of Kelaniya under the research grant number RP/03/02/06/01/2018 and the National Science Foundation of Sri Lanka under the research grant number RG/2013/EQ/01.

Abstract No: BO-50

Biosurfactant production by bacteria isolated from petroleum contaminated soil

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Biosurfactants are surface-active biomolecules produced by microorganisms, which are useful biomolecules in the remediation of petroleum contaminated environments. Two bacterial strains isolated from petroleum-contaminated soil of selected motor vehicle workshops and filling stations were screened and characterized morphologically and biochemically. The biosurfactant-producing ability of the strains was determined qualitatively and quantitatively by enrichment culture, hemolytic activity assay, Cetyltrimethylammonium bromide (CTAB) assay, oil displacement assay, foaming activity, and emulsification activity measurement. After conducting various morphological and biochemical studies, the strains were identified as bacteria belonging to the genus *Pseudomonas* and the genus *Micrococcus*. Both bacteria gave positive results for hemolytic activity, CTAB assay, and foaming activity, which gives beta-hemolysis on blood agar, blue colour halos, and stable foam, respectively. The highest displacement was observed from *Pseudomonas* where the diameter was 6.0 cm, while *Micrococcus* showed 3.6 cm activity. Although both bacteria showed an emulsion after 1 minute, the *Pseudomonas* strain showed the highest maximum emulsification index (E24%) of 57.1%. This suggests that the *Pseudomonas* strain could have more potential to facilitate the remediation of hydrocarbon-contaminated sites and produce a higher yield of biosurfactants than the *Micrococcus* strain.

Keywords: Biosurfactants, Bacteria, Enrichment, Petroleum contaminated soil

Acknowledgement:
This work was supported by the Accelerating Higher Education Expansion and Development Program (AHEAD) under the grant AHEAD/RA2/ELTALESE/KLN/SCI/OVAA/13.

Abstract No: BO-51

Characterization of lipolytic bacteria isolated from oil mill waste

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Microbial lipases are enzymes that can catalyze the hydrolysis of esters formed from glycerol and long-chain fatty acids. Microbial lipases are used as biocatalysts in various biotechnological applications due to their stability in organic solvents. In the present study, a bacterial culture isolated from oil mill waste was characterized using morphological, cultural, and biochemical properties. Isolate was subjected to qualitative screening of extracellular lipolytic activity using culture-based methods on Tween peptone agar, olive oil with phenol red agar, and egg yolk agar. The lipase was produced using submerged fermentation. Fermented culture supernatant was used as the crude lipase. The crude lipase was extracted, and the activity was measured using olive oil as the substrate, and the concentration of the free fatty acid in the reaction was determined by titrating with 0.1 M NaOH. The effect of detergent on crude lipase activity was also assessed using three different commercial detergents. Based on morphological, cultural, and biochemical characteristics, the strain was identified as a bacterium belonging to the genus *Pseudomonas*. This bacterium showed the opaque zone on tween peptone agar and egg yolk agar and it displayed a yellow zone on phenol red agar. Crude lipase of this bacterium showed 14.50 μmol/h/mL of activity at 37˚C and pH 8. Crude lipase investigated in the study showed varying relative activities to the three detergents tested, 51.8% being the highest. The lipolytic capabilities of the isolated bacterial strain hold great promise for various biotechnological applications requiring the enzymatic breakdown of lipids.

Keywords: Biocatalysts, Detergents, Lipases, Lipolytic bacteria, Oil mill waste

Acknowledgement
This work was supported by the Accelerating Higher Education Expansion and Development Program (AHEAD) under the research grant AHEAD/RA2/ELTALESE/KLN/SCI/OVAA/13.

Abstract No: BO-52

Profiling of phytochemical composition and potential bioactive compounds in *Calotropis gigantea*

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Phytochemicals derived from medicinal plants are important sources of therapeutic agents in pharmaceutical research and development. *Calotropis gigantea* is a medicinal herb that belongs to the family Apocynaceae, native to South and Southeast Asia. This latex bearing plant has two varieties: white-flowered and purple-flowered form. The current study was conducted to preliminary screen the phytochemicals and to assess the potential bioactive components found in the methanol fraction of leaves and flowers of *Calotropis gigantea* by Gas Chromatography-Mass Spectrometry (GC-MS). The dried powder of leaves and flowers of *C. gigatea* were subjected to cold maceration extraction by methanol. The rotary evaporated crude extract was dissolved in methanol to prepare 100000 ppm extract and it was subjected to GCMS analysis and 10000 ppm extract was used for screening tests. Alkaloids, phenols, tannins, carbohydrates and steroids were found in leaf and flower extracts after conducting a phytochemical screening. While reducing sugars, terpenoids, and flavonoids were only discovered in floral extracts. Both extracts were found to be devoid of saponins, proteins, and other essential amino acids. Fifty eight compounds were identified from the flower extract and fifty nine compounds were identified from the leaf extract by the GC-MS analysis. Most prevalent identified chemical compounds are 9,12,15-Octadecatrienoic acid (Z,Z,Z), 5-hydroxymethylfurfural, n- Hexadecanoic acid, gamma-Sitosterol, Squalene, Phytol, 9-Octadecanoic acid, 4-Hydroxy-2-methyl acetophenone, Ergost-5-ene-3-ol (3-beta), Stigmasterol, Neophytadiene, Squalene, ethyl-9,12,15-octadecatrienoate, Larisiresinol, Stigmasta-5,24-(28)-dien-3-ol (3-beta, 24 Z), Olean-12-en-3-ol acetate (3-beta), Lanosta-8,24-dien-3-ol acetate (3-beta) and Alpha-Amyrin. Most of these chemical compounds are responsible for significant bioactivities. The reported bioactivities of the identified compounds confirm that the *C. gigantea* comprised mainly of antioxidant, anti-microbial, anti-inflammatory, Anti-cancer, anti-diabetic agents. The findings of the study imply that *C. gigantea* is a valuable medicinal plant and potential bioactivities of the components need further study.

Keywords: *Calotropis gigantea*, GC-MS, Phytochemicals

Abstract No: BO-53

The effect of bisphenol A and its analogue, bisphenol S on stress response of developing zebrafish (*Danio rerio*)

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Bisphenol A (BPA) is a widely used industrial chemical and a xenoestrogen that poses significant biological effects in living organisms. Owing to the health effects of BPA exposure, Bisphenol S (BPS) was introduced as a safe alternative. However recent research has acclaimed the endocrine disruptive ability and negative health effects of BPS, raising concerns on the safety of BPS. Therefore, comparative assessments on the biological effect of BPA and BPS are essential. This study was conducted to comparatively assess the effects of bisphenols on the physiological stress of model organism, zebrafish. The stress response refers to a coordinated series of physiological and behavioural reactions in an animal that helps to restore internal homeostasis disturbed by environmental stressors. Hence behavioural and physiological assays are used in determining the stress level of zebrafish. Swimming activity and aggression are important behaviours influenced by physiological stress. Ammonia is an end product of protein metabolism, which is considered a primary universal waste product. Ammonia excretion is an essential physiological parameter to assess the physiological stress of aquatic organisms. The research was conducted to investigate the comparative impact of BPA and BPS on stress response by examining the swimming performance, aggression (mirror-biting test) and ammonia excretion of juvenile zebrafish. The study was conducted with 21-days old zebrafish, exposed to environmentally relevant concentrations of BPA (50 µg/L), BPS (50 µg/L) and treatment control for 63 days. The swimming speed, aggression and ammonia excretion were determined at the end of the exposure period. According to the results, the mean maximum swimming speeds of fish exposed to BPA (0.40 m/s) and BPS (0.36 m/s) were significantly lower than that of the control (0.56 m/s, $p<0.05$) and a notable difference was not observed between BPA and BPS exposed fish. The mirror-biting test indicated that both bisphenols showed higher aggression than the control (1.2 bitings/minute, $p < 0.05$) while BPA (98.8 bitings/minute) showed significantly higher aggression than BPS (48.3 bitings/minute, $p<0.05$). The ammonia excretion of BPA-exposed fish (1.161 ppm) and BPS-exposed fish (1.055 ppm) was considerably higher than the control (0.384 ppm, $p<0.05$), and a significant difference was not observed between BPA and BPS-exposed fish ($p>0.05$). In conclusion, both BPA and BPS can similarly reduce swimming speed and increase ammonia excretion as a response to stress induced by these bisphenols. However, the mirror-biting test, which measures the aggression level of fish implies that even if both bisphenols produce significant aggression, BPA causes notably higher aggression levels than BPS. The findings of the study suggest that BPS cannot be recommended as a safe alternative to BPA as both bisphenols potentially induce physiological and behavioural stress. More comprehensive physiological and cellular assays are encouraged to further comprehend the comparable effects of BPA and BPS on the physiological stress of aquatic organisms.

Keywords: Ammonia, BPA, BPS, Stress response, Zebrafish (*Danio rerio*)

Acknowledgement
This work was supported by the University of Kelaniya.

Abstract No: BO-54

Distribution of heavy metals across different tissue types in *Etroplus suratensis* from Mahakanadarawa reservoir: Investigating dietary implications for CKDu in Sri Lanka

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The escalating cases of chronic kidney disease of uncertain etiology (CKDu) in rural communities, especially in the Maradankulama-Mahakandrawa region of Sri Lanka, stipulate a critical public health investigation. Given the significant dietary reliance on *Etroplus suratensis* due to geographical and logistical complexities in obtaining sea fish, bioaccumulated toxic metals in this species can be a potential risk factor for CKDu. This study investigated the heavy metal content (As, Pb, Cd, Cr, Ni) in the gut, gill, and muscle tissues of *E. suratensis* sourced from the Mahakanadarawa Reservoir in the CKDu endemic Mihintale region. To obtain representative *E. suratensis* samples from across the Mahakanadarawa Reservoir, fish were collected using a randomized sampling method. Multiple random points within the reservoir were pre-determined and fish were caught at each location by local fishermen using appropriate techniques. The captured fish were identified as *E. suratensis* and 36 samples were separated as gut, gills, and muscles for the toxic metal analysis. The heavy metal content (As, Pb, Cd, Cr, Ni) in these samples was then analysed using inductively coupled plasma mass spectrometry (ICP-MS). To thoroughly compare metal concentrations across tissue types, the non-parametric Kruskal-Wallis ANOVA test was utilized followed by post-hoc Tukey HSD tests. The non-parametric ANOVA assessed statistically significant differences in metal levels between muscle, gill, and gut tissues. Post-hoc Tukey tests then enabled pairwise comparisons between each tissue type to determine which specific metal concentrations differed. There were significant differences between tissue types for concentrations of As, Cd, Cr and Ni ($p<0.001$). Post-hoc Tukey tests showed As, Cr, Cd and Ni were significantly higher in gut compared to that of muscle and gill tissues ($p<0.05$), with the order Gut>Gill>Muscle. Pb did not deviate significantly across tissues, however, mean Pb concentrations exceeded the WHO/FAO permissible limits for dietary intake in all tissues, while Cd remained within acceptable levels. Compared to gut and gills, muscle contained relatively low concentrations of As (0.01±0.01) mg/kg, Cr (0.22±0.03) mg/kg, Pb (0.508±0.36) mg/kg, and Cd (0.015±0.13) mg/kg and Ni (0.06±0.01) Although edible muscle in some samples met regulatory limits, frequent consumption of *E. suratensis* from this CKDu endemic area may pose a health risk, warranting further study on geographical and seasonal variation. Ultimately, this study contributes to the growing body of evidence suggesting that bioaccumulation of toxic metals in fish poses significant CKDu risk factors.

Keywords: Bioaccumulation, CKDu, *Etroplus suratensis*, Heavy metal, Inland fish

Abstract No: BO-55

Assessment of contaminant levels of hazardous toxic metals and subsequent risk analysis in agricultural soil and selected comestibles within a region afflicted by CKDu in Sri Lanka

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Agricultural commodities constitute a pivotal component of the human daily sustenance, yet they are susceptible to contamination by pernicious heavy metals, notably Hg, Cd, Pb, and As. Consequently, agricultural products represent a substantive source of apprehension for human well-being and health. This study aims to evaluate related risk indices of agricultural soils (n=25) and selected comestible grains, namely *Oryza sativa* (n=25), *Vigna radiata* (n=25), *Vigna unguiculata* (n=25), and *Vigna unguiculata* subsp. (n=25), within the endemic region of Nikawewa Grama Niladhari Division (GND) in North Western Province (NWP) and the reference region, Wewagedara GND in NWP where no evidence for Chronic Kidney Disease of unknown etiology (CKDu). The concentrations of metals in the collected samples were determined by using Inductively Coupled Plasma Mass Spectrometry (ICP-MS) and based on that risk indices were calculated. The mean geo-accumulation index (I_{geo}) for four metals in soil was As - 0.82, Cd - 1.47, Cu - 0.91, and Pb 1.31. That indicates no anthropogenic activities related to As, Cd and Cu while Pb is responsible for moderate pollution in endemic area. Estimated Daily Intake (EDI) values for these heavy metals were calculated with respect to the all grains. EDI means of As and Pb in the endemic and the reference areas for all grain samples were within the Tolerable Daily Intake (TDI) set by United States Environmental Protection Agency (USEPA) (As-0.300 μg/kg/day) and World Health Organization (WHO) (Pb-3.600 μg/kg/day) while Cd (EDI in endemic area; *Oryza sativa*-6.385 μg/kg/day, *Vigna unguiculata*-3.386 μg/kg/day and *Vigna unguiculata* subsp.-3.866 μg/kg/day) highly exceeded the tolerable weekly intake (TWI) of European Food Safety Authority (EFSA) (Cd-2.5 μg/kg/week) in both areas. EDI of Cr in rice samples (1.138 μg/kg/day) in endemic area exceeded the TDI set by EFSA (1.0 μg/kg/day) and all other values of Cr were below the TDI in both areas. According to the USEPA (intolerable cancer risk (CR) - > 1 x 10^{-4}) cancer risk exist for all these staple grains. I_{geo} of Pb in the soil, raising concerns about their bioavailability and uptake by the food crops and EDI were indicated the long-term consumption of these foods especially *Oryza sativa* poses a serious threat to human health. Implementing proper soil management practices, monitoring heavy metal levels in crops, and raising public awareness about safe consumption practices are crucial steps towards mitigating the risk of CKDu.

Keywords: CKDu, Heavy metals, Rice, Risk assessment

Abstract No: BO-56

Preliminary study of anti-inflammatory action of Sri Lankan "dasapanguwa"

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The herbal mixture known as "Dasapanguwa" which is frequently used as a traditional medicine in Sri Lanka, contains ten components, including the dried rhizome of *Zingiber officinale* (Inguru), dried stem of *Gerontogea corymbosa* (Pathpadagam), dried berries *Solanum xanthocarpum* (Katuwalbatu), dried seeds of *Coriandrum sativum* (Koththamalli), dried leaves of *Justicia adhatoda* (Pawatta), dried stem of *Tinospora cordifolia* (Rasakinda), dried stem of *Coscinium fenestratum* (Venivalgata), dried rhizome of *Alpinia calcarata* (Araththa/Snap ginger), dried stem of *Glycyrrhiza brachycarpa* (Valmee) and dried stem of *Solanum melongena* (Eggplant) as most common combination. The objectives of this project were to extract the chemical constituents of each ingredient and the dasapanguwa mixture decoction, to determine the anti-inflammatory action of each extract in dasapanguwa as well as dasapanguwa mixture using the "Heat-Induced Hemolysis" assay. In the present study, the individual ingredients were extracted by deionized water and the dasapanguwa mixture decoction was screened for their anti-inflammatory assay; Heat-Induced Hemolysis. Water extracts were collected according to the ayurvedic traditional method. According to the obtained results of the anti-inflammatory assay, the ability to inhibit protein denaturation (anti-inflammatory activity) varied in the order of dasapanguwa mixture 523.2±31.0 µg/mL > *Glycyrrhiza brachycarpa* 560.8±59.8 µg/mL > *Alpinia calcarata* 572.9±18.6 µg/mL > *Coscinium fenestratum* 787.9±39.4 µg/mL > *Solanum xanthocarpum* 1634.3±39.0 µg/mL > *Gerontogea corymbosa* 1880.4±312.2 µg/mL > *Tinospora cordifolia* 3662.2±366.4 µg/mL > *Justicia adhatoda* 4184.9±109.6 µg/mL > *Zingiber officinale* 4290.3±991.9 µg/mL > *Coriandrum sativum* 5531.7±1883.0 µg/mL > *Solanum melongena* *6930.3±45.5* µg/mL. The highest IC_{50} value resulted in the dasapanguwa mixture and the individual extraction of *Solanum melongena* resulted in the least IC_{50} value. This study supported the traditional ayurvedic practice of using "Dasapanguwa" as a good source of anti-inflammatory activity. The combination of ten herbals is given higher anti-inflammatory activity than individual herbals.

Keywords: "Dasapanguwa", Antioxidant activity, Anti-inflammatory activity, $IC_{50.}$

Acknowledgment
This work was supported by Department of Chemistry, Faculty of Science, University of Kelaniya, Sri Lanka under the research grant RP/03/02/06/06/2021.

Abstract No: BO-57

Characterization of adsorption properties of naturally occurring clay deposits in Mannar District to remove lead and cadmium from aquatic systems

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Water is a fundamental resource for life on earth. Water pollution by heavy metal contamination has a major negative impact on human health due to its toxicity. To remove heavy metals from aquatic environments several methods have been implemented. From these methods, use of natural clays for adsorption of heavy metals is considered to be environmentally friendly and cost-effective method. Montmorillonite is one major type of natural clays which is well known ~~for~~ its adsorption ability. Therefore, this study was basically focused on assessing the potential of lead and cadmium adsorption by MMT-rich clay in different places in Sri Lanka. Three soil samples from selected places of Mannar District were collected and conditions were optimised for Pb^{2+} and Cd^{2+} adsorption. Then the adsorption was assessed using Atomic Adsorption Spectrophotometer. 100 mg/L initial concentration, 0.10 g adsorbent dosage, and pH 4 as optimum conditions for Pb^{2+} adsorption, whereas 100 mg/L initial concentration, 0.10 g adsorbent dosage, and pH 6 as optimum conditions for Cd^{2+} adsorption were observed. Langmuir constants obtained for Pb^{2+} and Cd^{2+} were -1.233 L/mg and 0.0477 L/mg. Freundlich constants obtained for Pb^{2+} and Cd^{2+} were 2.489 mg/g and 0.764 mg/g respectively. Based on the values obtained for the constants, 1/n, $q_{max,}$ and R_L, it was assumed that both metal ions show multilayer adsorption on a heterogenous surface, which favours Freundlich isotherm. Optimized conditions were applied to the soil samples collected from Giant's tank, Marvelankeni, and Allavankai areas areas of Northern province. Reduction percentages obtained for adsorption of Cd^{2+} by soil samples from Giant's tank, Marvelankeni, and Allavankai areas were 91.385%, 98.381%, 68.152% respectively and adsorption capacities were 111.239 mg/g, 119.755 mg/g, 82.969 mg/g respectively. Reduction percentages obtained for adsorption of Pb^{2+} by soil samples from Giant's tank, Marvelankeni, and Allavankai were 48.472%, 30.561%, 58.481% respectively and adsorption capacities were 211.807 mg/g, 133.561 mg/g, 255.286 mg/g respectively. The values obtained were compared with the control sample (reduction percentages 75.633%, 83.751% respectively for Cd^{2+} and Pb^{2+}), adsorption capacities 92.076 mg/g and 365.986 mg/g respectively for Cd^{2+} and Pb^{2+}. Based on these results, there might be a potential of using Montmorillonite rich soil in Mannar district to remove Pb^{2+} and Cd^{2+} from aquatic systems.

Keywords: Cadmium, Lead, Montmorillonite, Water pollution

Abstract No: BO-58

Pueraria phaseoloides and *Croton laccifer* as sources for green manure formulations in Sri Lanka

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One of the critical problems that Sri Lanka is facing today is the inorganic fertilizer problem, which has severely affected the economy and agriculture in the country. For this crisis, a potential and a profitable solution can be obtained using local green manures. Green manures are the plants that are incorporated into the soil while still green. They facilitate the plant growth by enhancing the soil health and fertility. In Sri Lanka, several plant species, *Gliricidia sepium*, Pora wel (*Pueraria phaseoloides*), Kappetiya (*Croton laccifer* L.), Ipil ipil (*Leucaena leucocephala*)-and Gansooriya (*Thespesia populnea*) are used as green manures since the past. This study evaluated the effectiveness of *Pueraria phaseoloides* and *Croton laccifer* L. as local green manures. In this research, experiments have been done on total nitrogen content, nitrogen release into the soil, impact of green manure on a selected plant growth (*Capsicum annuum)* and changes in soil parameters after the application of green manure. For the determination of nitrogen amount, the Kjeldahl method and Ion selective nitrate probe were used. Results indicated that *Pueraria phaseoloides* leaves contained the highest amount of nitrogen as ammonium nitrogen (0.63%), while its stems contained the highest amount of nitrogen as nitrate nitrogen (0.11%). Similar observations were also made with *Croton laccifer*, where its leaves showed the highest amount of nitrogen as ammonium nitrogen (3.05%). Nitrogen release experiments showed that the nitrogen levels in soil increased over the time after the incorporation of plant materials. Incorporation of *Pueraria phaseoloides*, into soil increased the ammonium nitrogen percentage from 0.11% to 0.7% and the nitrate percentage in soil was increased from 0.005% to 0.09%. Similarly, incorporation of *Croton laccifer* into soil increased ammonium nitrogen percentage from 0.11% to 0.92%. In the growth experiment, *Pueraria phaseoloides* and *Croton laccifer* plant materials were incorporated into soil, in pots, where chilli was used as the test plant. Results showed a 49.1% and 43.4% increase in height for *Pueraria* and *Croton*, respectively and a significant difference in plant height ($P < 0.001$) when compared to the control. Furthermore, the water holding capacity of soil was tested to study the changes of soil parameters after the incorporation of green manure. The results indicated that there was a significant increase, 20.9% and 16.5% for *Pueraria* and *Croton*, respectively in the water holding capacity of soil with and without the incorporation of *Pueraria phaseoloides* and *Croton laccifer* plant materials. The overall results indicated that *Pueraria phaseoloides* and *Croton laccifer* can be used as a potential solution for the fertilizer problem.

Keywords: Green manure, Ammonium, Nitrate, Pueraria, Croton

Abstract No: BO-59

Antifungal activity of fresh fruit extract of *Garcinia quaesita* against *Fusarium proliferatum* causing crown rot disease in banana

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Tropical fruits and vegetables are susceptible to several devastating post-harvest diseases. The crown rot disease of bananas is caused by *Fusarium proliferatum*, which causes a drastic decrease in consumer compliance and becomes a problem related to consumption. Though it can be controlled by approved natural or commercial fungicides, natural antifungal plant extracts are safer options due to their non-toxicity compared to synthetic fungicides. *Garcinia quaesita* is an endemic plant in Sri Lanka used as a spice and a medicinal plant. The poisoned food technique was used to determine the percentage inhibition of mycelial growth and the minimum inhibitory concentration of the plant extract on the test pathogens. Hence, the main objective of this study was to determine the antifungal activity of hydroethanolic extract (1:1 v/v) of fresh fruit of *G. quaesita* at different concentrations against *F. proliferatum* using the standard food poisoning method. The same procedure was carried out with a positive control (50% Captan) and a negative control (dimethyl sulfoxide). A round disk of 6 mm diameter was taken from a 7-day-old culture with grown mycelium and inoculated in the center of the PDA media plate with the treatments. The zone of inhibition (mm) and the percentage of growth inhibition were determined using three different concentrations of *G. quaesita* fruit extract (5000 ppm, 2000 ppm, 1000 ppm) with three replicates. All three concentrations of the plant extract significantly inhibited mycelial growth compared to the negative control. *G. quaesita* fruit showed 47.39% growth inhibition of *F. proliferatum*. The minimum inhibitory concentration for *G. quaesita* extract was 5000 ppm, which was significantly different as determined by Tukey's mean comparison test ($p \leq 0.05$), with a zone of inhibition of 20 mm. The extract of *G. quaesita* shows promise as an alternative safe, eco-friendly, cheap, and easily degradable fungicide derived from plants. It also has great potential for providing new fungicides that are highly beneficial.

Keywords: Banana, Food poisoning method, *Fusarium proliferatum*, *Garcinia quaesita* extract, Zone of inhibition

Acknowledgment
This work was supported by the University of Kelaniya under the research grant RP/03/02/06/04/2021.

Abstract No: BO-60

Evaluation of *Mimosa pudica* and *Mimosa pigra* as green manure for agricultural production

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Due to the ongoing energy crisis and rising fertilizer input cost, there is renewed interest in organic manuring for agricultural production. Commonly used organic manure sources include farmyard manure and green manure prepared from nitrogen-fixing legumes. This work investigates two nitrogen fixing shrubs for N accumulation, N release patterns upon soil incubation and their effect of released N on plant growth. The two plants used belong to genus Mimosa namely *M. pudica* and *M. pigra*. The selection of these leguminous plants was based on their ability to form symbiotic relationships with nitrogen-fixing bacteria and capability to convert atmospheric nitrogen into ammonia, a valuable source of nitrogen that can be used as green manure. Mimosa plants were cut and separated into leaves, stems, and roots. The available ammonium N and nitrate N content in each plant part was determined by Kjeldahl method and nitrate ion selective electrode. Their capacity to release usable N into the soil was determined by incubating plant parts with soil in litter bags under aerobic conditions. The efficacy of the green manure on plant growth was determined by pot experiments and the data were statistically analyzed. The leaves of *M. pudica* showed the highest amount of ammonium nitrogen (2.05 ± 0.40%), while the roots of *M. pigra* showed the highest amount (0.79 ± 0.13%). The leaves of *M. pudica* (0.03 ± 0.01%) and roots of *M. pigra* (0.03 ± 0.01%) showed the highest amount of nitrate nitrogen. When the plant parts were cut, separated, and incorporated into the soil for a period of 24 weeks, the rate of N mineralization increased the ammonium and nitrate nitrogen availability. *M. pudica* showed an increase of ammonium N from (0.190 ± 0.032% to 0.66 ± 0.10%), while *M. pigra* showed an increase from (0.12 ± 0.03% to 0.73 ± 0.04%). The incorporation of these plant parts into soil planted with *Capsicum annuum* (Chilli plant) in a pot experiment bioassay showed a discernible effect on plant growth. Notably, the incorporation of *M. pudica* leaves (34.3 ± 0.5 cm) and *M. pigra* leaves (30.5 ± 0.2 cm) resulted in greater plant heights compared to the control group (16.2 ± 0.1 cm), which resulted in significant differences (p value, $0.024 < 0.05$) in plant growth. The findings of the study suggest that the plant segments of *M. pudica* and *M. pigra* possess a substantial quantity of nitrogen that can be effectively utilized. Hence, these plants possess the potential to serve as a viable green manure resource.

Keywords: Green manure, Leguminous plants, Mimosa, Nitrogen fertilizer, Sustainable agriculture, Soil fertility

Abstract No: BO-61

Investigation of in vitro antioxidant and alpha-amylase inhibitory activities of *Garcinia quaesita Pierre* fruit seed

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Garcinia quaesita is a traditional, endemic plant with remarkable medicinal value found in Sri Lanka. *Garcinia quaesita Pierre*, locally known as Rath Goraka, is a tropical fruit tree that thrives in regions with warm and humid climates. This plant's culinary and medicinal qualities make it remarkably potential for future exploitation. The main objective of this research was to investigate the total phenolic content (TPC), total flavonoid content (TFC), in vitro antioxidant, and alpha-amylase inhibitory activities of hexane, ethyl acetate, and ethanol extracts of *G. quaesita* fruit seed. Folin -Ciocaltue method was used to determine the total phenolic content. An aluminum-chloride colorimetric assay was used to determine the flavonoids. The constituents in the dried seeds of the *G. quaesita* were extracted using sequential Soxhlet extraction using hexane, ethyl acetate, and ethanol respectively. Crystals were observed to form within the hexane and ethyl acetate extracts after allowing them to stand for a week following extraction. Each extract was evaporated to dryness to obtain seed oils. The crystals and the seed oils were purged with nitrogen and stored at -20 ºC until further use. The total phenolic content was expressed as mg Gallic Acid Equivalents per gram (mg GAE/g). Results showed that the ethanol extract exhibited a significantly higher TPC (205.13±7.99 mg GAE/g) compared to the ethyl acetate extract (82.79±5.10 mg GAE/g). Total flavonoid content was expressed as mg Catechin Equivalents per gram (mg CE/g). Similarly, for the TFC assay, the ethanol extract showed a significantly higher value (56.30±3.07 mg CE/g) compared to the ethyl acetate extract (17.81±1.41 mg CE/g). Results indicated that the ethanol extract has significantly higher antioxidant activity (IC_{50} value of 95.08±3.58 µg/mL) compared to the BHT (butylated hydroxytoluene) standard (IC_{50} value of 118.94±4.84 µg/mL) while the ethyl acetate extract has moderate antioxidant activity (IC_{50} value of 288.51±1.01 µg/mL) in the 1,1-diphenyl-2-picrylhydrazyl (DPPH) assay. The alpha-amylase inhibitory assay was carried out to study the anti-diabetic activity of the extracts. Results showed that the ethyl acetate extract of *G. quaesita* fruit seed has moderate alpha-amylase inhibitory activity (IC_{50} value of 97.80 ±0.39 µg/mL) compared to acarbose (IC_{50} value of 63.47±0.12 µg/mL). On the other hand, the ethanol extract showed a relatively lower alpha-amylase inhibitory activity (IC_{50} value of 160.59 ±2.16 µg/mL). The p-value (p=0) in the one-way ANOVA test indicated that there was a significant difference between the alpha-amylase inhibitory activity of *G. quaesita* fruit seed extracts and the standard(acarbose). Pearson's correlation analysis results showed a strong positive correlation between TPC, TFC, and radical scavenging antioxidant activity of *G. quaesita* fruit seed extracts. Therefore, it can be suggested that the combination of polyphenolic compounds, flavonoids, and other biologically active metabolites present in fresh fruit seeds of *G. quaesita* extract is responsible for its robust antioxidant properties.

Keywords: *Garcinia quaesita* fruit seed, Total phenolic content, Total flavonoid content, Antioxidant activity, Alpha-amylase inhibitory activity

Acknowledgment
This work was supported by the University of Kelaniya under the research grant RP/03/02/06/04/2021.

Abstract No: BO-62

Variation in total polyphenolic content, water-soluble solid content, aroma and taste of Ceylon black teas of different climatic regions

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Sri Lankan black teas are classified as high-grown, medium-grown and low-grown based on their geographical origin. There are seven climatic regions. Nuwara Eliya, Dimbulla, Uva and Uda Pussallawa in high grown area, Kandy in medium grown area, Ruhuna and Sabaragamuwa in the low-grown area. The main objective of this study was to analyze the total polyphenol content, Water Soluble Solid Content, Aroma and taste in unblended Sri Lankan black teas collected from different factories representing different tea growing regions and FBOP, BOP and BOPF grades. Total polyphenolic content TPP ISO 14502-1 standard method, Water Soluble Solid Content WSS Refractometer Method and taste done by a tea taster were determined for each sample. TPP content of the Dimbulla region varied from 13.58 ± 0.65 % to 16.51±1.57. WSS content varied from 33.50 ± 0.03 % to 37.6 ± 0.02 %. Average taste scores varied from 4.48 ± 0.81 to 5.12 ± 0.11. TPP content of the Nuwara Eliya region varied from 17.55 ± 1.33 % to 17.92 ± 0.63 %, and WSS content varied from 34.80 ± 0.01 % to 43.60 ± 0.02%. The average taste score varied from 5.75 ± 0.53 to 6.25± 0.10. TPP content of the Uva region varied from 13.56 ± 1.13% to 16.91 ± 1.25 %, and WSS content varied from 33.10 ± 0.02 % to 42.50 ± 0.09 %. The average taste score varied from 4.24 ± 0.36 to 4.72 ± 0.11. TPP content of the Uda Pussellawa region varied from 12. 45 ± 1.29% to 16.06 ± 2.57%, WSS content varied from 30.40 ± 0.01% to 34.0 ± 0.02%. The average taste score varied from 4.20 ± 0.46 to 4.68 ± 0.11. TPP content of the Kandy region varied from 14.27 ± 1.07 % to 17.03 ± 2.10%, and WSS content varied from 33.60 ± 0.02% to 39.30 ± 0.07%. The average taste score varied from 3.92± 0.23 to 4.28 ± 0.30. TPP content of Ruhuna region varied from 15.57 ± 0.56 % to 16.77 ± 1.04%, WSS content varied from 26.80 ± 0.04% to 44.10 ± 0.05%. The average taste score varied from 3.80± 0.14 to 4.00 ± 0.35. TPP content of Sabaragamuwa region varied from 14.53 ± 2.02 % to 16.62 ± 1.37%, WSS content varied from 31.50 ± 0.04 % to 40.20 ± 0.05%. The average taste score varied from 3.80± 0.20 to 3.92 ± 0.23. BOPF-grade teas of every region showed the highest mean value of water-soluble solid content. Nuwara Eliya region showed the highest mean values of total polyphenol content and highest mean values of taste score among other regions. FBOP and BOP grades of the Nuwara Eliya region showed the highest mean values of water-soluble solid content among other regions.

Keywords: Black tea, Tea taste, Total polyphenol, Water soluble solid

Acknowledgement
This work was supported by the University of Kelaniya under the research grant RP/03/02/06/02/2022.
This work was supported by Finlays Colombo Limited.

Abstract No: BO-63

Detection of microcystins (cyanotoxin) in selected drinking water wells in the Gampaha district, Sri Lanka

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The prevalence of toxic cyanobacteria and various cyanotoxins, such as microcystins (MCs) in drinking water sources have gained considerable attention worldwide due to their potential health risk. Approximately 80% of the Sri Lankan rural population and 34% of the urban population rely on well water for their daily needs. Therefore, people could be exposed to cyanotoxins by consuming well water. This study investigated the presence of potentially toxic cyanobacteria and microcystin variants in the household well water samples collected from the 13 divisional secretariats in the Gampaha district, the second-most populated district in Sri Lanka. Twenty-six well water samples were collected, and physicochemical parameters such as temperature, salinity, pH, conductivity, and Total Dissolved Solids (TDS) were measured in triplicates, *in situ* using a multi-parameter. All samples met the Sri Lankan Standards (SLS) for drinking water in terms of pH, salinity, temperature and TDS. One well water sample collected from Wattala did not meet the SLS standards in terms of conductivity (829.00±2.05 µS/cm), indicating the well's unsuitability for water consumption. Morphological identification of cultures originating from well water samples in cyano-specific BG11 medium indicated the presence of nine cyanobacterial genera, including *Gloeobacter*, *Myxosarcina*, *Dermocarpa*, *Xenococcus*, *Synechococcus*, *Pseudanabaena*, *Chroococcus*, *Lyngbya* and *Geitlerinema.* Among them, *Synechococcus* and *Pseudanabaena* are reported to be microcystin producers. The presence of extracellular MCs in water samples was detected by High-Performance Liquid Chromatography (HPLC). Extracellular MCs were extracted from water samples using 70% methanol. MC variants and their concentrations in each well water sample were determined using MC-RR-YR-LR standard mixture (Cat no. 33578; SIGMA ALDRICH) by comparing peak retention times and the area of the peaks. HPLC analysis revealed the presence of the microcystin variant MC-LR only in two water samples collected from wells located in the Divulapitiya and Katana areas with MC-LR concentrations of 195.1 µg/L and 278.3 µg/L, respectively. These values exceeded the standard guideline value of 1 µg/L for MC-LR set by the World Health Organization for drinking water**.** This indicates the potential health risk for consumers of those wells because there is a potential for hepatotoxic MCs to cause acute and chronic illnesses in humans.

Keywords: Cyanobacteria, HPLC analysis, Microcystins, Morphology

Acknowledgement
This work was supported by the National Science Foundation of Sri Lanka under the research grant ICRP/NSF-NSFC/2019/BS/01

Abstract No: BO-64

Analyses of biometric parameters, feeding, and fisheries aspects of Spotted Sardinella (*Amblygaster sirm*) occurring along the Negombo coastal waters of Sri Lanka

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Amblygaster sirm is one of the major food fish in the small pelagic fishery in Sri Lanka. The study analyzed biometric parameters, feeding habits, and fisheries aspects of *A. sirm* in Negombo coastal waters. Two hundred *A. sirm* individuals were collected from the Negombo fish landing center and monthly interval from August 2022 to March 2023. The weight and total length of the collected fish ranged from 17.50 g - 109.00 g and 12.80 cm - 22.60 cm respectively. The length-weight relationship ($W=aL^b$) of males, females and pooled was $W= 0.0029\ TL^{3.3546}$, $W= 0.0035\ TL^{3.2819}$ and $W= 0.0030\ TL^{3.3459}$. The significant deviation of the 'b' values from 3.0 indicates an allometric growth pattern for *A. sirm* in the coastal waters of Negombo (one-sample t-test-$p<0.05$). The Fulton's condition factor (K) using the formula $K = 100*W/TL$, 0.9047 ± 0.1074, 0.94392 ± 0.08699 and 0.92331 ± 0.09995, for males, females and pooled respectively. The stomach-fullness of fish examined: were 40% empty, 15% one-fourth full, 12.5% half full, 27.5% three-fourth full, and 5% full stomach. Food and feeding analyses showed that ingested food includes 14.29% of phytoplankton including 1.53% of algae, 23.98% of mollusc larvae, 25.51% of crustacean larvae, 15.31% of fish eggs, 12.76% of arthropod appendages, 2.55% of synthetic fibers and 4.08% of unknown particles. According to the average Gastro Somatic Index, the highest and lowest feeding intensities using stomach fullness index were observed in the size class of 17.5 cm - 18.5 cm and 12.5 cm - 13.5 cm respectively. Their most preferred prey was crustacean larvae. The major vessel type used in fishing was Fiberglass Reinforced Plastic (OFRP) boats, operated within 15 - 20 fathom in depth. The small mesh drift gillnets with 31.75 mm and 38.1 mm mesh sizes was popular among the community. Of that, 38.1 mm mesh sizes are widely used. Synthetic materials in stomach content provide compelling evidence of the widespread contamination of marine ecosystems by human-made materials. The ingestion of these synthetic materials by fish poses a threat not only to their health but also to the overall ecological balance of marine habitats. Therefore, long term monitoring and research is recommended for the sustainable utilization of spotted sardinella fishery resources in Sri Lankan coastal waters.

Keywords: Biometric parameters, Feeding habit, Fisheries aspects, Spotted Sardinella

Abstract No: PO-01

Simple cubic structured ferromagnetic thin films with two spin layers explained by fourth order perturbed Heisenberg Hamiltonian

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Fourth order perturbed Heisenberg Hamiltonian was employed to find the energy of simple cubic ferromagnetic ultra-thin films with two spin layers with all seven magnetic energy parameters. All the magnetic energy parameters such as spin exchange interaction, magnetic dipole interaction, second order and fourth order magnetic anisotropy constants, in plane and out plane applied magnetic fields, demagnetization factor and stress induced anisotropy were included in the fourth order perturbed Heisenberg Hamiltonian. 3D plot of total magnetic energy versus angle and spin exchange interaction were plotted using the different values of fourth order magnetic anisotropy constants. All other magnetic energy parameters were fixed at constant values. All the peaks are closely packed in the graphs plotted using fourth order perturbed Heisenberg Hamiltonian compared to peaks in the graphs plotted using second and third order perturbed Heisenberg Hamiltonian. Several magnetic easy and hard directions were found in all the 3-D plots. The order of magnetic energy was changed when the values of fourth order anisotropy constants of two spin layers are varied. The order of magnetic energy is higher (10^{42}), when the values of fourth order magnetic anisotropy constant in the top spin layer is less than the bottom spin layer. The order of magnetic energy is lower (10^{41}), when the values of fourth order magnetic anisotropy constant in the top spin layer is higher than the bottom spin layer. In addition, the graphs of energy versus angle were plotted to find the magnetic easy and hard directions.

Keywords: Fourth order perturbed Heisenberg Hamiltonian, Magnetic anisotropy constant, Magnetic thin films, Spin, Stress induced anisotropy.

Abstract No: PO-02

The influence of substrates on the device performance of the TCO/CBD-CdS/ ED-CdTe and TCO/CBD-CdS/CSS-CdTe solar cells

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The development of cost-effective efficient photovoltaic cells is crucial for generating electricity with the most abundant solar energy to eliminate the energy crisis globally. At present, there is a growing interest in CdS/CdTe solar cells due to minimal material cost and easy and cost-effective methods of thin film deposition. The aim of this work is to investigate the influence of different transparent conducting oxide (TCO) substrates in superstrate configuration (glass/ITO:5 Ω/sq, glass/FTO:13 Ω/sq, and glass/FTO:7 Ω/sq) on the device performance of CdS/CdTe solar cells. Herein, chemical bath deposited CdS (CBD-CdS) layers were grown using 0.0333 mol/L $Cd(CH_3COO)_2$, 0.0667 mol/L $CS(NH_2)_2$, concentrated NH_4OH and 1.0 mol/L $NH_4(CH_3COO)$ at 90 ℃ for 55 min. Subsequently, the CdTe layers were deposited using electrodeposition (ED) and close spaced sublimation (CSS) techniques as required. For electrodeposition of CdTe layers, $CdSO_4$ (1.0 mol/L) and TeO_2 (1.0 mmol/L) precursors were used at pH of 2.3 and 65 ℃ and deposition was run for 3 hrs. The CSS-CdTe layers were developed by maintaining the substrate and source temperature at 580 ℃ and 640 ℃, respectively, and the deposition proceeded for 25 min. at 7.9 Torr. The glass/TCO/CBD-CdS/ED-CdTe samples were treated with $CdCl_2$, and glass/TCO/CBD-CdS/CSS-CdTe were undergone NP etching as suitable post-deposition treatments. The device fabrication was completed with the back contact formation (Cu/Au). The devices; glass/TCO/CBD-CdS/ED-CdTe/Cu/Au and glass/TCO/CBD-CdS/CSS-CdTe/Cu/Au prepared with FTO:13 Ω/sq delivered the highest efficiency of 5.7% (J_{SC} = 19.2 mA/cm^2, V_{OC} = 0.672 V, FF = 44%) and 8.6% (J_{SC} = 30.3 mA/cm^2, V_{OC} = 0.606 V, FF = 47%), respectively while the cells prepared with glass/ITO:5 Ω/sq delivered the lowest efficiency. Hence, the glass/FTO:13 Ω/sq substrate was recognized as the most appropriate substrate for the fabrication of CBD-CdS/ED-CdTe and CBD-CdS/CSS-CdTe solar cells. The resultant optical transmittance (over 80%, above 500 nm) and surface roughness (RMS roughness of bare FTO:13 Ω/sq was 12.49 nm, and FTO:13 Ω/sq/CBD-CdS was 10.15 nm) of CBD-CdS further confirmed the suitability aptness of the glass/FTO:13 Ω/sq substrate in CdS/CdTe based solar cell fabrication.

Keywords: Chemical bath deposition, Electrodeposition, Close spaced sublimation, TCO substrate, Surface roughness

Acknowledgement
This work was supported by the State Ministry of Skills Development, Vocational Education, Research and Innovations, Sri Lanka under the Edu-Training program on Prototype Manufacturing of Solar Panels.

Abstract No: PO-03

A study on a natural rubber and coconut coir-based carbon black composite

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Carbon black (CB) is extensively employed as a reinforcing filler in various industrial applications. Widely available polymer-filler composites are synthetic. A main motive of this research was to synthesise and characterise an eco-friendly polymer composite for applications in bicycle tyre and tube industry. The study utilised coconut coir to produce CB and used it as the filler in natural rubber (NR). The coconut coir-based carbon black (CCCB) was prepared by the combustion of coconut coir at 200 ^{0}C in a nitrogen atmosphere. Instead of sulphur, pentane-1,5-diylidenediamine (PDD) with equal amounts of ammonia and glutaraldehyde was employed as a cross-linking agent at a low temperature to process NR. The NR and CCCB composites (NR-CCCB) were synthesised incorporating 50 mL of NR latex, 6 ml of PDD solution, and different amounts of CCCB. The mixture was stirred at 45 ^{0}C for 3 hours, casted into the moulds and made NR-CCCB composites having different weight percentages of CCCB (0, 2, 4, and 6%). The structural properties and mechanical properties, including Young's modulus, tensile strength, and elongation at break, were assessed to evaluate the influence of CCCB on the composite material. X-ray diffraction was conducted on CCCB, and scanning electron microscopy was conducted on both the composites and CCCB to understand the structural changes and morphological characteristics. The X-ray diffraction analysis indicated that the CCCB is inexhibit an amorphous phase. Morphological analysis revealed a uniform dispersion of CCCB within the rubber composite, which contributed to the enhanced mechanical properties observed in the composites. The particle size of CCCB was estimated to be 70-80 µm. The density of NR-CCCB increased from 887 kg m^{-3} to 1241 kg m^{-3} by 40% with the increase in filler loading. Universal testing machine was used to study the mechanical properties of NR-CCCB and the reference bicycle tube. The results demonstrate the increase of tensile strength and Young's modulus of NR-CCCB 0.75×10^6 N m^{-2} to 1.32×10^6 N m^{-2} and from 0.72×10^6 N m^{-2} to 1.25×10^6 N m^{-2} respectively, with increasing filler content, resulting in increased hardness, stiffness, and strength of the rubber. However, the elongation at break of NR-CCCB decreased from 476% to 422% with increasing filler content, indicating a decrease in the flexibility of the NR composites. The density and Young's modulus of the reference bicycle tube were measured as 1262 kg m^{-3} and 5.67×10^6 N m^{-2} respectively.

Keywords: Carbon black, Coconut coir, Natural rubber, Natural rubber, Tensile strength, Vulcanisation

Abstract No: PO-04

Controlled K −frames in quaternionic setting

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Quaternion is an extension of complex numbers from the two-dimensional plane to four-dimensional space and forms non-commutative division algebra. A feature of quaternion is that the multiplication of two quaternions is non-commutative, from the non-commutativity the quaternionic Hilbert spaces are defined in two ways such as right quaternionic Hilbert space (V_H^R) and left quaternionic Hilbert space (V_H^L). K −frames are more general than ordinary frames in the sense that the lower frame bound only holds for the elements in the range of K, where $K$is a bounded linear operator in V_H^L. Controlled frame is one of the newest generalizations of the frame which has been introduced to improve the numerical efficiency of interactive algorithms for inverting the frame operator. In this research, the notion of a controlled K −frame is introduced in left quaternionic Hilbert space along the lines of their real and complex counterparts and some of their properties were analysed. Let V_H^L be a left quaternionic Hilbert space, $K \in B(V_H^L)$ and $C \in GL^+(V_H^L)$, where $B(V_H^L)$is the set of all bounded linear operators and $GL^+(V_H^L)$ is the set of all positive bounded linear operators in V_H^L with bounded inverse. A sequence of family $\Phi = \{\varphi_k\}_{k\in I}$ in V_H^L is called a $C-$ controlled $K-$ frame for V_H^L if there exist constants $m, M > 0$ such that $m\|K^\dagger\varphi\|^2 \leq \sum_{k\in I}\langle\varphi_k\rangle\langle\varphi\rangle \leq M\|\varphi\|^2$, for all $\varphi \in V_H^L$. First, we established a result that shows that any $K-$ frame is a controlled K −frame under certain conditions. Let K and C be self -adjoint with $CK = KC$. If $\Phi = \{\varphi_k\}_{k\in I}$ is a $K-$ frame for V_H^L then $\Phi = \{\varphi_k\}_{k\in I}$ is a $C-$ controlled $K-$ frame for V_H^L. Then we derived a necessary and sufficient condition for a sequence to be a controlled $K-$ frame and we have shown that every $C-$ controlled $K-$ frame is a $C^{-1}-$ controlled $K-$ frame. Suppose that $K \in B(V_H^L)$. A sequence $\Phi = \{\varphi_k\}_{k\in I}$ is a $C-$ controlled $K-$ frame for V_H^L if and only if $R(K) \subseteq R(T_{C\Phi})$, where $R(K)$ is the range of K. Suppose that $CK = KC$. If $\Phi = \{\varphi_k\}_{k\in I}$ is a $C-$ controlled $K-$ frame for V_H^L then $\Phi = \{\varphi_k\}_{k\in I}$ is a $C^{-1}-$ controlled $K-$ frame for V_H^L. Finally, we proved that the sum of two controlled $K-$ frames remains a controlled $K-$ frame under certain conditions in left quaternionic Hilbert space. Let $CK = KC$. Suppose that $\Phi = \{\varphi_k\}_{k\in I}$ and $\Psi = \{\psi_k\}_{k\in I}$ are $C-$ controlled $K-$ frames for V_H^L with bounds m, M and m', M', respectively. If $T_\Phi {T_\Psi}^\dagger = C^{-1}KK^\dagger$, then $\{\varphi_k + \psi_k\}_{k\in I}$ is also a $C-$ controlled $K-$ frame for V_H^L.

Keywords: Frames, Quaternion, Quaternionic Hilbert space, K −frames, Controlled frames

Abstract No: PO-05

A study on mechanical properties of a polymer composite based on areca nut fiber

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Plant-based raw food items such as fruits and vegetables are damaged during storage and transportation due to high temperatures, water vapours, mechanical shocks and vibrations, microorganisms, etc. This study is aimed at developing a packaging material using areca nut fibers and Chemifix as an effective substitute for available packaging materials. The areca nut husks were used to extract the fibers. The fibers were extracted by the retting process, and the extracted fibers were subjected to alkali treatment. The samples were made by combining Chemifix with areca nut fibers in various ratios to obtain 0% wt, 9% wt, 11% wt, 14% wt, 20% wt, 25% wt, and 30% wt fiber content in the prepared composite samples. A pure Chemifix sheet and commercially available cardboard, gypsum, and medium-density fiberboard (MDF) were used as reference materials. The prepared composite samples' density, thermal conductivity, water absorption, Young's modulus, tensile strength, and elongation were measured and compared with those of the reference samples. The density and thermal conductivity of the composite samples with 20%, 25%, and 30% areca nut fiber weight percentages ranged from 350 to 700 kg m^{-3} and 0.2 to 0.3 W m^{-1} K^{-1}, respectively. The density and thermal conductivity of the reference samples (0% wt) were 1372 kg m^{-3} and 0.78 W m^{-1} K^{-1} respectively. 9% wt and 11% wt fiber containing composite samples showed high resistance to water absorption. The other four composite samples absorbed more water than 100% of the sample mass. However, a low water absorption rate was present in all composite samples than in the commercial samples tested in this study except gypsum board. Young's modulus and breaking point of samples with 20% wt, 25% wt and 30% wt were in order of 10^8 N m^{-2} and 10^7 N m^{-2} respectively. The elongation of the samples decreased with the increasing fiber content. The reference sample (0% wt) had an elongation exceeding 100%. This study reveals that the prepared composite samples with a moderate fiber content (20%) show promising properties suitable for the storage and transportation of raw plant products.

Keywords: Areca nut fibers, Bio composite, Chemifix, Packaging material, Thermal conductivity.

Abstract No: PO-06

Investigating the ability to purify wastewater by using Activated Porous Carbon (APC) produced from waste surgical masks

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Since the early days of the year 2020, most people have been wearing face masks to protect themselves from COVID 19 pandemic. As a result of that, another environmental problem arises with waste face masks all over the world. Therefore, this study aims to convert commonly used, waste polypropylene surgical masks, into Activated Porous Carbon (APC) and compare its wastewater treatment applications with commercially available activated carbon (AC). Waste polypropylene surgical masks can be converted into APC through the two main processes called sulfonation and carbonization. First, waste masks were mixed with concentrated H_2SO_4 and heated under the temperature of 110 $^{\circ}$C for the sulfonation. Then, the collected samples were carbonized by mixing with KOH in different mass ratios 1:1, 1:1.5 and 1:2 (samples: APC 1, APC 2 and APC 3 respectively) and again these samples were heated under the temperature of about 400 $^{\circ}$C. Adsorption ability of activated carbon depends on porosity, surface area of the sample and also size of the substance that we want to remove from wastewater. According to the Scanning Electron Microscope (SEM) images of the samples, even though there is no any considerable porous structure on the all APC samples, roughly surface area of the APC 1 sample is higher than the other APC samples. This can be caused to the higher adsorption of the APC 1 sample. Here, the adsorption ability of the APC samples was tested by using two chemical dyes, four cations and four anions. According to the concentration reduction results of commercial AC sample and APC samples, a high concentration reduction was obtained from APC 1 for both Congo red and Methylene blue dyes. Molecular size of the two types of dyes can be caused to those results. Even though these two dyes are organic and aromatic compounds molecule size of the Congo red is larger than the Methylene blue. It allows to adsorb Congo red more effectively than the Methylene blue. When considering the results obtained for the cations and anions adsorption, APC samples showed lower capability compared to commercial AC. Among the tested APC samples, again APC 1 had the best adsorption ability. Further, obtained results for the ion adsorption clearly indicated there is high capability to adsorb large substances effectively than small substances. Ions in the solution directly affect the conductivity of the solution. Therefore, in this work conductivity values of three collected water samples were measured by changing the contacted time with the sample. According to the decrement of conductivity values, there is a considerable effect on the adsorption rate from the contacted time. Further, those conductivity results also showed the best ion adsorption ability of APC sample1 than the other samples. Hence, APC 1 sample with a 1:1 KOH mass ratio can be identified as the best adsorbent with good surface structure.

Keywords: Adsorption, Carbonization, Sulfonation, Waste masks

Abstract No: PO-07

Effect of pH on the morphology of chemical bath deposited ZnO nanowires

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ZnO is a non-toxic chemical compound that forms nanostructures like nanoparticles, nanowires, nanotubes, and so on. Among these nanostructures, ZnO nanowires have shown the potential for use in applications like light-emitting diodes (LED), lasers, light detectors, chemical and biological sensors, photovoltaic cells, field-effect transistors (FET), nanogenerators, and so forth. ZnO nanowires can be synthesised using a variety of techniques, such as chemical vapour deposition (CVD), chemical bath deposition (CBD), and hydrothermal methods. Among these methods, CBD is a cost-effective, simple method to fabricate well-crystalline ZnO nanowires. The morphology of the ZnO nanostructures greatly varies with the alteration of growth parameters like growth temperature, growth time, precursor concentration, and pH level of the precursor. Herein, pH is an easily controllable parameter that has a significant effect on the morphology of ZnO nanowires as well. In this research, we synthesised ZnO nanowires using the CBD method and investigated the effect of the pH level of the precursor on the morphology of the as-synthesised ZnO nanowires. The pH values 2, 4, 6, 6.5, 7, 8, and 10 were selected for the study, and the nanowires were grown on a seed layer for better crystallinity. First, the seed layer was deposited on a borosilicate glass slide by spraying the seed solution (3.69 g of $Zn(CH_3COO)_2$, 18.9 ml of Ethanol, 0.1 ml of Monoethanolamine, 100 ml of deionised water) using the spray pyrolysis technique. Then, the sample was annealed at 300℃ for 1 hour. Next, the precursor solution (3.83 g of $Zn(NO_3)_2$, 2.82 g of Hexamethylenetetramine, 200 ml of deionised water) was subjected to pH alteration using dil. HCl or dil. NH_4OH and was then heated to 90℃ while magnetic stirring at 700 rpm. After that, the seed-layered glass slide was submerged in the solution for the chemical bath deposition for 2 hours. Finally, the sample was annealed at 300℃ for 30 minutes. The above-mentioned process was repeated for all the understudied pH values. Characteristics of the ZnO nanowire samples, such as average values of height, width, aspect ratio (height/width), surface-to-volume ratio, and wire density, were analysed using scanning electron microscopic (SEM) images. The outlook and the quantitative analysis of the SEM images showed that the most crystallised nanowires (hexagonal wurtzite shape) corresponded to pH 6.5, with the highest aspect ratio (10.308) and the lowest nanowire density (44 nanowires per μm^2). The highest surface-to-volume ratio was reported for the nanowires grown at pH 7 (1.049), followed by pH 6.5 (1.037). In general, ZnO nanowires grown at pH 6.5 showed the highest crystallinity in the understudied pH range.

Keywords: ZnO nanowires, pH, Morphology, SEM, Chemical bath deposition.

Abstract No: PO-08

Photocurrent improvement in grape dye sensitized solar cells by in cooperation of electrodeposited Cu particles in TiO_2 photoanode

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A worldwide effort is currently underway to address the world's energy crisis by finding sustainable energy alternatives. The Dye-Sensitized Solar Cell (DSSC) is a type of solar cell device that functions based on electrochemical principles and uses light sensitive dyes within its TiO_2 photoelectrode layer to absorb light. The DSSC, one of the potential solutions, appears to be the most viable option for a future renewable energy source due to its sustainability and environmental friendliness. In cooperation of metal particles like Au or Ag in nano scale to the photoanode is one of the promising methods to improve the efficiencies of these DSSCs. Among these metal particles Cu has some distinct properties such as abundance, low toxicity, low cost and it undergoes Localized Surface Plasmonic Resonance (LSPR) effect like Au nanoparticles. Therefore, to improve the DSSC performances, in this study, Cu particle incorporation to the TiO_2 electrode was carried out by electrochemical deposition method. Homogeneous TiO_2 paste prepared by mixing appropriate amount of TiO_2 powder (Titanium (IV) dioxide), ethanol, and acetic acid was deposited on a transparent Indium-doped Tin Oxide (ITO) conductive glass substrate by doctor blading method. Electrodeposition of Cu particles were potentiaostatically grown in the TiO_2 electrode at -700 mV vs Ag/AgCl reference electrode using a three-electrode electrochemical cell configuration with Pt as the counter electrode and 0.1 M sodium acetate and 0.01 M cupric acetate electrolyte at room temperature. Natural dye grapes have been used as sensitizer in the study. DSSCs were fabricated by sandwiching above TiO_2 films with a C coated counted electrode using KI/I_2 based electrolyte. The devices were characterized by analysing the UV – vis absorbance spectra and current density-voltage (*J-V*) curves and controlled potential coulometry measurements. The UV – vis absorbance spectrum revealed that the light absorption of DSSCs enhanced due to the incorporation Cu. The power conversion efficiency of 0.10%, photocurrent density (J_{SC}) of 501 µA/cm^2, open circuit voltage (V_{OC}) of 0.47 V, and fill factor (FF) of 42% were achieved after the Cu incorporation in the photoanode. It is found that due to the incorporation of Cu particles, a slight voltage drop was visible, but there was a significant increase in the photocurrent density (J_{SC}) from 308 µA/cm^2 to 501 µA/cm^2. The efficiency also increased from 0.07 to 0.10%. DSSC with the incorporated Cu particles showed 62% enhancement in the photocurrent compared to the DSSC without Cu particles.

Keywords: Copper, DSSC, Electrodeposition, Photocurrent

Abstract No: PO-09

Enhancing quasi solid-state dye-sensitized solar cell performance using mixed-polymer gel electrolytes: the influence of low and high molar-weight polymers

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Gel polymer electrolytes (GPEs) based quasi solid-state dye-sensitized solar cells (DSSCs) have attracted attention due to their relatively high chemical and physical stability, ionic conductivity, better mechanical properties, and enhanced safety. This study investigated the possibility of improving DSSC performances by preparing new GPEs using polyethylene oxide (PEO) with its low molar weight counterpart, polyethylene glycol (PEG). The studied plasticized gel electrolyte included organic solvents, ethylene carbonate (EC) and propylene carbonate (PC), a binary mixture of salts, LiI and Hex_4NI, and performance enhancers, 1-methyl-3-propylimidazolium iodide (MPII) and 4-tert-butylpyridine (4TBP), with the polymer matrix, $C_{2n}H_{4n+2}O_{n+1}$, having molar weights 40,000 (PEG) and 4,000,000 (PEO). The electrolyte was synthesized using the hot press method. The correctly weighted chemicals were stirred for about one hour at room temperature and then heated to about 100 °C for 10 min. Then after the sample cooled down to 40 °C iodine was added, and stirring was continued for an hour. The study aimed to optimize the DSSC performance by varying the weight (wt.) ratio of PEO and PEG in the electrolyte. The ionic conductivities of the GPEs were determined using impedance analysis through Nyquist plots. The electrolyte that contains 100 wt% of PEG with respect to the total polymer weight exhibited the highest ionic conductivity (0.826 S m^{-1}) and viscous liquid-type nature. Conversely, the electrolyte with a 100 wt% PEO is in solid form and displayed the lowest ionic conductivity (0.351 S m^{-1}). The mixed polymer electrolyte with a 1:1, PEO:PEG wt. ratio showed an intermediate conductivity and a good gel nature. Also, the conductivity of the GPEs behaves according to the Vogel-Tamman-Fulcher (VTF) relation. The DSSCs were assembled using N719 dye-sensitized TiO_2 nano-particle multi-layer photoelectrode and Pt counter electrode. The solar cell characterization results showed that the cells achieved the highest power conversion efficiency (PCE) of 7.09% for the 1:1, PEO:PEG wt. ratio with a J_{sc} of 13.80 mA cm^{-2}. The PCE values were relatively lower for the 3:1 (6.29%), and 1:3 PEO:PEG wt. ratios (5.99%). The lowest PCE out of the five compositions investigated was observed for the 100 wt% PEO content, which can be a result of the solid nature and poor conductivity of the electrolyte. The results demonstrated a notable advancement in performance with an improvement of 23.86% and 21.61% when compared to single polymer electrolytes comprising of PEO and PEG, respectively. In conclusion, the presence of both low and high-molar-weight polymers in the electrolyte has a significant impact on the performance of DSSCs. The study continues to fine-tune polymer composition and understand the efficiency-enhancing mechanism in mixed-phase gel polymer electrolytes.

Keywords: Dye-sensitized solar cells, Gel polymer electrolyte, TiO_2 multilayer

Acknowledgment
This work was supported by Post-graduate Institute of Science, University of Peradeniya, Sri Lanka under the research grant No. PGIS/2020/05.

Abstract No: PO-10

Development of a simple sol-gel based colorimetric sensor for the detection and quantification of Gallic acid

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The rapid and visual detection of Gallic acid (GA) is of significant importance, broadening its applicability to multiple domains. The primary goal of this research is to develop a colorimetric detection method for identifying gallic acid in unknown samples by exploiting gallic acid's chelating capability with iron (III). The sol-gel process is employed as a means to study and optimize the chelation of gallic acid with iron (III) for efficient detection purposes. Since various types of tetraethyl orthosilicate (TEOS) based sol-gel materials have been developed recently by incorporating polymeric/oligomeric components into silicate systems via the sol-gel process, the current work aimed at developing transparent monolithic silica disks doped with $FeCl_3$ (1666.67 ppm and 3333.34 ppm) prepared by acid-catalysed sol-gel reaction of TEOS. The sol-gel solution was prepared by hydrolysing precursors with ethanol as the solvent. Subsequently, $FeCl_3$ and a surfactant (Sodium Dodecyl Sulfate, SDS) were added to the sol-gel mixture. Distinctive colour response patterns of $FeCl_3$ doped monolithic disks, upon treatment with GA (10 ppm to 1000 ppm), were identified by extracting red, green, and blue (RGB) colour coordinates of digital images taken from a smartphone before and after the reaction with GA. The relationship between the Euclidean distances (EDs), calculated as the square roots of the sums of the squares of the ΔRGB values, and the concentration range of 10 ppm to 1000 ppm GA is linear. The limit of detection (LOD) for monolithic disks doped with $FeCl_3$ at 1666.67 ppm is 241.64 ppm, and for the monolithic disks doped with 3333.34 ppm of $FeCl_3$, it is 92.38 ppm, while the Limit of Quantitation (LOQ) is 732.25 ppm and 279.96 ppm, respectively. The colour shifts not only allow for visual estimation but also enable the quantification of GA concentrations. Currently, the dual nature of the analytical method ensures its practicality and effectiveness in assessing polyphenol content in the samples, measured in Gallic acid equivalents [mg (GAE)/ g]. However, it also indicates an opportunity for future refinement to achieve even greater precision and accuracy.

Keywords: Gallic acid, iron (III), Sol-gel, RGB, Euclidean Distance

Acknowledgment
This work was supported by University of Kelaniya under the research grant RP/03/02/06/02/2022.

Abstract No: PO-11

A statistical approach to assess faceted blue sapphire gemstones

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The gem industry is a promising contributor to Sri Lankan economic development. The gemstone market prices are set by professional gem evaluators based on their tacit knowledge. Although the valuation of gemstones is complex due to the high variability in their characteristics, establishing a standard model that minimizes overpricing or under-pricing of gemstones helps stakeholders and preserves the reputation of the gem industry. This research aims to develop a statistical model to assess faceted blue sapphires based on affecting factors of gemstones such as colour, inclusions, cracks, cut, weight, state of treatment, and calibration. All exported gemstone records from February to September 2022 were collected from the National Gem and Jewellery Authority. A total of 881 records composed of single (409) and batch assessments (472) of faceted blue sapphire were utilized for modelling. Multiple linear regression (MLR), quantile regression (QR), support vector regression (SVR), feedforward neural network (FFNN), and generalized regression neural network (GRNN) were employed in developing pricing models. However, MLR and QR models showed a reduction of some important variables from the model. Further, the MLR model was not adequate due to the violation of the assumptions for both heteroscedasticity and autocorrelation. The performances of SVR, FFNN, and GRNN models were compared using mean squared error (MSE), root mean squared error and mean absolute percentage error. MSE for SVR, FFNN, and GRNN were 0.0697, 0.0733, and 0.0730 respectively. Even though all three models exhibit similar performances, GRNN provided a closer approximation for most of the cases. Further SVR (MSE=0.0419) and GRNN (MSE=0.0700) models were separately developed to address the most common single-piece assessment. Results revealed that the SVR model with Gaussian kernel outperforms in single assessments while GRNN provides closer predictions to all assessments. Future studies can be conducted to develop a model using the generalized method of moments which is widely used in violation of both heteroscedasticity and autocorrelation. Moreover, this study can be extended to developing statistical models to assess other varieties of gemstones. Finally, developing and implementing an application decision support tool to assess gemstones would be highly beneficial.

Keywords: Multiple linear regression (MLR), Quantile regression (QR), Support vector regression (SVR), Feedforward neural network (FFNN), Generalized regression neural network (GRNN)

Abstract No: PO-12

Development of a cost-effective real-time commuter counting system for public transportation in Sri Lanka

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The use of smart systems in public transportation is relatively new in the Sri Lankan context. This study introduces a cost-effective solution for accurately counting the number of bus passengers at any given time. Current passenger counting systems in Sri Lanka often suffer from inaccuracies and inefficiencies, hindering the effective management of public transportation and addressing problems including long bus queues, ticketing fraud, long waiting times, etc. Precise passenger count is essential for optimising services and resources, ultimately enhancing the efficiency of public transportation in the country. The proposed system is designed to be installed in buses and includes an online platform where users can enter the bus number and check the passenger occupancy in real-time. The proposed system comprises several key components: two input sensors, a microcontroller, a wireless connectivity module, an in-built display, an input panel, and an output display. The two sharp IR sensor modules employed as input sensors are connected to a microcontroller. An inbuilt display connected to the microcontroller provides output information, including passenger count, number of vacant seats, GPS signal strength, and data transmitting capability. Data is wirelessly sent to a cloud database for storage, retrieval, and processing, enabling users to access relevant information via a web application. The algorithm employed in this system ensures precise passenger count by detecting specific sequences of readings from the two IR sensors. To increment the passenger count, the system requires the following sequence: "0-0, 1-0, 1-1, 0-1, 0-0." This sequence corresponds to the detection of a passenger boarding the bus. Each step in the sequence represents the state of the two IR sensors, with "0" indicating no obstacle and "1" indicating an obstacle (i.e., the presence of a passenger). The algorithm recognizes this sequence as an entry event and increments the passenger count accordingly. Conversely, the algorithm relies on the following sequence to accurately decrease the passenger count when a passenger exits the bus: "0-0, 0-1, 1-1, 1-0, 0-0." This sequence represents a passenger leaving the bus. The algorithm reduces the passenger count by monitoring the sensor readings and identifying this sequence. These specific sequences in the algorithm ensure reliable and accurate passenger counting. By requiring a particular order of sensor readings, false positives or negatives caused by noise or temporary obstacles are minimised, leading to a more precise passenger count. The online platform allows users to access passenger occupancy in a particular bus, which aids in real-time service optimization for public transportation management. The system achieves precise real-time passenger occupancy tracking using two Sharp IR sensors and a finely tuned algorithm. Tested results of the pilot system show that data empowered public transportation management in Sri Lanka by optimising routes, efficiently allocating resources, and significantly improving the overall commuter experience. In conclusion, the combination of affordability, reliability, and user-friendliness makes this proposed solution suitable for efficiently managing public transportation systems.

Keywords: Commuter counter, Passenger counting, public transportation, Sharp IR sensors

Abstract No: PO-13

Fabrication and characterization of electrodeposited nano structured copper oxide-based supercapacitors

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The increasing consumption of limited energy sources, primarily based on fossil fuels, and the resulting environmental issues, such as global warming and climate change, drive researchers to develop environmentally friendly and renewable energy conversions and storage systems. Supercapacitors (SCs) have emerged as a promising solution to meet the increasing global demand for efficient energy storage. The performance and efficiency of a supercapacitor depend directly on the electrode materials used. Nanostructured materials provide new and exciting approaches to developing supercapacitor electrodes for high-performance electrochemical energy storage applications. Interest in pseudocapacitive materials, particularly copper oxide, has grown due to its advantageous properties and application as electrode materials in energy storage devices. In this research, nano cuprous oxide thin films were used as supercapacitor electrodes, and Polyvinyl Alcohol-Potassium Hydroxide (PVA-KOH) gel polymer was used as both the electrolyte and separator for supercapacitors. The nano cuprous oxide films were synthesized on Ti substrates using the electrodeposition technique by controlling the pH of the deposition bath. For comparison, microstructured cuprous oxide thin films were also deposited on Ti substrates as electrodes using the electrodeposition technique. Structural and surface morphological properties of the fabricated electrodes were investigated using high-energy X-ray diffraction (HEXRD) and scanning electron microscopy (SEM). The HEXRD analysis showed the formation of a single-phase polycrystalline cuprous oxide film on the Ti substrate. The SEM revealed that the morphology of the electrodeposited cuprous oxide thin films strongly depends on the pH value of the deposition bath. The performance of cuprous oxide as an electrochemical supercapacitor electrode was analysed using cyclic voltammetry (CV), galvanostatic charge-discharge (GCD), and electrochemical impedance spectroscopy (EIS) techniques. In comparison to microstructured electrodes, the nano cuprous oxide electrodes demonstrate better electrochemical performance in terms of specific capacitance, energy density, and power density. The $Cu_2O//Cu_2O$ supercapacitor with nano-Cu_2O electrodes, prepared at pH 7.9, exhibited the highest specific capacitance of 176.02 mF/g, energy density of 61.4 mWh/kg, and power density of 44.23 W/kg. In contrast, the supercapacitor with microstructured electrodes, prepared at pH 6.3, exhibited a specific capacitance of 7.37 mF/g, energy density of 2 mWh/kg, and power density of 1.4 W/kg. The significant improvement is mainly attributed to the increased film surface area associated with cuprous oxide nanostructures. Therefore, nano copper oxide-based supercapacitor electrodes show great potential for supercapacitor applications.

Keywords: Supercapacitors, Nanostructures, Electrodeposition, Nano cuprous oxide, High-Energy X-ray diffraction

Abstract No: PO-14

Viscous Dissipation and thermal radiation of Williamson fluid flow over an exponentially stretching sheet

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This study investigates the viscous dissipation and thermal radiation of Williamson fluid flow over an exponentially stretching sheet. The analysis has been started with the governing equations of the fluid flow derived from the conservation of mass, momentum, energy, and concentration. The internal heat generation and absorption effect in the view of getting the influence of temperature difference between the free stream and stretching sheet have been incorporated. The Rosseland approximation and Taylor series expansion formulate the radiative heat flux. The density difference which interacts with the gravitational force, resulting in a natural convection heat and mass transfer process is described by the mass transfer phenomenon with the homogeneous first-order chemical reaction effect. The boundary layer approximations have been introduced to focus on the fluid flow near the stretching sheet. Furthermore, the governing system of partial differential equations has been converted into a nonlinear ordinary differential equation by using similarity transformations. The resulting non-linear coupled system of ordinary differential equations has been solved numerically by shooting techniques. The graphs have simulated and presented the qualitative impact of different flow parameters such as magnetic field, Prandtl number, Williamson number, Grashof number, and thermal radioactive parameter on the radial velocity, temperature, and mass concentration profiles. The study reveals that the Prandtl number intensifies the radial velocity and has a mixed impact on the temperature and concentration, which decreases with an increase in the magnetic parameter but increases temperature and concentration. Further with the increase of the Prandtl number, the velocity and the temperature decrease in general but increase the concentration. The radial velocity increases with the Radioactive parameter but the temperature and the concentration display mixed reactions to the parameter. The Grashof parameter intensifies the radial velocity but reduces the temperature and the concentration. The Williamson parameter does not significantly impact radial velocity, temperature, and concentration.

Keywords: Williamson fluid, Radiation, Viscous dissipation, Exponential stretching, Similarity transformations

Abstract No: PO-15

Feasibility of piezoelectric based mechanical vibration detector

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Piezoelectric force sensors are widely used in various industries, including aerospace, automotive, and medical, due to their unique properties. These highly sensitive sensors can detect even the slightest changes in force or pressure. In the automotive industry, existing optical-based classification systems can be expensive, making them unsuitable for widespread implementation. Therefore, this study aimed to design and construct a low-cost piezoelectric mechanical vibration detector system capable of estimating the mass of dynamic objects, specifically for vehicle classification. The piezoelectric plate used was a Lead Zirconate Titanate (PZT) $Pb(Zr_xTi_{1-x})O_3$ and had dimensions of 25.1 mm in diameter and 0.25 mm in thickness. To understand the behaviour of the piezoelectric sensor, equivalent circuit models were proposed and analysed. The compression mode design was chosen for this study due to its high rigidity, wider frequency range, and better durability, making it suitable for vehicle classification applications. The charge-amplifier circuit, tailored for compatibility with an Arduino Uno, was incorporated to make the output signal readable and compatible with digital processing. To evaluate the device's performance, extensive testing was conducted using controlled dynamic impacts. The mechanical vibration detector demonstrated exceptional accuracy and sensitivity in detecting varying levels of impact vibrations with frequencies ranging from 0.5 Hz to 5 Hz, proving its effectiveness for vehicle classification applications. The successful development of this piezoelectric mechanical vibration detector presents a promising solution for vehicle classification systems. By integrating these detectors into urban infrastructure, traffic management can be streamlined, and data-driven decisions can be made to improve transportation efficiency and reduce congestion. The construction of the low-cost piezoelectric mechanical vibration detector has shown its efficacy in detecting impact vibrations, making it a viable solution for vehicle classification in smart cities. Future research could focus on optimizing the design and expanding its application scope to further enhance its impact on urban planning and traffic management.

Keywords: Piezoelectric, Vibration detector, Dynamic force, Vehicle classification, Compression

Abstract No: PO-16

Investigation of multi-functional metamaterial unit cell operating at SHX-X Band frequencies

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Metamaterials are man-made materials having unique and distinct properties which are not available in natural materials. In this study, a metamaterial unit cell is fabricated with a square-circular-hexagonal split ring resonator. The feasibility of the fabricated unit cell as a perfect absorber, sensor, and antenna is investigated. The proposed unit cell structure is initially simulated, numerically analysed, and optimized using High Frequency Structure Simulator (HFSS), a commercially available EM simulation software. First, the potential of the designed unit cell to be functioned as highly efficient metamaterial absorber in the Super High Frequency (SHF) – X band is verified. Simulations revealed that the reflection coefficient S11 is lower than 10 dB across the whole test frequency range around 9.2 GHz and the absorptivity is 99.8%. Unit cell has been fabricated with standard PCB fabrication process. The fabricated unit cell is composed of alternate layers of Cu and FR4 dielectric medium in which a Cu split ring absorbs all incident electric and magnetic fields within a single planar layer that is only 0.6 mm thick. Experimental characteristics of the designed unit cell were analysed using the Vector Network Analyzer (VNA). To observe the resonant behaviour a non-contact measurement was performed with home-made copper ring due to the increased accuracy. Experimental results showed relatively high Q-factor revealing that the designed unit cell has lower energy dissipation as compared to the energy stored. By replacing the FR4 layer in the metamaterial absorber (MMA) unit cell with a sensor layer made of air, a design for a metamaterial sensor is suggested liquid density sensing applications. The liquids with different densities were inserted to the air layer and the respective resonance frequencies were obtained. A change in the resonant frequency shifting of the metamaterial unit cell show that it can be used as a liquid density sensor. The proposed sensor can be employed in microwave frequency range for chemical, biological, agricultural, and medical applications. Finally, a design for a metamaterial patch antenna is proposed using the same unit cell. It is made of three layers consisting of the patch and the ground layer made of Cu and the substrate with FR4 dielectric material in between. The patch antenna was found to resonate at several frequencies between 0 and 15 GHz, with the lowest S11 reflection coefficient measured at 7.52 GHz and -21.2456 dB. We envision that this antenna will find application in the miniaturization and integration of various telecommunication equipment functions, particularly for items that are used frequently in daily life such as mobile communication systems, smart phones, portable tablets, GPS receivers, wireless Internet devices, etc.

Keywords: Electromagnetic energy, Metamaterial microstrip patch antenna, Metamaterial sensor, Perfect metamaterial absorber, Wireless energy harnessing

Acknowledgment
This work was supported by the Accelerating Higher Education Expansion and Development (AHEAD) Operation of the Ministry of Higher Education of Sri Lanka, funded by the World Bank.

Abstract No: PO-17

Investigation of the elemental composition of sand along the eastern coastal region of Sri Lanka

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The eastern coastal region of Sri Lanka is abundant in valuable sand deposits. However, lack of knowledge regarding the elemental composition of this sand hinders its conversion into a wanted industrial raw material. This research focuses on conducting X-ray diffraction (XRD) elemental analysis in specific areas situated along the eastern coast of Sri Lanka. XRD spectroscopy serves as the primary method for identifying the elemental composition of these samples. The sample collection includes materials from Nilaveli, Irrakkakandy, Kumpurupiddi, Salappaiyaru, and Kuchchaveli in the Trincomalee coastal area. The samples underwent grinding using a steel roller, after which the ground soil samples were sieved through a mesh with a 1mm sieve size. Any remaining samples were further ground until they could pass through the 1mm sieve mesh entirely. These steps were iteratively performed with reduced sieve sizes of 0.5mm, 0.4mm, and 0.2mm. The fine sand samples with particle size less than 0.2mm underwent die pressing at a pressure of ten metric tons to produce the pellet sample. The electrical properties of mineral sand were examined using the *Keithley 2400* with a two-probe method. The results indicated that samples collected from Kumpurupiddi, Salappaiyaru, and Kuchchaveli displayed linearity in their current-voltage (IV) graphs, attributable to the presence of iron and aluminum. Nilaveli and Irrakkakandy region samples exhibit maximum conductivity. X-ray diffractometry was employed to determine the sand samples' phase composition. The XRD outcomes unveiled that the Trincomalee coastal line sample contained mineral constituents such as Ilmenite ($FeTiO_3$), Zirconia ($ZrTiO_4$), Albite (SiO_2), and Monazite. The Nilaveli samples primarily featured Titanium and iron as its elemental components. In Irrakkakandy and Kumpurupidi, silicon and Zirconium were identified as the primary elements, while silicon was the predominant element in the Salappaiyaru and Kuchchaveli samples.

Keywords: Mineral, Illuminate, Keithely, XRD

Abstract No: PO-18

Taekwondo head guard and chest guard for training and scoring

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Taekwondo is a highly popular martial art and Olympic sport that has been rapidly gaining worldwide recognition. With its dynamic kicks, precise strikes, and intricate footwork, Taekwondo requires a scoring system that accurately reflects the skill and technique of the participants. However, the traditional manual scoring system, which relies on a team of referees to keep track of points, has its limitations. It can be time-consuming, prone to human errors, and challenging to ensure consistency and fairness in scoring. To address these challenges, the use of electronic scoring systems has become a necessity in Taekwondo competitions. These integrate specialized gear like chest and head guards with advanced sensors. The Electronic Body Protector (EBP) system is crucial in modern Taekwondo, accurately capturing punches, kicks, and rotational kicks. Our solution involves specialized head and chest guards with advanced sensor technology. To detect forces, BMP 180 sensors are used in the chest guard. Positioned within airbags, these sensors detect even slight pressure variations from punches. These sensors, calibrated with precision, exhibit an exceptional capacity to detect even the most suitable pressure variations arising from punches. The calibration process fine-tuned the BMP 180 sensors, orchestrating a responsive mechanism where pressure changes triggered resistance alterations, thereby generating an accurate voltage output. As a result, player punches during matches are swiftly identified and meticulously recorded. Pressure changes trigger the BMP 180 sensor to alter resistance and generate an accurate voltage output. Thus, player punches during matches are swiftly identified and recorded. The chest guard also detects body kicks using BMP 180 sensors, and the head guard recognizes rotational kicks through a gyroscope sensor connected to an ESP 8266 microcontroller. The gyroscope detects angular changes, ensuring accurate rotational kick detection. The ESP 8266 microcontroller processes data from the gyroscope, transmitting it to the scoring system. ESP 8266 microcontrollers with Bluetooth modules facilitate data exchange between guards, ensuring real-time data transfer for reliable scoring. Our design offers a comprehensive scoring solution by combining BMP 180 sensors for punch and kick detection and a gyroscope for rotational kicks. The Scoring Board connects via Wi-Fi to the ESP8266 board, updating scores promptly upon sensor-detected hits. The ESP8266 board calculates hit scores and transmits the data to the Scoring Board, which updates the display in real-time, benefiting players and spectators. Wi-Fi connectivity ensures accurate and swift score updates during competitions. The Scoring Board is vital within the EBP system, enhancing accuracy and fairness. In conclusion, our proposed design offers an economical and accurate framework for punch and kick detection in Taekwondo. This innovation benefits athletes, coaches, and referees, driving the growth of Taekwondo as an exciting sport.

Keywords: Air Bags, Electronic scoring systems, Gyroscope and pressure Sensor, Real-time data transmission, Taekwondo.

Abstract No: PO-19

Mass and heat transfer of modified second-grade fluid flow through a porous media over a linearly stretching sheet

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In this research, we have developed a mathematical model to describe a boundary layer approximation of modified second-grade fluid flow over a linearly stretching sheet with mass and heat transfer in a porous medium. The purpose of the model is to study the qualitative impact of buoyancy parameter, second-grade fluid parameter, magnetic parameters, porous parameter, power-law index, and chemical reaction parameter on the flow profiles, the radial and axial velocities, temperature, and concentration. The analysis has been started with the steady state governing equations derived from the conservation of mass, momentum, heat, and concentration of the fluid flow. The boundary layer approximations have been obtained on the fluid flow near the stretching sheet with the no-slip condition. The system of partial differential equations has been transformed into a system of nonlinear ordinary differential equations using similarity transformations. The resulting system of ordinary differential equations has been solved numerically and obtain the radial and velocities, temperature, and concentration profiles. The qualitative influence of the above flow parameters on the flow variables has been simulated and graphically presented for comparison. The study reveals that in the shear-thinning fluids, radial and axial velocities increase with solutal Grashoff number, thermal Grashoff number buoyancy parameters, and second-grade fluid parameters. In contrast, the temperature and concentration decrease with the above flow parameters. The Magnetic, Chemical reaction, and porous parameters suppress both radial and axial velocities but enhance the temperature and concentration. A similar impact on flow variables can also be observed for the shear-thinning fluids.

Keywords: Modified second-grade fluid, Similarity transformations, Radial and axial velocities, Mass and heat transfer, Porous media

Abstract No: PO-20

Computational investigation of the effect of natural derivatives of Curcumin as anti-Asthma drugs

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Asthma, a chronic respiratory disease, necessitates long-term control medications to manage symptoms and maintain stable control. However, the search for novel therapeutics with improved efficacy and reduced side effects remains ongoing. This computational study focused on exploring the potential of curcumin derivatives as long-term control medications for asthma. Key molecular targets implicated in asthma pathogenesis, Interleukin-4, Interleukin-13, Nuclear factor kappa B (NF-κB), Tumor necrosis factor-alpha (TNF-α), Signal transducer and activator of transcription 6 (STAT6), Phosphoinositide 3-kinase (PI3K), Transforming growth factor-beta (TGF-β), Peroxisome proliferator-activated receptor gamma (PPAR-γ) and Cyclooxygenase-2 (COX-2), were selected for investigation. A library of Curcumin derivatives was designed, and molecular docking experiments were conducted using Auto Dock 4.2 to predict the binding affinity and binding modes of the derivatives with the selected asthma targets. Montelukast was used as the reference drug, which is a medication commonly used in the long-term control of asthma and the management of seasonal allergies. The results of the molecular docking revealed strong binding affinities of several curcumin derivatives towards the targeted asthma proteins: Nitro-curcumin, Cyclo-curcumin, and Desmethoxycurcumin (DMC). The docking scores and interaction profiles provided insights into the potential mechanisms of action of the curcumin derivatives as long-term control medications. Additionally, analysis of the binding modes offered understanding regarding the key interactions driving the binding process. Molecular dynamics (MD) simulations were performed to investigate the stability and dynamic behaviour of the selected curcumin derivatives in complex with the asthma targets. These simulations enabled the observation of conformational changes, flexibility, and stability of the curcumin derivatives within the binding pockets of the asthma targets over extended time scales. Evaluation of stability was conducted using parameters such as root mean square deviation (RMSD) and root mean square fluctuation (RMSF). The information gained from MD simulations complemented the docking results, offering a comprehensive understanding of the binding modes and stability of the curcumin derivatives. Calculating binding free energies using advanced scoring functions provided by Auto Dock allowed the estimation of binding affinities, aiding in understanding the relative potency and selectivity of the derivatives towards the asthma targets. In conclusion, this computational study demonstrated the potential of curcumin derivatives as long-term control medications for asthma. This computational investigation has allowed for further experimental investigations and optimization of curcumin derivatives as effective long-term control medications for asthma.

Keywords: Asthma, Computational chemistry, Curcumin derivatives, Molecular docking, Molecular dynamics

Abstract No: PO-21

Computational assessment of novel derivatives of Epigallocatechin gallate as potential anti-Tuberculosis agents

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Tuberculosis (TB) is a highly contagious bacterial infection caused by *Mycobacterium tuberculosis*. This research focuses on the computational assessment of novel derivatives of Epigallocatechin Gallate (EGCG) as potential anti-TB agents. Through the utilization of molecular docking studies using AutoDock 4.2 and molecular dynamics (MD) simulations employing GROMACS, this study aims to explore the therapeutic potential of these EGCG derivatives. Specific molecular targets associated with TB, including Pantothenate kinase, UDP-N-acetylmuramoyl-l-alanyl-d-glutamate-2,6-diaminopimelate ligase, 3-oxoacy-(Acyl-carrier-protien) reductase, Decaprenylphosphoryl-β-D-ribose oxidase, Dihydrofolate reductase, Enoyl-[acyl-carrier-protein] reductase (NADH) were selected for investigation. Bedaquiline, an approved tuberculosis medication, was utilized as a benchmark molecule for validation purposes. By conducting molecular docking studies, strong binding affinities were observed between certain EGCG derivatives and the targeted tuberculosis proteins. To gain insights into the stability, dynamic behaviour, and conformational changes, MD simulations were performed using GROMACS, which allowed for extended-time observations of the EGCG derivatives within the binding pockets of the TB targets. Evaluation of stability parameters, such as root mean square deviation (RMSD) and root mean square fluctuation (RMSF) complemented the docking results, providing a comprehensive understanding of the binding modes and stability of the EGCG derivatives. Furthermore, the calculation of binding free energies using advanced scoring functions from AutoDock facilitated the estimation of binding affinities, thus aiding in the assessment of relative potency and selectivity of the derivatives towards the TB targets. The reference drug Bedaquiline, known for its effectiveness against TB, was also included in the comparative analysis. In conclusion, this computational study highlights the promising potential of EGCG derivatives as long-term control medications for TB. The integration of molecular docking, MD simulations, binding free energy calculations, and interaction studies provided valuable insights into the binding affinity, stability, selectivity, and delivery optimization of these derivatives. These findings significantly contribute to the field of computational drug discovery and pave the way for future experimental investigations and optimization of EGCG derivatives as highly effective long-term control medications for tuberculosis.

Keywords: Molecular Docking, EGCG, Derivatives, Tuberculosis, Molecular Dynamics

Abstract No: PO-22

A modified equation for Roche limit for celestial bodies with a fluid-like structure

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The Roche limit is a concept in astronomy that describes the minimum distance that a celestial body (say satellite) can approach another celestial body (say planet) without being torn into small pieces by tidal forces. This happens when the tidal forces generated on the satellite by the gravitational fields of the planet exceed the self-attractional forces of the satellite. If the planet and satellite are of similar chemical composition, the theoretical Roche limit is about 2.5 times the radius of the planet. Generally, two models have been used for the derivation of Roche limit. If the satellite is assumed to be a solid object, the Roche limit is given by $d = 1.22R_p\left(\frac{\rho_p}{\rho_s}\right)^{\frac{1}{3}}$ and if the physical properties of the satellite are akin to those of a fluid, the expression turns out to be $d = 2.44R_p\left(\frac{\rho_p}{\rho_s}\right)^{\frac{1}{3}}$. Here ρ_p and ρ_s are the densities of the planet and satellite, respectively and R_p is the radius of the planet. These equations have been derived in real physical space for the case where the motion of the satellite and the planet are in the same orbital plane, that is both objects must be in the same equatorial plane. But satellites or asteroids orbit different planes or can enter from another plane like Pluto's orbit. Therefore, a new equation for Roche limit for fluid like satellites, when the equatorial plane of the satellite is tilted to the orbital plane was developed using the tidal generating potential equation and self-gravitational potential equation. This equation takes the form $d = 2.423R_p\left(\frac{\rho_p}{\rho_s}\right)^{\frac{1}{3}}\left(\cos^2\alpha - \frac{1}{3}\right)^{\frac{1}{3}}$, where α is the angle between the orbital plane of the satellite and its equatorial plane.

Keywords: Astrophysics, Axial Tilt, Orbital Plane, Roche Limit, Tidal Potential

Abstract No: PO-23

Estimating the optimum plot size for coconut field experiment

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Coconut stands as a prominent plantation crop in Sri Lanka, contributing to around 12% of the country's total agricultural output, as reported by the Sri Lanka Export Development Board (2021). A significant focus should be drawn towards designing the field research with coconut palms because coconut is a highly heterogeneous perennial crop. The efficient testing of treatment effects in field studies depends on experimental precision. On the other hand, coconut crops show considerable vulnerability to weather and spatial fluctuations. Weather fluctuation affects experimental units depending on the degree of severity, enhancing the yield variability within experimental plots. This causes a high experimental error, masking true treatment effects. Therefore, a proper plot size should be used to treat and handle this uncertainty and improve the coconut experimentation. Remarkably, prior to this research, there was no predetermined optimal plot size for agricultural coconut experiments. Thus, this study bridges this need by carrying out extensive research into the optimal plot size for these experiments. Using optimum plot size helps minimize the yield variation between the individual coconut palms inside a plot. The aim of minimizing yield variance among individual coconut palms is to detect the treatment effects in a precise way. Two methods are available to determine the optimum plot size: The Maximum Curvature Method and Fairfield-Smith's variance law. The Maximum Curvature Method was selected to determine the optimal plot size for coconut experiments, as it has been frequently used for plot size determination in various field crops. The study analysed 26 years of coconut yield data from 1975 to 2000. The method was illustrated using a data set consisting of annual coconut yield from a design-free area at the Coconut Research Institute, Sri Lanka. The coconut palms were 16 years old and belonged to a "tall by tall" coconut cultivar. The obtained optimum plot sizes from the Maximum Curvature Method for coconut vary between four and ten palms per plot for 26 different years. According to the post Runs test, the sequence of optimal plot sizes stable over the years at a significance level of 5%. The results showed that the optimum plot size in coconut field experiments for a huge acreage of agroecological regions is six palms per plot. Thus, the disclosed finding can be defined as the optimum plot size for the Randomized Complete Block Design (RCBD). The practical implications of the result are for resource management, precision agriculture, sustainability, and adaptation to changing conditions. It will also contribute to the existing knowledge base by refining agricultural practices and enabling the integration of technology for improved coconut farming. Result consistency will be enhanced by analysing additional similar datasets and employing variograms to examine spatial fluctuations in addition to the statistical analysis.

Keywords: Heterogeneous, Maximum Curvature Method, Plot Size, Randomized Complete Block Design, Treatment effect

Abstract No: PO-24

Estimating COVID-19 prevalence in Sri Lanka

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Throughout the ages, man has had to face numerous crises and diseases. Among them, the COVID-19 virus can be considered as one of the most fatal diseases ever, and it has caused significant damage to the entire world. Moreover, due to the nature of the virus transfer modes, controlling the COVID-19 infection among people is a challenging task, and thereby, the spread of the virus still persists globally with less severity. Hence, an effective and accurate controlling measure is essential. The profile of the coronavirus progression in a sub-region can be changed due to numerous factors such as population density, public mobility, and available health facilities. Thus, at a time, diverse prevalence status of virus spread on different sub-regions is highly probable. This study attempts to construct a suitable sampling design to capture the prevalence of COVID-19 by modifying the stratified sampling technique to estimate the sample size adapting to the changing population of infected cases. This adaptation is essential as the increase of infected cases boosts the virus spread, and the standard sampling techniques do not address such dynamic population conditions in determining the sample size. Further, the study bridges the gap between the reported and actual infections per day, thereby giving accurate estimates of virus distribution and prevalence. The coronavirus progression over a region has a skewed pattern, and it should also be considered in the weight allocation method. Thus, the weights are determined based on the first derivative of reported infected cases. This derivative information is based on the recent dynamics of the infected cases. Consequently, larger weights were assigned when the virus progression increased, and smaller weights were assigned when the virus progression decreased. After that, the sample size for each sub-region was calculated by the modified stratified sampling method. To illustrate the accuracy of the sampling design, simulated data from different epidemic scenarios, such as community spread, cluster spread, and border spread, was used. This simulation allowed us to test the robustness of the techniques for the different states of the virus progression based on the infected cases. The sample size obtained through this dynamic sampling technique exhibits a direct correlation with the fluctuations in the number of infected cases, increasing as the infection cases rise and decreasing as they decline. In conclusion, the study results in a novel sampling technique that is sensitive to the dynamic nature of population sizes, and it can be straightforwardly applied to real-world data as well. Thus, this modified stratified sampling technique can be considered as an accurate sampling technique to capture the actual prevalence of COVID-19.

Keywords: Community spread, COVID-19, Epidemic scenarios, Stratified sampling technique, Virus progression.

Abstract No: PO-25

Designing a high-performance parametric speaker system: simulation and optimization

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The parametric speaker is designed to direct omnidirectional sound waves towards a specific target. Over the past two decades, numerous research studies have been conducted to optimize parametric speaker systems, with a focus on enhancing audio quality and extending the range of sound propagation. The objectives of this research include the enhancement of the audio quality, the reduction of total harmonic distortion through modulation techniques, and the amplification of the modulated output to increase the effective hearing distance. These goals were pursued alongside the development of a properly designed ultrasonic transducer array circuit, a critical component of a parametric speaker system. Prior to the conception of the novel parametric speaker system, a comprehensive simulation study was conducted using the commercially available COMSOL Multiphysics software. For this study, the Pressure Acoustics, Frequency Domain (acpr) interface, the Solid Mechanics (solid) interface, and the Electrostatics interface were utilized. The principal aim of this simulation study was to analyse the minimal electric potential required for an ultrasonic transducer element to generate a directional sound wave capable of propagating over a one-metre distance. To achieve this, a PZT-5H piezoelectric element with a stacked aluminium metal diaphragm was constructed. The electric potential across the piezoelectric plate was step by step varied from 5 V to 100 V. Polar plots illustrating the sound pressure level of ultrasound propagation in the air domain at a distance of one-thousand-four-hundred millimetres from the source were generated for each simulation. The simulation model of the piezoelectric element was meticulously constructed after a thorough examination of a cross-sectional cut of an ultrasonic transducer and the arrangement of layers within the metal cover. This model adopted a two-dimensional (2D) axially symmetric space dimension. This approach leveraged the rotational symmetry of the elements to simulate in 3D, thereby reducing simulation complexity. The analysis revealed that when the electric potential was below 10 V, the sound pressure remained below 60 dB. However, upon increasing the electric potential to above 60 V, although the expected directionality was achieved, distortions adversely affected the output signal. Such sound propagation characteristics were deemed unsuitable for a parametric speaker system. Upon analysing the polar graphs generated for a 30 V electric potential, it was evident that directionalized sound pressure levels in the air were achieved with minimal distortions compared to other simulated systems. Consequently, a 30 V electric potential was selected as the amplified signal voltage peak-to-peak for application to the designed ultrasound speaker. This approach was undertaken to ensure optimal performance and minimize distortion in the parametric speaker system.

Keywords: Parametric Speaker, Ultrasonic Transducer, piezoelectric, total harmonic distortion, COMSOL Multiphysics

Acknowledgment
This research will be supported by the Accelerating Higher Education Expansion and Development (AHEAD) Operation of the Ministry of Higher Education of Sri Lanka, funded by the World Bank.

Abstract No: PO-26

Identification of factors leading to elephant deaths in human-elephant conflicts

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Human-elephant conflicts (HEC) have emerged as one of the main challenges that Sri Lanka faces throughout several decades. According to the official data of the Department of Wildlife Conservation (DWC), the number of elephant deaths is higher than the number of human deaths due to HEC per year. This research focused on the North Central Province, where the highest number of elephant deaths have been recorded. Hence, the objectives of this research are to identify the main factors that have affected the deaths of elephants and to identify suitable models to predict the causes of elephant deaths due to human-elephant conflict. Although there has been much research related to HEC worldwide, no published research studies were found in the literature that utilized advanced statistical techniques such as Multinomial Logistic Regression (MLR), LASSO regression, Decision Tree (DT), Support Vector Machine (SVM), and Probabilistic Neural Network (PNN) for their studies. However, this research will address that research gap by constructing models for classifying the causes of elephant deaths resulting from HEC. Data was collected from various departments, including DWC, the Department of Meteorology, and the crop calendar of the Department of Agriculture. Furthermore, Pearson's Chi-square and Fisher's exact tests were used to identify the association between the cause of death and influencing factors. Five variables, including the elephant age group, grass levels, gender, rainfall season, and place of death, were found to significantly influence the causes of death of an elephant. MLR and Data Mining (DM) techniques were initially utilized, but due to multicollinearity arising in MLR, the LASSO technique was employed as a remedial method. To overcome the class imbalanced problem, 90% of the data were randomly selected for model building while maintaining the class ratio of the response variable, and the remaining 10% of the data were used for testing. Performance measures, overall classification accuracy (OCA), and Misclassification Percentage of Critical Cases (MPCC) were used to evaluate and compare the classification potential of models. Models such as final MLR, LASSO, DT, SVM with Polynomial and Gaussian Kernels, and PNN with spread 0.801 illustrated 42.30%, 50%, 53.84%, 69.23%, 73.07%, and 73.07% of OCA. In addition, the above models showed 34.61%, 30.76%, 7.69%, 11.53%, 19.23%, and 26.92% MPCC respectively. Finally, the SVM model with Gaussian Kernel exhibited high OCA (73.07%) with 19.23% of MPCC as the better model since the PNN showed a high MPCC of about 26.92%. These findings will be helpful for authorities in their future and existing projects.

Keywords: Causes of Elephant Death, Multinomial Logistic Regression, LASSO Regression, Data Mining Techniques

Abstract No: PO-27

Solutions of singular Sturm-Liouville problems using exponential integrators

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Sturm-Liouville problems play a major role in the fields of applied mathematics, physics, and engineering. Therefore, the solutions of SLPs are particularly influential in these study areas. In the mid-1830s, the French mathematician Charles-François Sturm and Joseph Liouville worked independently on the problem of heat conduction through a metal bar, developing techniques for solving a large class of partial differential equations (PDEs) in the process and the study of this Sturm-Liouville problem originated. In combination with Magnus expansion, the Lie group method is used to develop an algorithm to solve the Sturm-Liouville Problem with an arbitrary set of boundary conditions. This study concerns singular Sturm-Liouville problems and their solutions. We use Magnus expansion method, which is an exponential integrator that use the exponential function of the Jacobian for the numerical integration of the problem. The coefficients of the Magnus expansion method of 6^{th} -order were derived using two-point Gaussian Quadrature rule and Lagrange interpolation method. To validate and assess the accuracy and the performance of the method, the results were compared with the analytical solution and the 4^{th} -order method for a particular singular SLP. It was observed that the absolute and relative error values given by the 6^{th} -order method are almost comparable with those of the 4^{th} -order with slight variations which can be attributed to the rounding off errors. As expected, the complexity of the 6^{th} -order method is slightly high as the floating point (FLOPS) count shows. In conclusion, the accuracy of the 4^{th} and 6^{th} order methods are the same although the complexity of 6^{th} -order method is slightly higher. In future work, it is expected to improve the 6^{th} -order method by using the properties of Lie brackets and using different quadrature rule for the integrals.

Keywords: Singular Sturm-Liouville problems, Magnus expansion, Two-point Gaussian Quadrature rule

Abstract No: PO-28

A novel method for spectrophotometric detection of Glyphosate using a simple terpyridine-based Zn complex

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Glyphosate (*N*-[phosphomethyl] glycine, GLP) is an organophosphorus and widely applied as an herbicide. Also, it is a non-selective, effective, and broad-spectrum herbicide. Nevertheless, excessive use, misapplication, and residue of glyphosate adversely affect the environment. Therefore, it is very important to detect the glyphosate in environment samples. The current techniques for detection of glyphosates include chromatographic methods and spectrophotometric methods. However, these methods still confront many challenges such as complexity, requirement of sample preparation, time consuming, and low sensitivity. Thus, there is an exclusive need of a rapid and high sensitive system for detection of glyphosate. Therefore, in the present study, a simple terpyridine-based Zinc-complex (Zn-GLP) was successfully employed for the detection of GLP. 2,2':6,2"-Terpyridine is a tridentate ligand which contain three coordination sites belonging to three *N*-heteroaromatic rings. A range of applications of terpyridine based compounds has been reported including catalysis, supramolecular chemistry, medicinal applications, and as sensors. The capability of metal-terpyridine as a sensor is least studied for Glyphosate. A 4-functionalized terpyridine ligand, 4-(4-*N*,*N*-dimethylaminophenyl)-2,2':6,2"-terpyridine was synthesized through the Krohnke reaction by condensation of 2-acetylpyridine with 4-Dimethylamino-benzaldehyde followed by oxidation under ammonium hydroxide and finally a green colored solid was obtained in yield 54% . This product was recrystallized with ethanol to obtain the ligand in pure form. Then its Zn-complex was synthesized by treating 4-(4-*N*,*N*-dimethylaminophenyl)-2,2':6,2"-terpyridine ligand with $ZnCl_2$ in methanol. The ligand and Zn-complex were fully characterized by a combination of 1H NMR spectroscopy, UV-Vis spectroscopy, FT-IR spectroscopy and Fluorescence spectroscopy. The UV-Vis spectrum of Zn-complex exhibited bands at 240 nm, 285 nm, 315 nm, and a characteristic band at 410 nm. GLP content was tested at 410nm using UV-visible spectroscopy with method LOQ 18 ppm GLP, LOD 18 ppm GLP and the method sensitivity was found to be 10 ppb. Here, the yellowish colour of solution of Zn-terpyridine in methanol instantly disappeared when the concentration of added Glyphosate was above 1 ppm, and this could be observed in naked eye. Therefore, this work evident the Zn-terpyridine complex as a novel method for the detection of GLP.

Keywords: Glyphosate, Spectrophotometry, Terpyridine, Detection

Abstract No: PO-29

Exploring the best procedure for estimating extreme quantiles: a case study

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The investigation of extreme events within the insurance sector holds significant importance as it aids in evaluating the potential risk associated with such occurrences in the future. These events, including natural disasters, fires, and other unforeseen incidents, often lead to substantial insurance claims. The conventional Peak-Over-Threshold (POT) approach offers a solid theoretical basis for examining extreme claims risk. Nevertheless, this method is hindered by limited tail data. To address this limitation, the folding procedure, an improved POT approach, was introduced by the researchers as an alternative which effectively generates a larger tail sample. The objectives of the study were to compare and select the best procedure for estimating the extreme quantiles of the fire claims distribution. The study utilized daily fire claim data collected throughout the year 2021 from a leading insurance company in Sri Lanka. In the conventional POT approach, the excess values over a high threshold are modelled as a Generalized Pareto distribution (GPD). Unlike the conventional approach, the folding procedure involves folding data points below the threshold to values above it, prior to modelling the excesses as the GPD. The rule of thumb method was used to determine the threshold for both procedures. Additionally, to address the issue of limited tail data, the conventional POT approach was employed with various parameter estimation methods, including Maximum Likelihood Estimation (MLE), Probability Weighted Moment Unbiased (PWMU), and Biased (PWMB) methods, to estimate the parameters of the GPD, which are available in R software. However, for the folding approach, only the Maximum Likelihood Estimation (MLE) method was utilized, as it has been found to accurate, when a large sample is available for estimation. Finally, the accuracies of extreme quantile estimates obtained from the GPDs fitted through both procedures were compared using the Mean Squared Error (MSE) values. The method with the minimum MSE was selected as the best. The study unveiled a heavy-tailed distribution of fire insurance claims during the study period, exhibiting skewness and kurtosis values of 8.89 and 91.7 respectively. Furthermore, the folding procedure yielded a smaller MSE value (1.14), in contrast to the MLE based conventional POT method (1.26). However, the conventional POT approach with PWMB and PWMU exhibited more accurate estimation (MSE=0.30 and 0.38, respectively) than the folding procedure with MLE. In conclusion, the conventional POT method with PWMB was found to be the superior procedure for estimating extreme quantiles of the fire claims distribution, as compared to the folding procedure with MLE. This information would assist in implementing effective risk management strategies to mitigate financial impacts stemming from future extreme claims.

Keywords: Claim, Extreme value, Insurance, Risk

Abstract No: PO-30

A quantitative characterization of sector-wise performance interdependencies in stock market using changepoint and performance-induced distant clustering

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The Colombo Stock Exchange (CSE) is the Sri Lankan marketplace for companies to trade their stocks to the public. There are 19 sectors in the CSE before the Global Industry Classification Standard (GICS) classification. The stock market has become a significant icon in most of the country's economy. Due to the enhancement of the data science discipline, quantitative research on the stock market has gained popularity among scholars in the recent past. Most of the studies were conducted to predict the value of a stock and its volatility. However, this study explored potential performance dependencies among the 19 industrial sectors registered at the CSE. In known literature, this scope has not been addressed quantitatively. The sectorial All Share Price Index (ASPI) is used to characterize the sector interdependencies, as the volatility of ASPI implies the sector performance at a given time or a short period. Because diverse sector movements can offset each other, leading to a stable index, while extreme sector-specific events or trends can result in increased index volatility. The ASPI indices published by CSE from 2005 to 2019 were considered in the analysis. The persistency of ASPI volatility in a compact interval indicates the consistency of the performance in each sector. Thus, the comparison of volatility changes and their changing time, i.e., changepoint analysis, describes the changes in the sectorial performances. Consequently, the interdependencies among the sector-wise performances can be recognized by the emerging patterns of the changepoints, i.e., the clustered behaviour of the changepoints. Through this approach, the investigation seeks to identify significant transitions or shifts in the behaviour of each sector. Non-parametric methods were employed in the identification of the changepoints of the ASPI series. The standard clustering approaches could not be utilized in grouping the changepoints as the clustering metrics defined by the variation of performances are interconnected. Thus, a new clustering approach was developed using a cluster performance-induced distant measure defined based on a reference industrial sector. This analysis resulted in interdependency among the industrial sectors. Further, variation patterns among the changepoints were identified using interval scaling, and dependent industrial sectors were identified with the help of the performance-induced distant clustering approach. For example, the Bank Finance & Insurance, Telecommunication, and Trading sectors exhibited strong interdependencies. Also, the Construction & Engineering, Oil palms, and Hotel & Travels sectors exhibited strong interdependencies. So far, in qualitative relations, these interdependencies were merely recognized by the gut feelings of financial analysts. Nevertheless, this study provides a clear quantitative characterization of performance dependencies, and thus, the findings are crucial for determining investment strategies and minimizing risk in stock exchanges.

Keywords: Change-point, Clustering, Colombo stock exchange, Industrial sectors, Time series analysis

Abstract No: PO-31

Exploring data mining avenues in β-Thalassemia carrier identification

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Thalassemia is a genetic blood disorder that affects the production of haemoglobin and is a global health problem. In comparison to many other nations in the region, Sri Lanka also has a high prevalence of thalassemia. The traditional methods for identifying thalassemia carriers, such as genetics and blood tests, are expensive and time-consuming and may not be available to all demographic groups. Nevertheless, the use of data mining models for thalassemia carrier detection is still in its infancy, and there are few studies on its efficacy. Therefore, it is vital to investigate the efficacy and accuracy of data mining approaches for detecting thalassemia carriers, as well as the viability of employing these methods in clinical practice. Thus, the objective of this study is to develop a time-efficient model to detect the β-thalassemia carriers, which can reduce the time to take a decision and develop the built model as a decision support tool. Also, the earlier detection will help individuals to refer to necessary treatments further. This study is carried out with the data obtained from Hemal's Adolescent and Adult Thalassemia Care Centre, Mahara, one of the treatment centres for thalassemia. As the study population, 343 individuals' data values were considered from August 2019 to December 2019. When processing the dataset, 112 (36%) individuals were declared as β-thalassemia carriers, whereas 200 (64%) were identified as β-thalassemia non-carriers. Eight blood parameters, such as RBC, HGB, HCT, MCV, MCH, MCHC, RDW and HbA2 were identified by revealing the literature and the Chi-square and Mann-Whitney U tests were used to identify the association between the variables at 5% level of significance. A random over-sampling technique was used to overcome the class-imbalanced problem in the dataset, and based on that, model fitting was performed under the two data selection methods, i.e., Method 1: Model fitting before handling the class imbalance problem and Method 02: Model fitting with random over-sampling technique. Then 80% of the data was used for training the models, and 20% of the data was used for the evaluation. Support Vector Machine (SVM) and Probabilistic Neural Network (PNN) models were used to detect the β-thalassemia carriers. In comparison among methods, the better-performing models were given under Method 2, and the PNN model fitted under Method 2 (PNN Model 2) exhibits 98.75% overall classification accuracy. Here, the PNN model's network architecture consisted of eight nodes in the input layer, 320 nodes in the pattern layer, two nodes in the summation layer, and two nodes in the output layer. Further, the fitted PNN Model 2 can be utilised as a cost-effective and time-saving option to detect β-thalassemia carriers in a few seconds with acceptable accuracy and can be implemented as a decision support tool. However, it is recommended to get advice from a medical doctor for further investigation.

Keywords: Class-imbalance, Support Vector Machine, Probabilistic Neural Network, β- thalassemia carriers

Abstract No: PO-32

Energies of graphs by means of splitting and shadow graph operations

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Chemical applications of graph theory were presented by Hückel in his molecular orbital theory. In mathematical chemistry, the skeleton of non-saturated hydrocarbon is represented by a graph which is called the molecular graph. The energy levels of electrons are eigenvalues of the graph, and the strength of particles is closely identified with the spectrum of its graph. The sum of the absolute values of eigenvalues of the adjacency matrix of a simple, finite, and undirected graph G was defined as the energy of G. After the success of this theory, numerous various graph energies were introduced, using different matrices other than adjacency matrix, such as Laplacian energy and Randić energy from Laplacian and Randić matrices respectively. Applications of graph energy appeared in quantum chemistry to determine different characteristics of molecules. Graph energy is related to π-electron energy of a molecule, the generalized ABC energy is related to the polarization of bonds in a molecule, and the harmonic energy is a useful tool in predicting the boiling point, heats of vaporization, surface tensions and critical temperature of alkanes with high correlation coefficient values. There are many graph operations such as graph union, graph intersection, graph join, that can be used to obtain different graphs from a given graph. In this study, splitting and shadow graph operations will be discussed. These two graph operations enable us to acquire bigger graphs from a given graph. The objective of this research is to find generalized ABC energy, sum-connectivity energy and harmonic energy of much bigger graphs acquired from the given graph using the above graph operations. This allows us to obtain ABC energy, sum-connectivity energy and harmonic energy of bigger graphs using those energies of rather small graphs. Direct relationship between the original graph various energy and the relevant energy of the larger graph can be observed from the results. In this research, ABC energy of the splitting graph and shadow graph of any k-regular graph, and the sum-connectivity energy and harmonic energy of the shadow graph of any graph were obtained. These results were novel and verified through the simulations.

Keywords: Generalized ABC Energy, Harmonic Energy, Sum-Connectivity Energy, Splitting Graph, Shadow Graph

Abstract No: PO-33

A comparison of distance-based and model-based clustering methods

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Most of the statistical techniques assume the homogeneity of the sample data. However, not all the time, real-world samples are homogeneous. The existence of subgroups within a population leads to the non-homogeneity of the sample. In this case, it is not accurate to model the population using a single probability distribution. Hence it is essential to check the homogeneity of the sample. Clustering, an unsupervised learning technique, is being used to discover a population's subgroups and group each observation into a specific cluster. Mainly, clustering algorithms can be divided into two groups, namely model-based and distance-based algorithms. Model-based algorithms assume a probability distribution for clustering, while distance-based algorithms use a distance metric to classify observations into clusters. In the literature, it was suggested that the model-based clustering methods perform better than the distance-based methods using summary statistics and visualizations. In this study, an inference-based procedure has been used to assess the above claim. To compare the performances of model-based and distance-based algorithms, an extensive simulation study was conducted. In the simulation study, two univariate Gaussian mixtures with different parameter settings (mean, standard deviation, and sample size) were combined to generate a non-homogeneous sample. Then, model-based and distance-based algorithms were applied to the same simulated datasets with different cluster structures, knowing the actual cluster memberships. Further, the effect of bimodality conditions of Gaussian mixtures on both clustering methods was checked. To assess the performance of the two methods, identifying the correct number of clusters, Cluster Identification Ability (CIA), and categorizing the observations into the correct cluster memberships (clustering accuracy) were computed. CIA was computed using the percentage of iterations that identified the correct number of clusters, and clustering accuracy was measured using the Adjusted Rand Index (ARI). For most of the simulation settings, both methods required a sample size of less than 200 to achieve high clustering accuracy (approximately mean ARI value of 0.8). For example, a simulation setting with a mean difference of 3.1 and a standard deviation of 0.5 required sample sizes 20 and 10 for the model-based and distance-based methods, respectively. These minimum sample sizes vary depending on the method's high clustering accuracy, and in some cases, those are approximately the same. The inference-based study which is performed using the paired Wilcoxon signed-rank test indicated that the claim “model-based method outperforms distance-based method, or both performs similarly” is valid 82.7% of the time at a 5% level of significance. In conclusion, the CIA and clustering ability of the model-based method increased with the increment of sample size when the bimodality conditions were satisfied by the mixture. For the distance-based method, both abilities decreased as the sample size increased when the bimodality conditions were not satisfied by the sample.

Keywords: Non-homogeneity, Clustering, Model-based, Distance-based, Gaussian-mixtures.

Abstract No: PO-34

A quantitative analysis of fishery industry in modelling of production, trade dynamics, and COVID-19 impact estimation

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Sri Lanka, being an island, is granted an immense maritime boundary. The fishery industry is a prominent and significant part of the Sri Lankan economy, contributing around 1.5% of the Gross Domestic Product. The objectives of this research are to identify the factors affecting fish production, analyse the Net Trade Balance (cost difference between import and export of fishery products) in the fishery industry, and estimate the impact of COVID-19 on fish production. The monthly data from 2015 to 2022 is taken from the Statistics unit of the Ministry of Fisheries, Sri Lanka. This data is analysed, and the findings revealed that fish production in the country had decreased significantly over time, and thereby, it has impacted the import quantities as well. Further, almost 80% of the total fish production of the country is contributed by marine fish production and 20% by inland fish production. The variations in fish production are largely caused by the inland fish harvest; that is marine fish production has monotone dynamics. Concerning the seasonal pattern, less production is visible during May and June due to the monsoon. However, a clear upward trend in the inland fish harvest is visible during this time due to the renewal of freshwater. According to a recent survey in the Indian Ocean, the decrement in the fish population and habitats contributed to the lower harvest of fish production. Further, it has been identified the factors of fuel prices, fishing gear costs, ice cube prices, and unauthorized fish catch by foreign fishermen, as the other affecting factors in fish production. Concerning fisheries export, Tuna fish and prawns play a vital role in the export market. Despite the marine resources, Sri Lanka still imports fisheries products by spending foreign remittances. The Net Trade Balance (NTB) of fisheries products in Sri Lanka is investigated in this research and modelled by multiple linear regression models (net trade balance as the response variable, and harvest of 10 fish types as independent variables, based on significance) for pre and post, COVID-19 pandemic conditions. Further, the models can accurately predict the NTB (Pre-COVID model R^2 = 72.4%, post-COVID model R^2 = 80.6%). This model can be used in policy and strategy analysis by respective authorities such as the Ministry of Fisheries, Sri Lanka. Using the time series methods (Moving Average, Exponential Smoothing, and SARIMA), fish production is analysed. Combining these models, the impact of the COVID-19 pandemic on fish production from February to August 2020 is estimated at 15.81%. In conclusion, this research identified the fish production patterns, COVID-19's impact on production, and a model to estimate NTB, which also can be an analytical tool for the policymaking of the fisheries industry.

Keywords: Export, Import, Inland, Marine, Regression Analysis

Abstract No: PO-35

Atmospheric chemical composition of bulk precipitation of selected areas of Galle District.

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The quality of the atmosphere refers to its composition and the presence of pollutants, while precipitation can have direct effects on the quality of the atmosphere. Both wet and dry deposition contribute to the removal of pollutants and particles from the atmosphere. Therefore, it is very important to collect data on the chemical composition of the atmosphere to identify air pollution and its causes and to control air pollution. This study focuses on the chemical composition of precipitation in selected areas of Galle district, one of the most urbanized districts in the southern province. Wet precipitation samples were collected from three industrial sites, Unawatuna, Bataduwa, Koggala and the Sinharaja rainforest area of Lankagama, the country's last viable area of primary tropical rainforest. Wet precipitation samples were collected from September 2022 to February 2023, which covers the South-West monsoon, Second inter-monsoon, and North-East monsoon seasons and a total of 40 samples were analysed for pH, conductivity, Na^+, K^+, Mg^{2+}, Ca^{2+}, NH_4^+, Cl^-, F^-, Br^-, SO_4^{2-}, NO_3^-, Cu, Pb, Ni, Cd, Fe, Al, Zn, C, and Mn. Based on VWM (Volume Weighted Mean) pH values Unawatuna (6.95±0.6), Bataduwa (6.69±0.8) and Koggala (6.8±0.3) sites had slightly alkaline pH values, while the control site Lankagama-Sinharaja (5.73±0.02) had slightly acidic pH. The volume-weighted average concentrations of major ionic species in the precipitation samples from the industrial sites were in the order $Na^+ > Cl^- > SO_4^{2-} > Ca^{2+} > NO_3^- > NH_4^+ > K^+ > Mg^{2+} > Br^- > F^-$, while the control site followed the order of $Na^+ > Cl^- > SO_4^{2-} > Ca^{2+} > NH_4^+ > K^+ > NO_3^- > Mg^{2+} > F^- > Br^-$. The neutralization factor (NF) for Na^+ ions indicates that higher Na^+ concentrations contribute to the neutralization of acidic components at the Unawatuna, Koggala and Lankagama sites. When considering the marine contribution, The Enrichment Factors (EF) calculated for SO_4^{2-}/Na^+, Ca^{2+}/Na^+ and Mg^{2+}/Na^+ ratios were higher than the reference value, suggesting that several anthropogenic sources other than marine may be contributing. Among metallic constituents, Zn and Al concentration were higher at all sites except the Koggala site, which had higher Fe content. Pb and Ni concentrations were below the detection limit of ICP-MS at all sampling sites. This study confirmed the relationship between atmospheric chemical composition and nearby anthropogenic and natural sources, as well as the indirect relationship between rainwater analysis and air quality in a given region. Furthermore, the precipitation data from Sinharaja demonstrates the absence of pollution, further solidifying its reliability as a backdrop.

Keywords: Chemical composition, Wet precipitation, Tropical rainforest, Industrial sites

Abstract No: PO-36

Symmetric key encryption and decryption using graph theory

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In the twenty-first century, mathematical proficiency is crucial due to the widespread exchange of data and efficient communication across diverse fields. Data security employs encryption and various mathematical techniques to protect information systems. It safeguards against unwanted access, use, and damage. Graph theory is widely applied in the field of cryptography because a graph can be easily represented as a matrix on computers. The goal of this study is to make a novel connection between private key cryptography and graph theory principles that will safeguard data from unauthorized parties. In the encryption process, the original texts are converted into ciphertext by representing a splitting graph and using a minimum spanning tree, then computed into an adjacency matrix of ciphertext and partitioned it into a block matrix. Finally, obtained the resultant ciphertext using the receiver's private key. The decryption process follows a similar stage in reverse order. This suggested encryption algorithm demonstrates a new scheme for more complexity and security. The resulting ciphertext size is larger than the plaintext size and checked its validity.

Keywords: Cryptography, Decryption, Encryption, Graph Theory, Symmetric key Cryptography.

Abstract No: PO-37

Convective heat transfer through a pipe with mixed boundary conditions

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Convective heat transfer is crucial in various engineering applications, particularly in systems involving fluid flow through pipes. Understanding the heat transfer characteristics in such systems is essential for optimizing thermal performance and ensuring safe operation. The study of convective heat transfer through a pipe with mixed boundary conditions is significant for several reasons. It represents a more realistic representation of many industrial systems, where different pipe sections may experience diverse thermal environments. Also, accurately predicting heat transfer parameters under mixed boundary conditions is essential for designing and optimizing thermal systems, ensuring adequate heat dissipation or heat transfer efficiency. This study investigates convective heat transfer through a pipe with mixed boundary conditions: constant heat flux and variable wall temperature boundary conditions to examine the impact of temperature-dependent thermophysical properties on hydrodynamic and heat transfer characteristics. By conducting computational fluid dynamics (CFD) simulations, the velocity and temperature behaviours of the fluid are analysed under combinations of constant heat flux and variable wall temperature boundary conditions. The effects of fluid parameters are investigated to assess their influence on heat transfer performance. CFD analysis in COMSOL Multiphysics is carried out by coupling the continuity, momentum, and heat equations to determine the velocity and temperature profiles for a three-dimensional incompressible, steady, viscous laminar flow through a pipe with a diameter of $0.25m$ and length of $1m$. The mixed wall boundary conditions: linear temperature ($0.5m \leq z \leq 1m$) and constant heat flux ($z < 0.5m$) were considered. The results show that velocity reduces with increasing values of viscosity and magnifies with increasing values of density and volume expansion coefficients. Moreover, the temperature reduces with the increasing value of density.

Keywords: Convective heat transfer, CFD analysis, Laminar flow, Viscous flow, COMSOL Multiphysics

Abstract No: PO-38

Analysis of the interrelationship between weather parameters in Colombo area

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Colombo serves as the administrative, legal, and primary urban hub of Sri Lanka in terms of population. Its metropolitan vicinity houses around 5.6 million residents, with 752,993 within the Municipality. The city of Colombo is renowned for its tropical climate, characterized by consistently high average temperatures, substantial annual rainfall, and other meteorological factors. This study attempted to investigate the variations in the weather parameters and to model the interdependencies among those variables. The correlations of five weather parameters between January 2007 and May 2022 were analysed based on the monthly data collected from the Department of Meteorology in Colombo area. Rainfall, Minimum Relative Humidity, Maximum Relative Humidity, Wind Speed, and Temperature were considered in this study. Investigation of the correlation among various weather parameters holds paramount importance in understanding the intricate dynamics of Colombo's climate. A seasonal pattern was found in Minimum Relative Humidity, and high fluctuations were observed in Wind Speed and Rainfall out of the five weather parameters under study. Further, the study concluded that there is a moderate positive correlation ($r = 0.5$) between Rainfall and Minimum Relative Humidity and as well as between Rainfall and Maximum Relative Humidity ($r = 0.7$). A moderate negative relationship ($r = -0.5$) between Wind Speed and Maximum Relative Humidity is also found in this case study. In this research, vector autoregressive (VAR) models were employed to capture the relationships among weather parameters which indicated the presence of Granger Causality. According to the Granger Causality test it was found that Minimum Relative Humidity can be used in predicting the other four parameters i.e., Rainfall, Maximum Relative Humidity, Wind Speed, and Temperature. Maximum Relative Humidity can be used in predicting the Minimum Relative Humidity, Wind Speed, and Temperature. Also, Wind Speed can be used in predicting all other four weather parameters concerned in this study. It has been found that monthly average Temperature has the potential to serve as a predictive factor for all three of the weather parameters except Wind Speed under consideration in this investigation.

Keywords: Correlation, Cross Correlation, Granger Causality, VAR Model

Abstract No: PO-39

Study on tension detection and acceptance of glove liners

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The glove industry plays a leading role in the Sri Lankan economy. The quality of the final product is crucial when it comes to mass production. A significant shrink or extension of a glove can cause great losses to the company by increasing the number of defective products. The dimensions of knitted liners vary due to various factors in the knitting process. In finding a solution to this problem, the Six Sigma "DMAIC" approach is being used. This research investigated how the tension of the main yarn and yarn conditioning time affect liner dimension changes in a controlled temperature and humidity level. As for finding the dimension changes, the total length, cuff length, and the cuff width of the liners were considered. Relevant data was gathered from a leading glove manufacturing company in Sri Lanka. The Randomized Complete Block Design with 9-12 replicates, considering yarn conditioning time as blocks and tension ranges as treatments, was set up. Analysis of Variance suggested that there is a significant difference among the population means in all three dimensions. Hence, a multiple comparison test (Tucky's test) is used to compare means. The results confirmed that the changes in yarn conditioning time had a significant impact on total length and cuff width. Nonetheless, factorial designs suggested that the interactions of tension and yarn conditioning time had a significant impact on the dimensions of knitted glove liners. As the tension increased, the length of the liners decreased. As tension levels increased, cuff lengths began to shorten. In contrast, the increase in tension of the main yarn caused the cuff widths to lengthen. Low-conditioned yarns contained significantly different dimensions than the rest of the liners knitted with yarns that had been conditioned for at least 24 hours. Generally, industries determine the optimal tension values of the main yarn manually using test gloves, which is time-consuming and costly. As a solution, this research used statistical modelling concepts, which aided in the development of a model to predict the level of tension required when the relevant liner length parameters and conditioning times were provided. Multiple linear regression and data mining techniques were used, and the models were compared. By having the lowest Root Mean Square Error, the Generalized Regression Neural Network (GRNN) outperformed the regression model and decision tree model. The error of the implemented GRNN model is 0.1521, and the independent variables explained more than 90% of the mean tension.

Keywords: Glove liners, Randomized Complete Block Design, Generalized Regression Neural Network, Tension, Yarn

Abstract No: PO-40

Optimising energy efficiency in a PV-enabled base transceiver station

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The need for green energy sources has become paramount in the modern world due to the environmental hazards of non-green alternatives. Essential services, including the telecommunication industry, must also align with this goal. As foundational elements of the telecommunications network, base transceiver stations offer a ripe opportunity to integrate green energy solutions. However, the prevalent scenario reveals that many of these stations continue to rely on conventional grid-based power sources, with only a limited fraction equipped with standalone photovoltaic (PV) systems. This study addresses a pressing challenge in integrating standalone PV systems with base transceiver stations. Central to this challenge is the conundrum of power generation backups, specifically during the morning hours, when the battery reserves charged by the PV systems are frequently depleted. This operational gap necessitates the deployment of supplementary power generators, imposing substantial operational costs that diminish the cost-efficiency advantages anticipated with the introduction of PV systems. The methodology involved a detailed analysis of the selected base transceiver station's total DC power consumption patterns from 15th May 2023 to 21st May 2023. These insights guided the design of an efficient energy harvesting system enriched with a supercapacitor-battery hybrid energy storage arrangement. A Maximum Power Point Tracking (MPPT) controller was acquired to optimise system performance; its effectiveness was verified through efficiency calculations and PV array emulator Irradiance Profiles, and its efficiency exceeded 90%. An intelligent power management strategy was implemented, automatically switching to consume supercapacitor (SC) energy when the voltage level exceeds a threshold, conserving battery bank energy, ensuring uninterrupted operation, and extending battery lifespan. The prototype's operational modes, including neutral, SC charge recovery, and SC bypass, have been successfully demonstrated. Results indicate that the suggested photovoltaic system prototype effectively tracks the PV array's maximum power point (MPP), comparable to standard systems using traditional MPPT algorithms. This novel system promises to not only obviate the need for extensive generator backups but also potentially reduce their capacity compared to conventional configurations. Realising a green energy-powered telecom network is a vast and complex process, demanding guaranteed performance and cost-effectiveness for a period of at least about 15 years. This research marks a significant milestone in advancing green energy solutions and highlights the crucial role of base transceiver stations in establishing a sustainable telecommunication infrastructure. Embracing eco-friendly technologies is essential in safeguarding our planet and ensuring a brighter future for generations to come.

Keywords: Base Transceiver Station, Energy Harvesting, PV Systems, Supercapacitors

Acknowledgment
This work was supported by the internal research grant of the University of Kelaniya, Sri Lanka, under the research grant no. (RP/03/02/05/01/2023).

Abstract No: PO-41

Qualitative and quantitative analysis of the dengue fever model with reference to the data obtained from Sri Lanka

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Dengue is a rapidly emerging pandemic disease in many parts of the world, especially in tropical and non-tropical areas. The dengue outbreak has a multisectoral impact on the medical, societal, economic, and political sectors. The main economic impact of dengue is due to production costs. Lower-income groups may be more vulnerable to dengue and may also bear a higher financial cost as a result of it. Moreover, once a family's primary wage worker contracts the sickness, the lost productivity that results from the illness puts a financial strain on the family. This affects the household's ability to pay for treatment. Resource-poor countries are particularly hard hit because of inadequate public health infrastructure, lack of resources to combat the vector, and limited health care services to manage cases. Dengue incidence has increased in Sri Lanka over the past 20 years, with deaths and illnesses increasing disproportionately among adults compared to children. Dengue fever is caused by Dengue virus, first recorded in the 1960s in Sri Lanka. Aedes aegypti and Aedes albopictus are both mosquito species native to Sri Lanka. In this study, a SIR model for the human population and SI model for the vector (mosquito) population with a constant treatment function is considered to describe dengue transmission. The equilibrium points and the basis reproduction number (R_0) are computed. It is emphasized that reproduction number affects the asymptotic stability for both endemic and disease-free equilibrium points. The conditions leading to the disease-free and endemic equilibrium are determined. The eigenvalues of the Jacobian matrix corresponding to the reduced system are used to demonstrate the local stability for the equilibrium points, and the Lyapunov function theory is used to assess the global stability. When $R_0 \leq 1$, the disease-free equilibrium point exhibits global asymptotic stability. But as $R_0 > 1$, the endemic equilibrium point becomes globally asymptotically stable. Based on actual data gathered from the Institute of Epidemiology Unit Ministry of Health in Sri Lanka, the parameters for infection and disease-related death rates are estimated. The numerical simulation is used to validate the findings of the analytical results. It is important to determine a suitable capacity for treating a disease. We have observed that the treatment function affects the infected compartment. That is, the increased rate of treatment function reduces the infection. This shows that to eliminate the disease adequate treatment facilities must be provided.

Keywords: Dengue disease, Treatment function, Reproduction number, Global stability, Lyapunov function

Abstract No: PO-42

Development of an off-grid solar PV system with battery-supercapacitor hybrid energy storage

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In off-grid photovoltaic (PV) systems, the charge controller is a significant device since the system's end-to-end efficiency depends on its efficiency. Currently, the commercially available MPPT charge controllers have an average efficiency of 90%. Supercapacitors' (SCs') high energy density compared to traditional capacitors makes them used as energy storage devices. But theoretically, 50% of energy loss will occur in the capacitor charging loop if we charge it directly connecting to a power supply. According to the supercapacitor-assisted loss management (SCALoM) theory, inserting a useful resistive load into the capacitor charging loop, a portion of the above wasted 50% of energy can be utilised for beneficial work. This paper proposes a novel off-grid PV system with a battery-SC hybrid energy storage. This system utilises the SCALoM theory using the combination of a charge controller and battery as the useful load in the capacitor charging loop, while PV panels are used as the external power source. To achieve maximum use of the SCALoM theory, the SC must be kept under partially charged condition. An electronic switching network consisting of nine electronic switches was designed to realise this. Two SC banks, SC-1 and SC-2 were embedded in the prototype system. The proposed system operates in four different modes: SC-1 charging mode, SC-2 charging mode, SC bypass mode, and night mode. These modes are defined by the state of each switch in the switching network and the voltage of both SC banks. In SC-1 and SC-2 charging modes, the relevant SC bank is connected in series with the PV panels and charge controller while a DC load is connected in parallel to the SC bank. In this mode, the remaining SC bank is discharged through another DC load. In SC bypass mode, the operation of the system is the same as the typical off-grid PV system because both SC-1 and SC-2 are disconnected from the system so that the PV panels are connected in parallel with the charge controller. In this mode, DC loads are connected to the battery. In night mode, an SC bank is connected in series to the PV array and the charge controller and DC loads are connected to the battery again. For maximum utilisation, this system must be operated in SC-1 and SC-2 charging modes as much as possible throughout the day. The overall operation of the system is controlled by microcontroller-based control circuitry. This system achieved end-to-end efficiencies of 87.36%, 87.50%, 75.68%, and 93.28%, respectively, for SC-1 charging, SC-2 charging, SC bypass, and night modes, respectively. Therefore, it can be concluded that the end-to-end efficiency of an off-grid PV system can be increased by implementing a supercapacitor in a series configuration to the solar panel and to the charge controller.

Keywords: Charge controller, Energy efficiency, PV systems, SCALoM theory, Supercapacitors

Acknowledgment
This work was supported by the internal research grant of the University of Kelaniya, Sri Lanka, under the research grant no. (RP/03/02/05/01/2023). The authors also want to acknowledge the technical support provided by the research team of the Electronics Design and Innovation Centre (EDIC), Department of Physics and Electronics of the University of Kelaniya, Sri Lanka.

Abstract No: PO-43

The effectiveness of electrochemical oxidation in removal of sulforhodamine B textile dye from wastewater

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The rapid expansion of industries has indirectly resulted in a substantial rise in environmental pollution due to the increased discharge of wastewater. Moreover, the lack of suitable and efficient methods for wastewater treatment has aggravated a crucial global issue concerning wastewater. In this context, the textile industry bears the primary responsibility for generating a significant volume of wastewater, primarily due to the processes of dyeing. Out of various wastewater treatment methods, the electrochemical oxidation method has emerged as an effective approach offering advantages of higher selectivity, minimal chemical utilization, energy efficiency, in-situ treatment capability, relatively faster treatment and reduced secondary waste generation. This method harnesses electrically charged electrodes to degrade and eliminate pollutants. In this study, the electrochemical oxidation of synthetic dye sulforhodamine B (Acid red 52), a xanthene dye, was employed to facilitate the removal of dye from wastewater. This dye is extensively used in the textile industry due to its enhanced colourfastness and superior stability across diverse processing conditions. However, its persistent nature poses significant environmental challenges. A series of experiments were conducted using graphite electrodes to optimize the electrochemical oxidation for the removal of dye from wastewater. The research investigated the effects of several parameters on the electrochemical oxidation process. These parameters encompass the applied potential (3 V, 5 V, 9 V), supporting electrolyte concentration (NaCl) (1 g L^{-1}, 2 g L^{-1}, 3 g L^{-1}, 4 g L^{-1}, 5 g L^{-1}), treatment time (0.5 hours, 1 hour, 1.5 hours, 2 hours), and pH level (3, 4, 5, 7, 9) of the sample. The efficacy of sulforhodamine B degradation was assessed by UV-visible spectroscopy and chemical oxygen demand (COD) values. Furthermore, changes in conductivity and pH post-treatment were subjected to analysis. The analysis resulted in the determination of optimal parameters, including an applied voltage of 5 V, treatment time of 1 hour, pH of 7, and NaCl concentration of 3 g L^{-1}. Under optimum conditions it was able to achieve 95.61% colour removal, 99.64% dye degradation, and 66.18% COD reduction. These results confirmed that electrochemical oxidation is an efficient method for removing sulforhodamine B from textile wastewater. To validate the effectiveness of the optimized conditions in practical situations, wastewater samples containing sulforhodamine B collected from a textile industry in Sri Lanka were also analysed under the optimal conditions found. The results obtained impart the use of the electrochemical oxidation method in degrading sulforhodamine B present in textile wastewater in a sustainable and cost-effective manner.

Keywords: Electrochemical oxidation, Graphite electrodes, Sulforhodamine B, Textile industry, Wastewater

Abstract No: PO-44

Natural plant products as potential Cyclooxygenase-2 (COX-2) inhibitors: An *in-silico* drug discovery study

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Natural plant products have gained widespread recognition for their medicinal properties and have been used in traditional medicine for centuries. In recent years, there has been an increase in interest in exploring natural plant products as a potential source of new drug candidates for various diseases, particularly inflammation-related conditions. Cyclooxygenase-2 (COX-2) is a crucial enzyme involved in inflammation and is considered as a prime target for the development of anti-inflammatory drugs. In this study, we employed computational methods to investigate the potential of selected natural plant products as COX-2 inhibitors. A comprehensive screening of a database of natural plant products was conducted using molecular docking and molecular dynamics (MD) simulation techniques to identify potential COX-2 inhibitors. Molecular docking is a computational approach that predicts the binding affinity of ligand molecules to a target protein, while molecular dynamics is a computational simulation method used to study the behaviour and movement of molecules over time. Docking studies were carried out using a crystal structure of COX-2 as the receptor, and the binding free energies of the docked compounds were calculated. The results revealed that the selected natural plant products exhibited promising binding affinities to COX-2, suggesting their potential as COX-2 inhibitors. The binding energies in kilocalories per mole (kcal/mol) of the five ligands with the COX-2 protein can be arranged in descending order as; Tubulosine (-9.82), Dicentrine (-9.34), Celecoxib (-9.02), Crebanine (-8.87), and Cycleanine (-8.10), with 3,5'-dihydroxythalifaboramine exhibiting a binding energy of -7.38 kcal/mol. MD simulations were performed on protein-ligand complexes for 50 ns using CHARMM36 force field and the mean radius of gyration (Rg), root mean square deviation (RMSD) and root mean square fluctuation (RMSF) were calculated. The results of MD simulation analysis indicated the stability of the protein-ligand complex throughout the simulation time. These studied compounds belonged to diverse classes of natural products, including terpenoids, alkaloids, and phenolic compounds, which are known for their anti-inflammatory properties. Additionally, some of the identified compounds exhibited binding affinities to COX-2 that were comparable to or even better than known COX-2 inhibitors such as celecoxib, a selective COX-2 inhibitor, which is a currently prescribed drug for inflammation-related conditions. The MD analysis results along with docking results highlights the potential of natural plant products as a valuable source of COX-2 inhibitors, which could serve as a starting point for further experimental investigations and the development of novel anti-inflammatory drugs. The findings of this study contribute to the significance of natural plant products in drug discovery and provide insights into their potential as promising candidates for the treatment of inflammation-related diseases.

Keywords: Anti-inflammatory, Cyclooxygenase-2, Natural plant products, Molecular docking, Molecular dynamics

Abstract No: PO-45

Computational studies of derivatives of selected marine organisms on acute myeloid leukemia

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Acute myeloid leukemia (AML) is the most common subtype of leukemia cancer that produces an uncontrolled number of muted blood cells in the bone marrow. AML is common among adults, and it affects red blood cells, white blood cells and platelets. The anticancer activity of marine organisms has been proven in several *in vitro* and *in vivo* preclinical and clinical studies. Amongst several Marine ecosystems, Marine sponges are the richest source of anticancer compounds, because they are endowed with natural compounds that can act against AML by targeting active protein sites. This study highlights the investigation of binding interaction between the natural Marine derivatives and the proteins associated with AML and comparing the values with a reference drug using a computational chemistry platform. The natural Marine derivatives which are selected for the present study are lacking information about the drug potency against AML. The main proteins that are targets for this study are Receptor tyrosine kinase (C-Kit), FMS-like tyrosine kinase 3 (FLT3), Myeloid leukemia (MCL1), Glycogen synthase kinase (GSK3), Casein kinase 2 (CK2), while the derivatives of Marine sponges are Gracillin J, Gracillin K, Gracillin L and 3-norspongio. ARA-which is also known as Cytarabine is a Food and Drug Administration (FDA) approved drug for chemotherapy and it was used as a reference drug for this research. A molecular docking study was conducted to determine the binding energies of the interaction of selected proteins and ligand using Auto Dock 4.2 software in which the derivatives of Marine sponge's act as ligands for the active binding sites of proteins associated with AML. Further, Root Mean Square Deviation (RMSD) was calculated for the protein-ligand complexes to discover the stability of the protein-ligand complexes. The computational studies revealed that the natural derivatives of Marine sponges have the potential to act against the AML cancer cells due to the relatively high binding energies compared to that of ARA-C drug.

Keywords: Acute myeloid leukemia, Marine sponges, Derivatives, Molecular docking

Abstract No: PO-46

Selection of best fitting mathematical model to analyse the anthracene degradation ability of *Bacillus velezensis*

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Living things frequently come into contact with a wide range of harmful pollutants, including polyaromatic hydrocarbons (PAHs) like anthracene, which are highly carcinogenic and genotoxic. Microbial degradation is the most promising approach for removing anthracene from the environment, using microorganisms to transform it into nontoxic compounds, rather than using physical and chemical methods. The study aimed to assess the kinetic approach in anthracene degradation by *Bacillus velezensis,* isolated from the phyllosphere of leaf samples. Leaf samples *(Ixora chinensis, Ervatamia divaricate, and Plumeria sp.*) were collected by using random sampling techniques from the most polluted urban areas (Maradana, Orugodawatta, Pettah, Panchikawatta, Sapugaskanda, and Colombo Fort) in Sri Lanka. Then, in vitro, anthracene degradation patterns were analysed using HPLC analysis at different anthracene concentrations (100 ppm, 200 ppm, 300ppm, 400 ppm, 500 ppm, and 600 ppm) as a model of limited substrates while monitoring the growth patterns based on fluctuations in dry cell biomass. Anthracene was completely degraded in six days of incubation for low initial anthracene concentrations. Dry cell biomass and degradation percentages were measured with time for different initial liquid substrate concentrations of PAHs. The specific growth rates and degradation rates were calculated. The study used box plot analysis to identify and eliminate outliers from 65 data points, ensuring the validity and reliability of the findings. After eliminating four outliers, 61 usable data points were obtained, and the ANOVA was used to compare average specific growth rates between anthracene concentration groups, revealing all specific growth rates were statistically significant. The kinetic parameters of anthracene degradation were analysed by using various models including, Monod's, Haldane's, Wayman and Tseng's models because they focused on their convergence with experimental data. The models were evaluated by determining the parameter's significant value, Root Mean Square Error (RMSE), and the Adj.R^2 value. Among these models, Wayman and Tseng's model demonstrated the better fit for the experiment with Adj.R^2- 0.95191 and RMSE – 0.0019. The experimental kinetics data of anthracene degradation closely followed Wayman and Tseng's model, indicating that this model provided an accurate representation of the interaction between the PAH substrate (anthracene) and the growth kinetics of the microorganisms. The half saturation constant K_s, the maximum specific growth rate $\mu_{\max}$, the threshold substrate concentration S_θ, and the inhibition coefficient i were defined as Wayman and Tseng's model parameters and were estimated in their numerical values.

Keywords: *Bacillus velezensis*, Biodegradation, Kinetics, Substrate inhibition, Toxicity, Wayman and Tseng's model

Abstract No: PO-47

Numerical solutions of fuzzy differential equations using higher order methods

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Fuzzy differential equations (FDEs) are useful for modelling real-world problems in science and engineering and have been studied by many researchers. Fuzzy solutions are required for certain problems due to the inherent uncertainty of the initial conditions. For instance, Fuzzy Predator Prey (FPP) models and fuzzy RLC-circuit models. The predator-prey model and RLC-Circuit model consist of a system of first-order differential equations. When the initial conditions are imprecise, they can be modelled as triangular Fuzzy numbers. In this study, four fuzzy numerical methods: namely, fuzzy Euler method, 2nd and 3rd-order fuzzy Taylor methods, and 4th-order fuzzy Runge-Kutta method were used. Those methods were implemented and validated for the solutions of certain Fuzzy Predator Prey (FPP) models and Fuzzy RLC-circuit models using MATLAB. The absolute and relative errors were compared with the analytical solution when available and among the methods. It was observed that the 3rd-order fuzzy Taylor method gives a better approximation (and minimum error) for the models. In addition, stability analysis, qualitative error analysis, sensitivity analysis of the crisp parameters, and fuzzy initial populations of the above FPP model were studied. From the stability analysis, it was observed that there is a fuzzy stable equilibrium point for the FPP model. According to the sensitivity analysis of the crisp parameter in the FPP example, it can be concluded that when the natural growth rate increases, the prey population increases, and the maximum number of predators also increases in the shorter period, as the death rate per encounter of preys due to predation increases the maximum number of prey and predators decrease. The first peak in predators occurs sooner, and as the natural death rate of predators in the absence of the prey increases, the maximum number of prey increases, and as the death rate goes to zero, the predator population remains constant. When the reproduction rate of predators for each prey captured increases, the prey population decreases, and it does not show a significant variation in the peak of the predator populations. By the sensitivity analysis of the initial population in the FPP model, it was observed that the maximum number of preys is larger than the maximum number of predators and the fuzzy phase plane is closed or open. Also, it can be concluded that as in the unfuzzy version of the algorithms, there's a trade-off between step size, accuracy, and computational cost. In particular, if the step size is too large, the solution fails to converge.

Keywords: Fuzzy Differential Equations, Fuzzy Predator-Prey model, Fuzzy RLC-Circuit model, Fuzzy Taylor Methods, Fuzzy Runge-Kutta method.

Abstract No: PO-48

A complex sample design based analysis of determinants of secondary job holding of heads of households in Sri Lanka

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Heads of Households (HHs') play the most prominent role in families. This study was mainly focused on HHs' who were engaged in secondary jobs (SJ) in Sri Lanka. Exploring methods and techniques of incorporating complex sample design into analysis and identifying factors associated with secondary job enrolment of HHs' in Sri Lanka by developing a statistical model using complex sample design were main objectives of the study. The data of the Annual Labour Force Survey-2019 was collected from the Department of Census & Statistics. The sampling method of the survey was two-stage stratified. A sample where sampling method was not simple random sampling is called a complex sample. The study emphasized that analysing and modelling techniques developed for simple random samples could not be used for data from a complex sample. Thus, study used descriptive, univariate, bi-variate analysis techniques developed for complex sample data. Since both sample design and weights were used analysis is design-based. Complex sample binary logistic regression modelling techniques were used to acquire the status "being secondary employed or not". High class imbalances were noticed, and over-sampling, under- sampling, and SMOTE techniques were tried, and under-sampling was selected as the best way of balancing the data. Two models were developed, for the original data and for the under-sampled data. Nagelkerke R square and classification table were considered to compare the overall fit of two models. The overall accuracy of models developed for original and under sampled data given by classification table was 90.4% and 71.2% respectively. But class-wise accuracy was high in model fitted for balanced data set with under-sampling. Model developed for original data correctly predicts only 0.8% of SJ enrolment of HHs' and 99.9% correctly non-SJ enrolment while model fitted for balanced data correctly predict 41.1% of the SJ enrolment of HHs' and 86.9% non-secondary job enrolment. Model developed with interaction terms for the balanced data set had overall accuracy 74.1% which is not a considerable improvement compared to main effects model for the same dataset with 71.2% overall accuracy and, consisted of more predictor variables again led to choose main effect model. According to the model derived for the balanced data, being in rural sector, being male, engaging in occupations managers, senior officials and legislators, professionals, services and sales workers, skilled agricultural, forestry and fishery workers, monthly income below rs.15,000.00, increased the likelihood of being a secondary employed HH. Moreover, no published work could be found on a design-based analysis on this topic. Thus, study leads the government and employers to find out determinants of SJ holding of employed HHs' and to adjust their plans and improve the quality of primary and SJs.

Keywords: Balanced data, Complex sample, Design based, Heads of households, Secondary job

Abstract No: PO-49

Development of sand/graphene composite and its application for MCPA pesticide adsorption from water

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This research endeavours to synthesize a novel adsorbent, sand/graphene oxide composite (M-GO/S), achieved through the iterative deposition of graphene oxide layers on river sand employing a thermal annealing process. Scanning electron microscopic (SEM) and Fourier-transform infrared spectroscopy (FT-IR) characterization studies revealed the presence of a non-uniform graphene oxide coating on the surface of the sand and the incorporation of oxygenated functional moieties within the structure. Comparative evaluations show the heightened adsorption capacity of this new composite entity with alternative sorbent materials, such as activated carbon, graphene oxide, and sand to adsorb neutral 2-methyl-4-chlorophenoxyacetic acid (MCPA) pesticide molecule. To analyse the MCPA adsorption parameters, High-performance liquid chromatography (HPLC)was used (Solvent mixture - Acetonitrile: Distilled water (1:1); Flow rate - 1.5µLmin-1; Wave length - 275nm). The retention time for the MCPA was reported as 1.538s. The optimization studies and adsorption modelling were carried out, focusing on the adsorption of MCPA onto the M-GO/S. Accordingly, the optimum concentration, dosage, and contact time were 75 mg/L, 0.05 g, and 105 minutes respectively, at neutral pH values. The investigation of adsorption equilibrium isotherms has highlighted the Freundlich model's (multilayer adsorption) superior explanatory capacity in characterizing the adsorption phenomenon. Concurrently, the analysis of adsorption kinetics has demonstrated a favourable fit with the pseudo-second-order model (with a correlation coefficient denoted as 0.9754), implying a prevailing chemical sorption mechanism underlying the adsorption process. Although MCPA possesses either neutral or negatively charged (upon dissolution) surfaces, the M-GO/S composite exhibits significant adsorption capability towards MCPA. Consequently, the synthesized composite emerges as a viable candidate for effectively mitigating MCPA pesticide contamination from water.

Keywords: Adsorption, Graphene oxide, Kinetics, Sand, Pesticide

Acknowledgment
This work was supported by the research project PS/DSP/CKDU/ 06/3.5 titled “Establish a CKDu Information and Research Center at the University of Kelaniya, Sri Lanka.”

Abstract No: PO-50

The effect of food commodity price fluctuation on inflation in Sri Lanka

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In Sri Lanka, the intersection of inflation and food price fluctuations holds profound significance, affecting not only the nation's economic stability but also the daily lives of its citizens. While existing research has extensively focused on the impact of rice prices on inflation, no published studies have been found that specifically investigate the influence of fluctuations in vegetable and fish commodity prices on inflation. Hence, there is a research gap to have a comprehensive understanding about price fluctuation on inflation. Thus, the objectives of this research are to primarily consider the effect of price fluctuations in mostly consuming vegetable and fish commodities on inflation using suitable techniques. The study focuses on key commodities, including beetroot, cabbage, potato, and various fish types (Seer, Mullet, *Kelawalla*, and *Hurulla*). Monthly data from January 2014 to June 2022, sourced from the Central Bank of Sri Lanka and the Department of Census and Statistics, were utilized for the analysis, with no missing values. To measure inflation, the National Consumer Price Index (NCPI) was used. Since all the time series of monthly observations of fish and vegetable prices and NCPI were non-stationary, the first differencing of logarithm for all the series was used where it proved the stationary by both graphical and theoretical techniques. After investigating the lag structures for fish and vegetable models, the optimum and the better lags were found. The cointegration test for both models proved that there were correlations between several time series in the long run based on the optimal lag length. Hence, two Vector Error Correction (VEC) models were fitted for two groups of food commodity prices namely, Fish and Vegetables where VEC models are well-suited for examining the relationships between food commodity prices and inflation over time. Strong cointegration relationships were identified inside these two groups. According to the VEC Granger causality test, it was found that beetroot, cabbages and potatoes do Granger-cause in NCPI but cabbages and other selected fishes do not Granger-cause in NCPI. To study the impact on inflation, the impulse response function was used. It was found that price shocks of the *Hurulla* fish type have a significant positive impact on inflation than other fish types of Seer, Mullet, and *Kelawalla*. Beetroot price shocks have a significantly more positive impact on inflation than other vegetable types of potatoes, tomatoes, and cabbage. The model, which was fitted for fish prices, the percentage of forecasting errors for NCPI increases over time for each type of fish, according to the forecast error variance decompositions. In the model, which was fitted for vegetable prices, the percentage also increases with time, but it remains smaller compared to the fish. Sri Lanka needs effective strategies and policies to mitigate the challenges of unstable inflation, hence the understanding of price fluctuation on inflation empowers policymakers to craft targeted strategies to mitigate the impact of inflation on daily life.

Keywords: Inflation, Fish Price, Vegetable Price, Vector Error Correction model

Abstract No: SO-01

Optimising the power generation cost of microgrids using genetic algorithms - An analysis of the impact of crossover and mutation rates

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This study focuses on optimising microgrid costs, with a particular emphasis on the influence of crossover and mutation rates by applying genetic algorithms. As the demand for decentralised energy solutions in isolated and underserved areas grows, microgrids have gained popularity for their ability to incorporate renewable energy sources efficiently. However, their benefits over conventional power generation systems can diminish if not configured properly. The primary objective of this research is to identify the optimal operational conditions for harnessing genetic algorithms to optimise microgrid costs, with a specific focus on the Sri Lankan energy market. This endeavour aims to promote decentralised microgrid technologies and enhance the reliability of the energy service sector. Our methodology employs a Python-based genetic algorithm that iterates through 100 generations to identify the most cost-effective operational settings for microgrids. The cost optimisation equation considers operational expenses for each unit, carbon dioxide emissions costs, and the present value of future running expenses. The future running expense involves a summation over all power generation units, where the present value of the future cost of owning and operating each unit is calculated based on the discount rate and unit lifetime. Elitism is incorporated in the algorithm to preserve the best-performing individuals in each generation and increase the likelihood of converging towards the global optimum. To evaluate the impact of crossover and mutation rates on fitness, a series of experiments were conducted. The null hypothesis stated no significant effect on the fitness of a generation, while the alternative hypothesis considered a significant effect. For the crossover rate experiment, values ranging from 1% to 50% were tested by switching specific bits in the gene representation. The experiment was repeated 100 times to obtain average values and minimise outliers. Similarly, the mutation rate experiment included values from 1% to 50%, with random bit flips according to the specified probabilities. The experiment was also repeated 100 times for accurate evaluation. Statistical analysis relied on the Kruskal-Wallis H-test, with a subsequent Dunn post hoc test to identify significant pairwise differences in mutation rates. The Dunn post hoc test, using Holm's method for multiple comparisons, revealed significant differences in mutation rates at various levels of significance. Notably, no significant differences were found between mutation rates at the 50%, 25%, and 20% levels of significance. However, at the 10%, 5%, and 1% levels of significance, there were significant differences between certain pairs of mutation rates. It is important to consider that while a higher mutation rate tends to correlate with better fitness values, it can also lead to inconsistent results, potentially affecting the final output of the algorithm. Our study finds that crossover rates have minimal impact on microgrid cost optimisation using genetic algorithms. However, extreme values affect convergence and speed. Mutation rates significantly influence outcomes, with the ideal range being 1% to 10%. This insight aids energy professionals in optimising power generation strategies in Sri Lanka, driving the nation towards a sustainable and resilient energy market.

Keywords: Genetic Algorithm, Cost Optimisation, Microgrid Optimisation, Energy Management

Abstract No: SO-02

Machine learning model to predict bank customer's next expenditure with relevant merchant category

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The banking industry's increasing reliance on debit card transactions has generated a wealth of valuable data for understanding consumer behaviour. This study aims to develop a machine learning model to predict a customer's next expenditure and the corresponding merchant category using 50 customers' debit card transaction data for 11 years. Unlike existing research focused on bankrupt users and fraud detection, this study addresses the next expenditure prediction with merchant categories. For the bank, predicting a customer's next expenditure and merchant category enables targeted marketing efforts. The bank can send alert messages with discount offers specifically to each customer's spending habits, reducing marketing costs by only targeting relevant customers for relevant merchant types. Additionally, customers benefit from early reminders, allowing them to manage their finances effectively. For instance, a customer can receive a reminder about an upcoming insurance payment and allocate funds, accordingly, avoiding unnecessary expenses. This proactive approach can help reduce the number of bankrupt customers and long-term customer relationships. Challenges in this study include obtaining a dataset that is not readily available on the internet. The dataset was provided by the Digital Banking Department at the Head Office of the People's Bank while ensuring data privacy. Data preprocessing involved removing null values and unnecessary columns and creating customer IDs instead of account numbers. Then, identified 36 customers who consistently used debit cards and categorised merchant names into 11 groups. The dataset was split into training and testing sets using a specific date. Three machine learning algorithms, gradient boosting regressor, random forest regressor, and random forest classifier, were employed. Gradient boosting regressor is used to predict expenditures and merchant categories after encoding the categories using one-hot encoding. Random forest regressor is for expenditure prediction, and random forest classifier is used for merchant category prediction. Ordinal encoding was used to convert categories into numerical values. Model performance was optimised through hyperparameter (learning rate, number of trees, maximum depth of each decision tree, minimum number of samples required to split an internal node, minimum number of samples required to be at a leaf node, and fixed random seed for reproducibility) tuning using grid search, evaluating various combinations of hyperparameters through cross-validation. Models run through each customer's unique dataset since expanding patterns are different from each other. The results showed that the random forest regressor and random forest classifier-based method achieved higher accuracy compared to the gradient boosting regressor. This was evident from R^2 scores (0.9866 and 1.0605) and mean squared error values (MSEs are 313165.9622 and 5.6257). However, the method yielded R^2 scores exceeding 1 and a high MSE value due to an unbalanced dataset, where customers' debit card usage frequency varied. Obtaining a balanced dataset with an equal number of transactions for each customer is challenging, especially when requesting data from a bank. In the future, this study could be extended to predict the exact time and date of transactions using techniques like long short-term memory (LSTM) with a larger dataset like 1000 customers.

Keywords: Expenditure prediction, Gradient Boosting Regressor, Personalized Financial planning, Random Forest Classifier, Random Forest Regressor

Abstract No: SO-03

Enhancing usability in learning management systems: Exploring future prospects with virtual assistants

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In Sri Lankan universities, the Learning Management System (LMS) plays a major role in online program content development and management. Amidst the COVID-19 crisis, Sri Lankan university students had to rely heavily on LMS for all academic tasks. The academic workload, a prominent stress factor for university students, coupled with potential shortcomings in the Learning Management System (LMS), can result in diminished engagement, heightened stress levels, and adverse effects on the overall educational experience. Therefore, the main objective of this research is to evaluate the usability of existing learning management systems. The second objective is to discuss the characteristics of virtual assistants that can cater to Sri Lankan university students. The study takes a quantitative research approach, as its primary data is collected through an online questionnaire created from Google Forms and answered by 160 undergraduates from the Faculty of Science at the University of Kelaniya. Likert-Scale questions measured the frequency of engagement activities with the LMS, agreement with usability factors, and importance of features for a virtual assistant. The convenience sampling method was chosen due to the accessible participant pool and as a preliminary step for a future comprehensive study. The data was validated and analysed using SPSS software. Descriptive analysis and hypothesis testing with a single sample-sign test were carried out to observe the statistical significance of active user engagement in the LMS and the usability factors for the LMS. Additionally, the analysis used a machine learning algorithm called Random Forest Classifier in Python to identify the importance of characteristics and challenges for virtual assistants. This study considered eight features that were used as independent variables while using the preference for a virtual assistant as the dependent variable for the model. Based on the data analysis, users generally engage actively with the LMS. However, some features like forums, discussions, video conferencing, and chat need to be more utilised due to limited user awareness. Students express positive views about the current LMS's accessibility and satisfaction levels, which meet acceptable Human-Computer Interaction (HCI) standards. The importance of features found by the machine learning model emphasizes the importance of simplicity and relatability for effective virtual assistants. Future research could benefit from a stratified random sampling method that provides better coverage of the population, including students from all faculties, improves the accuracy of data analysis and the machine learning model for a broader representation, and extends insights into learners' experiences.

Keywords: Learning Management System, Usability, Virtual Assistant, Student Engagement, User Satisfaction

Abstract No: SO-04

Real-time system for place recognition by interpreting Sri Lankan sign language into text using machine learning approach.

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Sri Lankan sign language (SSL) serves as a vital visual-gestural communication system for the deaf community in Sri Lanka. However, effective communication between hearing-impaired individuals and the general population is limited due to challenges in understanding sign language. Further interpreting dynamic signs is more challenging due to the complexity involved in the sequence of unique expressions in SSL. To address this issue, a novel SSL to Sinhala text interpreting technology was developed, focusing specifically on dynamic signs associated with Sri Lankan locations. The research dataset encompassed a dynamic sign dataset comprised of 30 videos per category, each precisely divided into 30 frames. This robust dataset further strengthened the effectiveness of our approach in enhancing location-specific dynamic sign recognition. This study contributes to bridging a critical gap in Sri Lankan sign language recognition by assessing our model's performance on dynamic signs across three and five distinct locations. To recognise these dynamic gestures, a vision-based approach was chosen, providing a simpler and cost-effective solution compared to sensor-based systems. The study integrated Media Pipe and a Long short-term memory (LSTM) neural network as part of a combined methodology to enable gesture detection and interpretation. By leveraging these techniques, a camera-based, low-cost solution was successfully developed for interpreting SSL's dynamic gestures. The study systematically tested multiple models, tuning LSTM and dense layers with varying neurons, resulting in an optimal model. Following rigorous 50-epoch training, our model exhibited an accuracy of 98.89% for dynamic signs across three distinct locations and an accuracy of 93.33% for dynamic signs across five locations. Cross-validation techniques were employed to assess the system's performance and ensure its generalizability across different datasets. By validating the system through cross-validation, its robustness and reliability were tested, enabling a more accurate interpretation of SSL's dynamic gestures. The proposed SSL to Sinhala text interpreting technology has the potential to significantly improve communication between hearing-impaired individuals and the general population in Sri Lanka. By leveraging vision-based methods and incorporating dynamic gesture recognition, this technology can enhance the accessibility and inclusivity of communication for the deaf community. Further research and enhancements are being carried out to expand the system's capabilities for more place recognition and address the challenges associated with dynamic gestures and facial expressions in SSL recognition.

Keywords: Deaf communication, Dynamic signs, Long short-term memory, Sri Lankan sign language, Vision-based approach

Abstract No: SO-05

Capturing sentence-level positional data into N-gram profiles for document classification

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Document classification is a crucial aspect in natural language processing with a wide range of applications in various domains such as email spam filtering, hate speech detection, political bias assessment, etc. While modern *transformer-based* classification approaches have shown promising results in this area, they rely on expensive parallel processing hardware, leaving them out of reach for simpler applications. Therefore, it is still safe to assume that there is room for improvement in terms of developing approaches with lower computational complexity. *N-grams* are a simple and efficient way of representing text data as features based on the distribution of contiguous tokens within the text. This approach is widely used in text analysis and research due to its language independence and minimal pre-processing requirements. However, most of these models do not possess sentence-level positional information in their *n-gram* profiles. Hence, in this study, we propose a revised algorithm for generating *n-gram* profiles related to document categories in a classification task. We combine this new algorithm with the *Euclidean* distance metric to assign class labels for raw documents. This algorithm was evaluated on two main tasks: language classification and subject classification (in English). Our results show that this approach achieves accuracy levels comparable to state-of-the-art models. For the language classification task, we were able to showcase an accuracy of 91% on the WiLI Benchmark Dataset consisting of 235 languages in total with an average prediction time of 1.88×10^{-2} seconds. Furthermore, we investigated several configurations in the dimensions of *n-gram range* and *n-gram cutoff length* for the subject classification task. The best performing configuration of a fixed n-gram length of 5 and a cutoff length of 5000 assumes an accuracy of 50% with an average inference time of 3.29×10^{-2} seconds on the 20 Newsgroups Dataset spanning a whole of 20 newsgroups categories. Overall, our findings suggest that this approach of including sentence-level positional data in *n-gram* profiles can facilitate an algorithm of minimal complexity, and this algorithm, combined with a suitable *n-gram range* and *cutoff level*, can perform well for document classification, particularly when dealing with noisy data with similar categorical labels.

Keywords: Document Classification, N-Grams, Natural Language Processing, Language Classification, Subject Classification

Abstract No: SO-06

Embedded scoring methodology for the self - Assessment of the privacy and security concerns in telemedicine systems in Sri Lanka

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Telemedicine, a subset of telehealth, has garnered increasing attention for its potential to transform healthcare delivery. This analysis was undertaken with the goal of developing an embedded scoring system for a self-assessment questionnaire aimed at gauging patients' familiarity with privacy and security concerns associated with telemedicine adoption in Sri Lanka. To achieve this objective, our methodology commenced with an exhaustive review of published research papers pertaining to privacy and security issues within the telemedicine sector and associated scoring mechanisms. Subsequently, we deployed an online questionnaire to gather comprehensive data encompassing a range of scenarios, including privacy, data storage, consent, encryption, authentication, authorisation, and network security. The selection of these categories was rooted in international policies such as HIPAA, adapted to suit the Sri Lankan telemedicine landscape. Upon the formulation of the questionnaire, we employed the Likert scale to quantify responses, enabling us to assess the significance of various dimensions. Data analysis was executed utilising IBM SPSS (Statistical Package for Social Sciences) software, with qualitative inquiries supplemented by predefined response options. Key findings from our study revealed notable gaps in patient awareness and understanding. Over 45% of telemedicine users admitted to not having reviewed the privacy or security policies associated with their telemedicine applications. Similarly, more than 40% of telemedicine system users lacked knowledge of well-established privacy and security regulations, including HIPAA, HL7, and GDPR. Additionally, patients exhibited uncertainty regarding the average size of documents or images shared through telemedicine applications. Alarmingly, approximately 50% of patients were unfamiliar with encryption algorithms such as DES, AES, RSA, Blowfish, and Twofish, despite being well-versed in data-recovery techniques and antivirus software usage. This study, conducted with a sample size of 100 respondents, underscores the pervasive limitations in patient understanding of critical aspects related to telemedicine application use. Moreover, it emerged that telemedicine system users often accessed government-blocked, insecure, or unavailable websites within their regions. In response to these findings, we have developed an informative website aimed at enhancing telemedicine users' knowledge by disseminating the insights gleaned from our analysis. In conclusion, the implementation of our embedded scoring method yielded not only high completion rates but also valuable, thoughtful responses. This study underscores the imperative of bolstering patient education and awareness to ensure the secure and responsible adoption of telemedicine in Sri Lanka's healthcare landscape.

Keywords: Telemedicine, Security, Privacy, Patients' perspective, Embedded Scoring

Acknowledgement: This work was supported by the Faculty of Science, University of Ruhuna, under the research grant number: RU/SF/RP/2022/06

Abstract No: SO-07

A machine learning approach to predict profitable vegetable crop and land requirements in Sri Lankan agriculture

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More than 80% of the Sri Lankan population depends on agriculture as their livelihood. The main challenges in the agriculture sector are how to select profitable vegetable crops, reduce excess vegetable stocks, and minimise product loss in vegetable varieties. Traditionally, agricultural decisions are made without adequate knowledge of their expected outcomes, causing low productivity. In this context, technology-based decisions in the agriculture sector provide accurate and timely information about weather, market trends, and prices. This research study aims to provide accurate decisions to the challenges by predicting the most profitable vegetable crop and required land extent for cultivation. This analysis considers a range of factors, including weather conditions, cultivation expenses, seasons, location, production, and crop cultivation data. The dataset contains a limited number of records gathered from farmers and agriculture institutes. Multiple machine learning algorithms were employed to develop accurate crop prediction models, namely, random forest (RF), multinomial logistic regression (MLR), and long short-term memory (LSTM). In addition, the extent of land required for cultivation was predicted using linear regression (LR) and random forest regressor (RFR). The multinomial logistic regression archives a higher accuracy of 0.84 for crop prediction, and the random forest regressor algorithm gives an accuracy of 0.83. The LSTM model gives an R^2 score of 0.831. The model provides the profitable crop as an output, and it is used as an input to the land extent prediction system. The application predicts the land extent for selected crops using RFR and LR. RFR gives a higher R^2 score of 0.956 compared to the LR model (R^2 = 0.45), demonstrating its superior fit to the data. The. The root mean squared error of the RFR was 23.95, whereas the LR model had 89.29. Using advanced machine-learning techniques, the research provides valuable predictions on profitable crops and land extent to be cultivated in a particular area to increase productivity. This will help the farmers and stakeholders to make accurate decisions to maximise profitability and ensure efficient resource utilisation. Furthermore, the developed model can be expanded with various crop categories to build profitable farming on a broader scale. The impact of this work extends to enhancing food security and reducing poverty in Sri Lanka by allowing farmers with the tools and knowledge to make correct decisions at the correct time.

Keywords: Linear Regression, Long Short-Term Memory, Multinomial Logistic Regression, Random Forest, Random Forest Regressor

Abstract No: SO-08

QUBO formulation of the closest string problem

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The closest string problem is an NP-complete problem which appears more commonly in bioinformatics and coding theory. From a theorist's point of view, more interesting applications are found in automata theory, specifically in the context of Finite Automata and Push-Down Automata. The corresponding optimisation problem deals with determining the string corresponding to the minimal Hamming distance between the candidate string and all given strings. Less surprisingly, classical approaches have been pursued with two prominent algorithms being the genetic algorithm and simulated annealing. Latest improvements to quantum computing devices with a specialisation in optimisation tasks, such as D-Wave systems, suggest that an attempt to embed the problem in a model accepted by such systems is worthwhile. In this study, the interests lie in modelling the problem based on binary variables. More specifically, two slightly different Quadratic Unconstrained Binary Optimization (QUBO) formulations have been proposed, one using the Kronecker delta function and the other through the help of a bijective function. The interest in the use of a bijective function for a formulation was inspired by the fact that the Kronecker delta function can incur additional computational overhead and the potential to eliminate it by exploiting the inherent numerical representation of symbols. Subsequently, an evaluation based on a few simple test cases was carried out on both formulations. Here, the D-Wave Leap cloud solvers have been utilized and minor-embedding is implicitly handled. For evaluation purposes, a metric called the Occurrence Ratio (OR), which is based on the number of occurrences in D-Wave output was defined. Additionally, the Maximum Occurrence Ratio (MOR) was defined as the maximum value obtained for OR for any solution. With minimal hyperparameter tuning, the expected solutions were obtained for every test case, where MOR was the same as OR, except for one case ($MOR \neq OR$). Since only the basic constraints have been followed to set the values for the Lagrange parameters in the Hamiltonian (QUBO), hyperparameter tuning is essential for, cases such as $MOR \neq OR$. To address practical and implementation issues, an inherent decomposition strategy based on the possibility of having substrings has been elucidated to accommodate the restricted qubit count. It is deduced theoretically, that the required qubit count is mn, where m is the number of symbols in a string and n is the number of strings, whereas due to practical limitations, this number is usually higher. Conclusively, the need for further investigation on tuning the hyperparameters is emphasised.

Keywords: Quadratic binary optimisation, QUBO models, Quantum annealing, Quantum algorithms, Combinatorial optimization

Abstract No: SO-09

Enhancing optical flow for a smoother identification of global motion

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In the domain of computer vision, optical flow stands as a cornerstone for unravelling dynamic visual scenes. However, the challenge of accurately estimating optical flow under conditions of large displacement remains an open question. The conventional image flow constraint is vulnerable to substantial nonlinear elements, rapid temporal variations, or spatial changes in the intensity function. The inaccurate approximations inherent in numerical differentiation techniques can further amplify such intricacies. In response, this research proposes an innovative algorithm for optical flow computation, utilising the higher precision of second-order Taylor series approximation within the differential estimation framework to improve the robustness and accuracy of optical flow. By embracing this mathematical underpinning, the research seeks to extract more information about the behaviour of the function under complex scenarios with large nonlinear components, rapid temporal changes, or spatial changes in the intensity gradients and estimate the motion of areas with a lack of texture. The experimental results demonstrate that the proposed algorithm outperforms the existing optical flow algorithms, revealing its capability to estimate global motion accurately even in challenging scenarios. An impressive showcase of its capabilities emerges through its competitive performance on renowned optical flow benchmarks such as KITTI (2015) and Middlebury. The average endpoint error (AEE), a quintessential measure of the accuracy of optical flow algorithms, which computes the Euclidian distance between the calculated flow field and the ground truth flow field, stands notably diminished, validating the effectiveness of the algorithm in handling complex motion patterns. Further experiments conducted against OpenCV optical flow implementation show a significant performance over state-of-the-art algorithms, indicating its potential for practical application in a range of real-world scenarios that require accurate global motion estimations, such as autonomous navigation, video surveillance, flight stabilisation in drones, video stabilisation and motion-based recognition, where accurate motion estimation between consecutive frames is imperative.

Keywords: Optical Flow, Computer Vision, Motion detection, Dense Optical Flow, Motion analysis

Abstract No: MO-01

Investigating the effect of climate factors on dengue incidence in Kandy, Sri Lanka

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Dengue, a mosquito-borne disease, poses significant public health challenges in tropical and subtropical regions globally. About two-thirds of the world's population live in areas infected with dengue. It is one of the major emerging public health problems locally as well as globally. Dengue has been hyper-endemic in Sri Lanka in recent years. According to the epidemiology unit of Sri Lanka, dengue fever and the more severe dengue hemorrhagic fever became nationally notifiable diseases in Sri Lanka in 1996. The prevalence of dengue infections on a yearly basis has been increasing over time. Now it has become the leading killer mosquito infection in Sri Lanka. In urban areas, the dengue incidence is the highest, notably highest in Colombo and Gampaha districts. Currently, Kandy district is the third highest-risk area for dengue transmission in the country. The incidence of dengue was caused by several factors, one of which is the climatic conditions referring to temperature, rainfall, and humidity were reported to be important influential dengue transmitters. Since climate conditions influence the dengue transmission cycle, the relationship between dengue incidence and climatic conditions is investigated in this study. This study focuses on developing a suitable statistical model that describes the relationship between dengue incidence and meteorological factors such as temperature, humidity and rainfall in Kandy. Since the dengue incidence is a count data, the Poisson regression approach is considered to fit the model. For this study, monthly dengue incidences in the city of Kandy from 2007 to 2019 were obtained from the epidemiology unit of the Ministry of Health of Sri Lanka. The monthly climate data in the city of Kandy (monthly average temperature in ^{o}C, monthly average humidity, and monthly average rainfall in mm for the same period) were obtained from yearly statistical abstracts from the Department of Census and Statistics of Sri Lanka. Since the data was identified as over-dispersed, which has higher variance than the mean value, the negative binomial model was incorporated. Finally, models were compared with respect to the deviance values and the Akaike Information Criteria. Results reveal that the negative binomial model is the best-fitted model for the data. Further, rainfall was identified as the most significant variable for the dengue incidence in Kandy. The results of this research may help to improve the precaution strategies against dengue incidence in the near future. That is, the relevant authority may alert the public during the rainy season and do pre- cleaning activities of the environment.

Keywords: Climate factors, Dengue transmission, Public health, Over-dispersion, Poisson-regression

Abstract No: MO-02

In vivo and *in silico* analysis of inhibition of rice (*Oryza sativa*) bran lipase with guava leaf (*Psidium guineense swartz*) extract

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Rice (*Oryza sativa*) bran (RB) is one of the most important co-products in the rice milling industry. It is frequently utilized in animal feed or discarded as waste. After milling, the majority of RB cells are ruptured, and the bran layer is removed from the endosperm. Due to that, the RB lipids encounter highly reactive rice bran lipase (RBL) enzymes which hydrolyze the RB lipids into free fatty acids. Hence RB has a short shelf life. This is the major drawback of using RB as an animal feedstock. This study focused on inhibiting the RBL activity using natural potent inhibitors and determining the mechanism of inhibition to increase the shelf life of RB. The RBLs were isolated by ion-exchange chromatography at pH 10.0 buffer. Guava (*Psidium guineense swartz*) leaf ethanol: water extracts were tested for inhibition of RBLs. Orlistat, a human gastric and pancreatic lipase inhibitor was used as a positive control. The percent RBLs inhibitory activities were assessed using phenyl acetate assay and the guava leaf ethanol: water extract inhibited the RBL activity (47.81% ± 9.44%). The in vivo data were validated by computational analysis. Homology-modeling of RBLs size in 40 kDa and 32 kDa, and molecular docking (AUTODOCK4) were carried out with the lactone orlistat to determine the best docking poses with the lowest estimated Gibbs free energy values (ΔG) for the mechanism of inhibition. Orlistat lactone ring carbon bound covalently to the serine residue in the characteristic GXSXG pentapeptide sequence (where X=any amino acid) in the catalytic site of the RBLs enzyme. Therefore, lactones present in guava leaf ethanol: water extract has the potential to inhibit the activity of RBLs with a similar mechanism of orlistat. Our finding suggests that guava leaf ethanol: water extract can be applied as a natural solution to increase the shelf life of RB.

Keywords: Rice bran, *Oryza sativa*, *Lipase*, Orlistat, *Psidium guineense swartz*

Abstract No: MO-03

Pyrolysis of plastic waste into liquid fuel

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The accumulation of plastic waste in the environment has emerged as a significant global concern. The versatile properties of plastics, such as low weight, low cost and durability which led to their widespread use as substituents for traditional materials like wood, metals, ceramics, and glasses. However, the improper handling and disposal of plastic waste have imposed negative consequences for the environment. The non-biodegradable nature of plastics makes them persist in the environment for extended periods, causing pollution and posing threats to ecosystems. Pyrolysis of plastic waste has been studied extensively in recent years as an effective solution, by exposing the plastic waste to high temperatures in an oxygen-free environment to decompose it into fuel oil, char, and gases. In this study, the waste of four types of plastics samples, low-density polyethylene (LDPE), high-density polyethylene (HDPE), polypropylene (PP), and a mixture of these three types of plastics, were subjected to pyrolysis. Lab-scale, low-cost pyrolysis system was used to obtain liquid oils and herein, the non-condensed vapor was trapped into an organic solvent. Thermal pyrolysis or non-catalyzed pyrolysis resulted in a liquid yield of 65.64 ± 5.42 – 79.57 ± 1.66 wt.% at a temperature range of 340 – 360 ℃. Considering catalytic activity, high temperature stability, local availability, and abundance, four types of naturally available minerals were selected as potential catalysts for the pyrolysis of waste plastics. The mineral which resulted in the highest liquid yield was identified as the best-performing catalyst and used for further analysis. The catalyzed process resulted in an increased liquid yield of 71.79 ± 0.99 - 80.29 ± 1.76 wt.% at the temperature range of 290 – 320 ℃. The calorific value of the resulting oil in thermal and catalyzed pyrolysis processes were 10,850 -10,961 Kcal/kg and 10,556 - 11,473 Kcal/kg respectively. This reveals that the mineral selected is an ideal catalyst for pyrolysis of plastics and further indicates the quality enhancement of the fuel produced in catalyzed pyrolysis. Further, the fuel quality indicators; calorific values, density, kinematic viscosity, ash content, and water content of the resulting liquid oils under both catalyzed and uncatalyzed/thermal pyrolysis processes were significantly compatible with commercial grade diesel and kerosene fuel oils.

Keywords: Pyrolysis, Mixed plastics, Liquid oil, Catalysts, Physical properties

Acknowledgment
This work was supported by World Bank (AHEAD DOR) under the research grant AHEAD/RA3/DOR-12.

Abstract No: MO-04

Development and validation of an analytical method to detect Monosodium Glutamate in food samples and analysis of MSG in selected Sri Lankan food products

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Monosodium glutamate (MSG) is a synthetic flavour enhancer commonly used in the food industry, even though it comes from a natural source. Although MSG is commonly utilized as a food additive to improve taste, it has been linked to various health problems in humans. The potential health effects that have been associated with MSG include Chinese restaurant syndrome, asthma and respiratory reactions, migraine headaches, and allergic reactions. Researchers have conducted studies on animals to explore the effects of consuming MSG. Use of MSG in foods has been regulated in many countries. Although the food regulations of Sri Lanka clearly provide for the type of foods that MSG is not permitted, analytical facilities are not available in the country for quality assurance. In this study, a liquid chromatography-tandem mass spectrometry (LC-MS/MS) method was developed and validated to quantitatively analyze MSG and determine its presence in selected food products available in Sri Lanka based on the food regulations. The food products were purchased from supermarkets and they included seasoning cubes, seasoning powders, biscuits, chips, sauces, and soups. Separation of MSG was done using a C-18 column with mobile phase A (0.1% formic acid in type 1 water) and mobile phase B (acetonitrile) with the isocratic elution (A:B 30:70). Retention time of MSG was 2.5 min. The specific glutamate ion transitions detected were 148.00 to 84.00, 102.00, and 130.00 m/z. Key analytical parameters were validated according to the ICH guidelines. The method was linear in the range of 0.50-10.00 mg/L, with a correlation coefficient (R^2) of 0.9994 and was accurate between ±5% range from the true value. The CV% values of 4.99%, 1.71% and 0.94% for three concentration levels (0.5 ppm, 2.5 ppm and 10.0 ppm respectively) that covered the calibration series obey the accepted criteria of <5% for precision. The analytical method developed and validated was successfully employed for the analysis of MSG in various food samples. The MSG contents in the analyzed food samples varied from 0.007 g/100g to 32.11 g/100 g. Accordingly, pasta and noodle seasonings had the highest MSG content, 0.21-0.68 g/packet. Other products rich in MSG were bouillon cubes (0.26-0.86 g/cube), and seasoning powders and mixtures which contained between 0.001-13.8g/pack of added glutamate. Thus, consumption of more than two items from this list of food products can exceed the safe consumption limit of an adult (960mg/day). Tandem mass detection is a specific method to detect MSG for regulatory purposes. Thus, this LC-MS/MS method developed and validated enables the detection of added glutamate in food products, offering an opportunity to address the presence of hidden MSG through food control measures. Implementation of proper regulatory practices to control food additives by detecting and quantifying MSG in post-marketing food products provides insight to prevent health-related issues and diseases associated with excessive glutamate consumption.

Keywords: Ion transitions, ICH guideline, LC-MS/MS, MSG

Acknowledgement: This work was supported by University of Kelaniya, Sri Lanka as providing a University Research Grant (Grant No: RP/03/02/06/03/2021).

Abstract No: MO-05

In vitro evaluation of antibacterial activity mediated by palmyra pulp and sprout silver-zinc oxide nanocomposites

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Pathogenic bacterial resistance to antibiotics has become a significant barrier to the accurate identification and treatment of infectious diseases. To address this challenge, there is a high demand for new chemical substances acting as antibiotics or potential antibacterial targets. Biogenic metal nanoparticles (NPs)/ nanocomposites (NCs) show promise as sustainable solutions, exhibiting remarkable antimicrobial activities against various bacteria, viruses, and fungi. This study uses palmyra pulp and sprout extracts, rich in phytochemicals, to sustainably synthesize AgNPs, ZnO NPs, and Ag-ZnO NCs. Additionally, it aims to explore the effectiveness of overcoming bacterial resistance by suppressing resistance mechanisms through biogenic NPs and NCs. The study explored the impact of different factors (ion precursor concentration, extract-to-metal ion ratio, pH, irradiation methods, and incubation time) on nanomaterials (NMs) synthesis. The biogenic NMs were characterized by UV-Vis spectroscopy, FTIR, SEM, TEM, and XRD analysis. Antibacterial activity against *Escherichia coli* and *Staphylococcus aureus* was also investigated. The positive controls used for comparison were Azithromycin and Tetracycline (2000 ppm: 100 µL). NMs synthesis was verified by surface plasmon resonance peaks: 436-438 nm for AgNPs, 350-354 nm for ZnO NPs, and 350-450 nm for Ag-ZnO NCs. FTIR analysis revealed the involvement of bioactive compounds as reducing and capping/stabilizing agents in phytoextracts. SEM analysis confirmed successful Ag-ZnO NCs synthesis, with spherical AgNPs aggregating on nanoflower-shaped ZnO NPs. TEM images showed the coexistence of Ag on ZnO for NCs, with an average particle size ranging from 11-120 nm for NMs. XRD analysis indicated a hexagonal wurtzite structure for ZnO and a face-centered structure for Ag during Ag-ZnO NCs formation. Biogenic AgNPs and Ag-ZnO NCs displayed the highest growth inhibition, while ZnO NPs had the least inhibitory activity. Pulp and sprout-mediated AgNPs (2000 ppm: 100 µL) showed greater inhibition zones against *E. coli* (16.0 ± 0.6 mm, 15.0 ± 1.0 mm respectively) and *S. aureus* (18.0 ± 0.3 mm, 19.0 ± 0.3 mm respectively). Pulp and sprout-mediated Ag-ZnO NCs (2000 ppm: 100 µL) exhibited average inhibition zones of 15.0 ± 0.3 mm and 14.0 ± 0.3 mm against *E. coli*, and 17.0 ± 1.0 mm and 16.0 ± 0.5 mm against *S. aureus*, respectively. The inhibition zones for Azithromycin against *E. coli* were 3.5 cm and Tetracycline against *S. aureus.* was 4.5 cm. There were no significant differences ($p \geq 0.05$) in growth inhibition between pulp-mediated AgNPs and Ag-ZnO NCs against *S aureus* and between sprout-mediated AgNPs and Ag-ZnO NCs against *E. coli*. However, there were highly significant differences in growth inhibition between extracts mediated AgNPs and ZnO NPs, and between ZnO NPs and Ag-ZnO NCs against both bacterial strains. These findings highlight the sustainable synthesis of Ag-ZnO NCs using palmyra pulp and sprout extracts, which effectively inhibit bacterial growth.

Keywords: Antibacterial activity, Ag-ZnO NCs, Biosynthesis, Palmyra pulp and sprout, Sustainable

Acknowledgment
This work was supported by the Institute of Chemistry Ceylon, Rajagiriya under the research grant umber 19/02.

Abstract No: MO-06

Microplastic contamination in shrimps from the Negombo Lagoon- Sri Lanka

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Microplastics (MPs) are minute pieces of plastic debris that are smaller than 5 millimeters in size. They are created through the fragmentation or degradation of more oversized plastic items such as bottles, bags, and packaging materials. Additionally, MPs can also be intentionally manufactured for certain products like microbeads in personal care products. Microplastic pollution has turned into a severe global issue affecting freshwater systems, coastal regions, and oceans. These non-biodegradable materials have a detrimental impact on marine species and ecosystems, causing disruption to their feeding, breathing, and reproduction. The intention of this study was to identify and categorize the MPs present in shrimps from the Negombo lagoon, Sri Lanka, based on the type, shape, size, and color and to characterize the polymer composition of the identified MPs. Fresh samples of two species of shrimps, *Penaeus monodon* (n=25) and *Penaeus indicus* (n=95) were collected from the ten locations where the known habitats of shrimps in the Negombo lagoon and MPs were isolated by gastrointestinal tracts and gills by alkali digestion followed by vacuum filtration. Stereomicroscopy coupled with advanced micro-imaging and analyzing software was used for characterizing the isolated MPs. From those samples, 415 MPs were identified and characterized. The results showed that the average number of MPs per individual was higher in *P. monodon* (4.72 ± 2.72) compared to *P. indicus* (3.13 ± 2.04). The average number of MPs per gram of gut tissue was also higher in *P. monodon* (8.29 ± 4.63) compared to *P. indicus* (5.52 ± 3.78). Identified MPs were categorized into five size groups, <100 μm, 100-250 μm, 250-500 μm, 500-1000 μm, and >1000 μm. The majority of MPs identified were under the category of >1000 μm, and six color categories were observed, with blue being the most prevalent. The study identified two main types of MPs; fibers and fragments, and the predominant form of MPs was fiber (93.0%), with the remaining being fragments. The polymer composition of most of the MPs included polystyrene, polyamide, polyester, polypropylene, and rayons, as identified by μ-FTIR and ATR-FTIR studies.

Keywords: Microplastics, Negombo lagoon, Shrimps, FTIR, Pollution

Acknowledgment
The work is financially assisted by the University of Kelaniya under the research grant (No-RP/03/02/06/02/2021), and technical support provided by the Centre for Environment, Fisheries and Aquaculture Science (Cefas), UK under the research grant for Commonwealth Litter Programme (CLiP) and National Aquatic Resources Research and Development Agency, Sri Lanka.

Abstract No: MO-07

The occurrence of extreme hydrological events in Colombo district and their impacts

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Extreme hydrological events in the Colombo district of Sri Lanka were assessed using the Standardized Precipitation Index (SPI) and the Rainfall Anomaly Index (RAI) and possible adaptation measures to reduce the impacts in the affected areas were proposed as objectives in the research. The analysis encompasses rainfall data from 1989 to 2020 and focuses on four meteorological stations within the Colombo district: Colombo, Ratmalana, Angoda, and Homagama. Rainfall data and impact data were obtained from the Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS) website and the Desinventar website, respectively. RStudio and Microsoft Excel were used for the calculations. The daily rainfall data and the monthly rainfall data were used to calculate the Rainfall Anomaly Index (RAI), and the Standard Precipitation Index (SPI), respectively. The SPI for a three-month period (SPI3) was employed to analyze flood and drought conditions. The RAI serves as a complementary tool to assess wet and dry events. The findings from the SPI analysis indicate several notable periods of extreme wetness, including November and December 1997, March to May 2008, January, February, September, and October 2011, and May, June, and July 2016. These periods pose a high risk of flooding in the Colombo district, potentially leading to significant environmental impacts. The RAI index confirms the occurrence of extremely wet events in October 1997 and May 2016. Furthermore, the research identifies drought periods, particularly in 1992, 1994, 2012, and 2016, using SPI calculations. However, the absence of substantial drought impacts in the Colombo district, which is located within the Wet Zone of Sri Lanka, indicates that the local population may not be severely affected by the dry events. Deaths, injuries, property damages and destructions, and destruction of crops are some of the impacts that people are directly and indirectly affected due to flood. The findings of this research highlight the effectiveness of the SPI and RAI indices in assessing extreme hydrological events. It is fair to conclude that floods have occurred in 1999, 2006, 2008, 2009, 2010, 2011, 2016, and 2019 because impact statistics and identified wet periods from calculations are compatible with each other in those years. It also suggests several measures to reduce damage from flooding, such as improving drainage infrastructure, implementing rainwater harvesting systems, and maintaining clean streets and sidewalks. By understanding the patterns and impacts of extreme wetness and dryness, appropriate adaptation measures can be implemented to mitigate the environmental and societal consequences of climate change in the region.

Keywords: Colombo, Drought, Flood, Impacts, Rainfall data, SPI

Abstract No: MO-08

Photocatalytic activity of Cobalt-doped Fe_2TiO_5 nanoparticles from natural Ilmenite using acid leaching steps under visible light

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This research project was primarily carried out to observe the photocatalytic decolourisations of Cobalt-doped Fe_2TiO_5 nanoparticles in wastewater contaminated with dyes. The possibility of using commonly accessible Ilmenite as a raw material in a low-cost, non-toxic, stable, and highly reactive process of synthesising the aforementioned Fe_2TiO_5 is also explored in this research. Acid-leaching techniques were used, to remove impurities. Then Ammonia solution was used for precipitation, followed by filtration, drying, and calcination at 700^0C to produce Fe_2TiO_5 nanoparticles. Cobalt salt was added to the acid leachate, and the same precipitating and calcination procedure was followed to produce $CoO/Co_2O_3/Co_3O_4/Fe_2TiO_5$, which were then characterised utilising PXRD, Raman spectroscopy, XRF, XPS and SEM. PXRD patterns collected to identify the crystal structure of the synthesised nanoparticles show the presence of pseudobrookite, Fe_2TiO_5 and α-Fe_2O_3. Moreover, finding peaks in PXRD analysis for $CoO/Co_2O_3/Co_3O_4$ is challenging due to the low concentration of Co utilised. Raman analysis part depicts the existence of α-Fe_2O_3 and the anatase phase of TiO_2 in the Cobalt-doped sample. XRF analysis was performed on a Cobalt-doped sample to identify the elemental distribution of Ti, Fe, Co and other elements. XPS analysis reveals the presence of Ti, Fe, O, C, and Co in the Cobalt-doped sample, confirming the $CoO/Co_2O_3/Co_3O_4/Fe_2TiO_5$ composition. The aforementioned analysis techniques confirm the Fe_2TiO_5/TiO_2 in the initially synthesised undoped sample. SEM image of synthesised Fe_2TiO_5 shows the distribution of an irregular nanostructure of small and large nanoparticles. However, the Cobalt-doped sample shows how the irregularity is disturbed. The catalytic activity of Fe_2TiO_5/TiO_2 and Cobalt-doped catalysts was observed in the presence and absence of persulfate under sunlight using UV visible spectroscopy. The $CoO/Co_2O_3/Co_3O_4/Fe_2TiO_5$ nanoparticles showed 37.31% dye removal for Methylene Blue after 2 hours, which was an insignificant result under sunlight. However, the addition of persulfate also did not show any significant improvement in the dye removal percentage, with only 32.54% decolouration of Methylene Blue observed after 2 hours. These results show a negligible photocatalytic effect in Cobalt-doped Fe_2TiO_5 nanoparticles using low concentrations of Cobalt.

Keywords: Acid, Base, Cobalt-doped, Ilmenite, Photodegradation

Acknowledgement
This work was supported by the College of Chemical Sciences, Institute of Chemistry Ceylon, Sri Lanka.

Abstract No: MO-10

Evaluation of the risk model for Covid-19 using Geographical Information Systems

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Globally, the COVID-19 pandemic poses a threat to human life and has far-reaching consequences for socioeconomic systems. Governments worldwide are implementing various strategies to restore normalcy while effectively dealing with the ongoing pandemic. However, Sri Lanka, being a developing country, still faces challenges in returning to pre-pandemic conditions. However, the health sector is currently lacking the capability to monitor and assess risks using new technologies effectively. Additionally, the absence of data collection has led to the collapse of the entire information base. This study focuses on Sri Lanka and evaluates different COVID-19 risk scenarios based on hazard, vulnerability, and capacity factors three policy scenarios are established for this analysis based on the success of key social restriction policies: high-restriction, low-restriction, and no-restriction policies. The weights assigned to the criteria are as follows: affected people 0.27, settlement areas 0.18, public facilities 0.20, access roads and the mobility of people 0.16, and government policies 0.19. Both remote sensing and non-remote sensing data are utilized for analysis, and an Analytical Hierarchical Process (AHP) is employed to calculate the weights for each factor. The final Geographical Information Systems (GIS) based multi-criteria risk map is validated using district-level actual patient data, demonstrating significant accuracy. In both years, Sabaragamuwa Province exhibits high accuracy, with rates of 79% for 2021 and 95% for 2022. However, certain districts, such as the Eastern Province, North Province, and North Western Province, show lower values due to the low resolution of the data and the challenges associated with errors and misinterpretations in the non-spatial data collected by authorities. To improve provincial-level risk modeling, incorporating divisional secretarial data and local economic, geographical, and political factors could yield better results. The study highlights the importance of utilizing GIS effectively for risk assessment and management in various scenarios, including those beyond the current COVID-19 pandemic. However, this methodology can be adapted for studying and effectively replicating responses to future disasters, which may impact the country's well-being.

Keywords: Covid-19, GIS, Remote Sensing, AHP, Risk

Abstract No: MO-11

In silico ADMET analysis of compounds identified in the genus Impatiens in oral administration

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New drug discovery and development avenues have opened up due to the rapid advancement of computational methodologies and technologies. Impatiens is a genus of flowering plants in the family Balsaminaceae that has a long history of traditional usage in folk medicine and cultural traditions. Although prior studies have been conducted on the phytochemical compounds of Impatiens species, there is limited information available about their pharmacokinetics and oral toxicity. Thus, the purpose of this study is to analyze the ADMET (absorption, distribution, metabolism, excretion, and toxicity) properties of compounds identified in the genus Impatiens, *in silico*. Due to the time-consuming and costly nature of traditional experimental methods, *in silico* approaches are required to screen and prioritize potential candidates. Sixteen (16) compounds from the genus Impatiens were chosen to evaluate the ADMET and physicochemical properties using the *in silico* online tools, pkCSM, and Molinspiration. As a standard for comparison, Colchicine was used as the negative control as it is a known toxic compound. Molinspiration results showed that all the compounds, except for Esculin, followed Veber's rule. Conversely, all compounds including Esculin adhered the Lipinski's rule. Additionally, pkCSM results indicated Caffeic acid, Sinapinic acid, (R)-(-)-Linalool as promising candidates for oral drug administration because of their advantageous ADMET profiles and non-toxic properties. On the other hand, compounds such as Esculetin, Scopoletin, Esculin, and 2-methyl-1,4-naphthoquinone, were classified as toxic compounds since they had unfavorable ADMET profiles and exhibited Low LD50 values, hepatotoxic and mutagenic properties. R)-(-)-Linalool emerged as the phytochemical with the greatest potential for the development of oral drugs, meeting the crucial requirements outlined by Veber's and Lipinski's rules. Remarkably, it showcases outstanding attributes, including high intestinal absorption (93.163%), impressive Blood-brain barrier permeation (0.598 logBB), notable Caco2 permeability (1.493 log Papp in 10-6 cm/s), favorable water solubility (-2.612 log mol/L), significant fraction unbound (0.484 Fu), a high LD50 (2.024 mol/kg), and no inhibition of CYP450 enzymes. Additionally, it demonstrated non-mutagenic and non-hepatotoxic properties. Nonetheless, further *in vivo and in vitro* studies are required to promote R)-(-)-Linalool as a promising oral medication candidate. These experimental studies will assure the chemical compound's effectiveness, security, and possible applicability for therapeutic usage in humans.

Keywords: *In silico,* ADMET properties, Genus Impatiens, Physicochemical properties, pKCSM

Acknowledgment
This work was supported by Oxford Brookes University-United Kingdom and British College of Applied Studies, in Colombo.

Abstract No: MO-12

Antimicrobial and Antifungal Activities of Silver Nanoparticles Biosynthesized by *Pothos scandens* and *Kaempferia galanga* Aqueous Extracts

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In order to alleviate the clinical challenges associated with antibiotic use, there is an immediate need for innovative solutions. Utilizing nanotechnology-based antimicrobials represents a promising approach to enhance the effectiveness of natural products. Ayurvedic medicine has long relied on the utilization of *Pothos scandens* (family: Araceae, common name: climbing aroid, Sinhala name: Pota Wal, Tamil name: Annaparuva) and *Kaempferia galanga* (family: Araceae, common name: aromatic ginger, Sinhala name: Inguru Piyali, Tamil name: Kacholum). Leaves, barks, and gums of *Kaempferia galanga* are used to address a variety of microbial-related ailments. The objective of this study was to biosynthesize of PS-AgNPs and KG-AgNPs and conduct *in vitro* screening for antimicrobial properties. *Pothos scandens* bark pieces (10 g) and *Kaempferia galanga* rhizome (100 mg) derived aqueous crude extracts (PSA and KGA) was prepared under sonication (44 kHz, 40 ºC, 30 min). PSA and KGA coated AgNPs (PS-AgNPs and KG-AgNPs) were biosynthesized under different conditions i.e., homogenization, magnetic stirring, exposure to UV or sun light with loading different concentrations (2.5, 5, 7.5 mg/mL). Antimicrobial properties of crude extracts, PS-AgNPs and KG-AgNPs and uncoated AgNPs (U-AgNPs) were screened *in vitro* (1 mg/per well) in triplicate, using agar well-diffusion method against standard microbial and fungal strains *Staphylococcus aureus* (ATCC 25923), *Escherichia coli* (ATCC 25922), *Pseudomonas aeruginosa* (ATCC 27853) and *Candida albicans* (ATCC 90028). Gentamicin (intravenous solution at 40 mg/mL diluted to 0.4 mg/mL), 10 µg per well was used as the positive control against microbes and fluconazole (intravenous solution at 2 mg/mL diluted to 1 mg/mL), 25 µg per well was used as the positive control against fungal cultures. AgNPs were characterized using size distribution data, polydispersity index (PDI), zeta potential, FTIR, AFM and SEM imaging. SEM and AFM imaging revealed the presence of spherical PS-AgNPs and KG-AgNPs with size ranges 50–300 nm. Inhibition zone diameter (IZD) of PS-AgNPs against *S. aureus* was 15±0.816 mm, while it was zero for PSA. IZD for KG-AgNPs against *S. aureus* was 13±0.816 mm, while it was zero for KGA. PS-AgNPs (11±0 mm) showed antimicrobial activities against *P. aeruginosa* and against KG-AgNPs (15±0.816 mm) while it was zero for both PSA and KGA. IZD for PS-AgNPs and KG-AgNPs against *C. albicans* were 14±3.741 mm and 16±1.632 mm while it was zero for both PSA and KGA. PS-AgNPs, PSA, KG-AgNPs and KGA did not exert any bioactivity against *E. coli* and U-AgNPs did not exert any bioactivity against the three microbial strains. The present study revealed that the novel PS-AgNPs and KG-AgNPs formulation is a promising antimicrobial agent against *P. aeruginosa* and *S. aureus*.

Keywords:
nanotechnology-based antimicrobials, ayurvedic medicine, biosynthesize, *Pothos scandens*, *Kaempferia galanga* rhizome

Abstract No: MO-13

Chemical and microbiological investigation on radiolytic degradation of antibiotic Amoxicillin in water

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The occurrence of antibiotics in wastewater effluents and their release into natural waters have significantly contributed to the development of antimicrobial resistance, posing an ultimate threat to human health. Resolving the issue becomes further challenging by the poor removal efficiencies in conventional wastewater treatment techniques. Advanced oxidation processes like gamma irradiation, have gained attention as better alternatives. In the present study, gamma radiation induced degradation of antibiotic Amoxicillin in aqueous medium was studied with the objective of examining the effectiveness of the gamma irradiation treatment. Aqueous solutions with variable initial concentrations of Amoxicillin trihydrate were irradiated at ^{60}Co gamma irradiation facility for varying radiation doses between 0.5 and 7 kGy. The irradiated solutions were directly analyzed using UV-visible spectrophotometry and High-Performance Liquid Chromatography (HPLC), while Fourier-Transform Infrared (FT-IR) spectroscopic and Proton Nuclear Magnetic Resonance (NMR) spectroscopic analysis were performed after freeze-drying. Antimicrobial activity was determined by the Agar well diffusion method against bacteria species *Staphylococcus aureus.* The aforementioned chemical and microbiological analysis were performed compared to the unirradiated solution (control) and the HPLC analysis results were utilized for the construction of the degradation curves. In comparison with the control, the disappearance of characteristic peaks of Amoxicillin including UV absorption at 228 nm, IR peaks at 1770 cm^{-1} and 1313 cm^{-1} and signature NMR peaks of the β-lactam ring, was observed in irradiated solutions. In HPLC analysis, the peak area of retention time corresponding to Amoxicillin was reduced by irradiation, while a number of new peaks emerged. Shifting of UV-Visible baseline to higher values, emergence of a new UV absorption band at 350 nm and gradual decrease of bacterial growth inhibition area with the increasing radiation dose were among the other observations of the study. Based on the chemical and microbiological experimental results, it was concluded that the effective destruction of the β-lactam chemical structure of Amoxicillin in an aqueous medium was feasible using gamma irradiation, leading to the elimination of its bioactivity.

Keywords: Amoxicillin, Gamma radiation, Degradation, Water radiolysis

Abstract No: MO-14

Reexamining the causal relationship between government expenditure and national income in four South Asian countries

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This study reexamines the causal relationship between government expenditure and national income to verify whether Wagner's Law holds in the context of four South Asian countries. According to Wagner's Law, an increase in national income increases public expenditures. The sample includes four South Asian countries; Pakistan, India, Sri Lanka, and Bangladesh from 1980 to 2020. National income and government expenditure are measured by real GDP (Gross Domestic Product) and real total government expenditure respectively. Per capita measures are obtained by dividing the real measures by population figures. First, the stationarity properties of the two macro variables are assessed using the Augmented Dickey-Fuller (ADF) test. Second, the Johansen co-integration test is used to examine whether the variables under investigation have common trends in the long run. Next, causality testing techniques in the Granger framework are used to examine the causality relationship in the forms of Wagner's hypothesis and its reverse. Based on the results of the co-integration test, vector autoregressive (VAR) models are used for Pakistan and India. Since a long-run equilibrium relationship exists between the two variables for Sri Lanka and Bangladesh, vector error correction (VEC) models are used to detect the direction of causality. The results reveal a bi-directional causality running from national income to government expenditure and vice versa for Sri Lanka. However, for the remaining three countries, there is no evidence supporting a causality relationship in either direction between the two variables although two variables appeared to be co-integrated in the long-run for Bangladesh. On the one hand, a bi-directional causal relationship implies the importance of treating the two variables jointly in policy making to enhance the economic growth and development of a country. On the other hand, the lack of empirical evidences for a causality relationship running from government expenditure to national income is weakening the perception of particularly developing countries those who tend to consider the government as a major actor in enhancing national income.

Keywords: Causality, Granger, South Asia, VAR, VEC, Wagner's Law

Abstract No: MO-15

Visible light sensitized antibacterial paint using copper doped TiO_2 nanoparticles

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Bacteria can survive on surfaces increasing the possibility of transmission of diseases. Places such as food-processing facilities, restrooms, and hospitals have a high risk and require some additional protection against bacteria. Paints can be an attractive antibacterial method boosting their value as a coating and eliminating the need for additional antibacterial methods on surfaces. Titanium dioxide (TiO_2) nanoparticles would be the ideal antibacterial material to be incorporated to produce antibacterial paints, due to their photocatalytic, chemically stable, non-toxic properties and low cost. The antibacterial activity of TiO_2 results from its photocatalytic activity. However, due to its wide bandgap (3.2 eV) and fast recombination rate of photogenerated species, TiO_2 is activated only under high energy radiation such as ultraviolet radiation. The ultraviolet radiation accounts for nearly 3% and visible light for 45% of the solar radiation at ground level of the Earth. Modifying TiO_2 nanoparticles into a visible-light sensitive material, would make TiO_2 nanoparticles and the paint a self-activating antibacterial material. Reducing the bandgap is the best way to do this modification and, in this project, copper has been doped into the TiO_2 nanoparticles to reduce the bandgap (the band gap was reduced to 2.5 eV). Sol-gel technique was used to synthesize and dope the nanoparticles. Pure and 3%wt Cu-TiO_2 nanoparticles were synthesized. X-ray fluorescent (XRF) data was used to confirm the doping concentrations of the synthesized Cu-TiO_2 nanoparticles as 3%wt. X-ray diffraction (XRD) data was used to identify the phase of the nanoparticles as anatase. Using UV-visible spectroscopic data, the radiation absorption of the nanoparticles was observed to be shifted from 190×10^{-9} m to 350×10^{-9} m with the copper doping. The scanning electron microscopic (SEM) data confirmed that the particle sizes were in nanometer range both for pure and doped samples. Antibacterial activity of the paints was tested using agar well diffusion method with the visible light and without the visible light against the bacteria *Escherichia coli* (Gram-negative) and Methicillin-resistant *Staphylococcus aureus* (Gram-positive). The inhibition zones (clear circular area in which bacteria are unable to grow, around antimicrobial wells) of Ciprofloxacin ($C_{17}H_{18}FN_3O_3$) (a well-known antibiotic) was compared with the inhibition zones of paints. The unmodified paint showed 0.2 and 0.1 of the antibiotics' effect against Gram-positive and Gram-negative bacteria, respectively. Addition of TiO_2 increased it up to 0.27 and 0.27. Exposure to the visible light increased it further up to 0.3 and 0.3. Addition of Cu-TiO_2 increased it to 0.47 and 0.5. Exposure to visible light has increased it further to 0.57 and 0.63. The standard deviation of these values was 0.18. Copper doped TiO_2 has significantly increased the antibacterial activity of the paint against both types of bacteria. A better effect was observed in the visible light as compared to the condition without the visible light.

Keywords: Antibacterial, Bandgap, Solar radiation, Titanium dioxide

Abstract No: MO-16

Undergraduates' perception on Collaborative learning; A case study based on Faculty of Health-Care Sciences, Eastern university, Sri Lanka

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Currently, higher education is moving towards student-centered learning from teacher-centered learning, to enhance the active involvement of the students in the teaching-learning process. As a student-centered learning approach, Collaborative Learning is an active learning strategy where students work in small groups to optimize their teaching-learning activities. It promotes the students to help and support each other by working as a team. Collaborative Learning is important in Health care education since the health professionals work as a team in order to solve complex problems and as well as to serve their community. To facilitate the collaborative learning strategy among undergraduates, this study aimed to assess the students' perception on Collaborative Learning. Third-year first-semester Medical and BSc Hons (Nursing) undergraduates were included in this cross-sectional descriptive study following a small group discussion. Out of 72 Medical students, 52 students participated in this study. And out of 32 BSc Hons (Nursing) undergraduates 23 students responded. A self-administered questionnaire was used to collect the data by using Google Forms. The questionnaire consisted of five perception statements with a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). Descriptive statistics were used to describe the students' perception on collaborative learning. Chi square test was used to identify the significant difference between MBBS and BSc Hons (Nursing) Undergraduates on collaborative learning. The majority of the participants prefer the collaborative learning method over the traditional teaching method. 57.7% Medical & 56.5% BSc Hons (Nursing) undergraduates strongly agreed that Collaborative Learning improves their active participation in the classroom. 98.1% of medical undergraduates perceived that they could build strong relationship with their peers while attending Collaborative Learning. A chi-square test showed that there was no significant difference between medical and BSc Hons (Nursing) undergraduates. The general outcome of this study revealed that the undergraduates of the Faculty of Health-Care Sciences, Eastern University, Sri Lanka have a positive perception on Collaborative Learning.

Keywords: Active Learning, Collaborative Learning, Medical undergraduates, Nursing undergraduates, Teaching-Learning

Abstract No: MO-17

An attempt to establish a cutoff value for peripheral blood hematopoietic progenitor cell count to predict the viable CD34 count in multiple myeloma patients undergoing autologous peripheral blood stem cell transplantation

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Multiple myeloma (MM) is a common hematological malignancy characterized by the proliferation of abnormal plasma cells in the bone marrow, leading to immune dysfunction and bone damage. Autologous peripheral blood stem cell transplantation (aPBSCT) is a pivotal treatment for MM, extending survival rates. The success of aPBSCT relies on the composition of the mobilized peripheral blood cells, particularly the hematopoietic progenitor cells in peripheral blood (HPC_PB). In aPBSCT, viable CD34 cell count (V_CD34) which is enumerated by the flow cytometer (FC) is used to calculate the minimum stem cell yield required for a successful transplantation. Therefore, detecting the optimal HPC_PB count in relation to V_CD34 is crucial for enhancing the effectiveness of aPBSCT and also for the proper management of MM patients. To establish a cutoff value for HPC_PB using an automated hematology analyzer (AHA) as a predictor for V_CD34 in the peripheral blood of MM patients undergoing aPBSCT. This initiative aims to replace or supplement the flow cytometry (FC) facility with AHA, as AHA provides a cost-effective, user-friendly, faster, and more accessible method for assessing cellular profiles during PBSCT. This transition addresses the limitations of the FC technique, which encompass high expenses, complexity, the demand for specialized personnel, substantial sample sizes, time-intensive procedures, and restricted availability. MM patients representing males (n=23) and females (n=22) at the age of 40-65 years, admitted to the Bone Marrow Transplant Unit (BMTU) in Apeksha Hospital, Maharagama, Sri Lanka were selected for the study (n=45). The ninth day from the mobilization of the bone marrow cells was considered as the day of harvesting. The Sysmax-1000 AHA was used to enumerate HPC_PB and, V_CD34_PB was enumerated by flow cytometer (FC) BDACS Lytic ™ using already collected samples for routine testing. First, the data were separately tested for normalization, followed by correlation bivariate analysis and, Receiver Operating Characteristic (ROC) curve analysis to establish relationships and cutoff values for HPC_PB respectively. In the ROC analysis, the two groups of V_CD34_PB were defined as; Group 1 <90 cells/µL & Group 2 >=90 cells/µL.In the statistical analysis, the HPC_PB_AHA showed normal distribution while V_CD34_PB_FC did not follow it. HPC_PB possessed a significant (p=0.000) strong positive Spearman bivariate correlation (r = 0.930) with the V_CD34_PB. The cutoff value obtained for the HPC_PB is 89 cells/µL, at V_CD34_PB of 90 cells/µL with sensitivity (97.1%), specificity (99.9%), and area under the curve of 0.978 with statistically significant (p=0.022 <0.05). Accordingly, the HPC_PB_AHA could be suggested to use as a predictive marker to determine the V_CD34_PB_FC. This enables to conduct aPBSCT even in peripheral hospitals in the absence of FC by employing cost effective AHA methods. However, these initial findings should be validated by conducting more research with the increasing number of patients that includes a variety of clinical and demographic variables.

Keywords: Autologous Peripheral Blood Stem Cell Transplantation, Flow cytometer, Hematopoietic progenitor cells, Multiple Myeloma.

Abstract No: MO-18

Deep learning driven mobile robot to detect and classify tomato leaf diseases

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Tomato (*Solanum lycopersicum L*.) is a nutritious fruit widely grown as a vegetable in Sri Lanka, with various varieties including HORDI tomato hybrid 03, Thilina, etc. Plant diseases affecting tomato crops result in reduced production and require continuous manual monitoring for diagnosis. Due to the increasing agricultural yields, plant diseases are also on the rise, often affecting the leaves. Traditional methods of disease detection are time-consuming and pose challenges for large-scale farmers. This research focuses on employing a deep learning-driven mobile robot to detect and classify tomato leaf diseases, offering a more efficient and farmer-friendly approach. The system comprises a rover with an adjustable robotic arm holding a camera that can reach a height of up to 03 feet that travels across tomato fields to detect tomato plants and capture images of the tomato leaves. The control system of the mobile robot consists of three stages; the first stage controls the robot chassis with an Arduino board, interpreting user commands for movement. The second stage uses another Arduino board to manage behavior, including obstacle avoidance and navigation. The third stage involves a Raspberry Pi board controlling a camera module for imaging and video capturing for object recognition. I2C, SPI, and serial communication protocols facilitate smooth coordination between the boards, allowing easy development, debugging, and upgrades of individual components. The acquired data via the robot system were utilized for disease diagnosis, classification, and decision-making in the care of tomato plants. Two deep learning-driven computer vision models were developed for disease prediction. The object detection model enables the robot to identify leaves and locate the robot arm. The classification model is employed for the classification and prediction of tomato leaf diseases. The object detection model was trained using 352 annotated tomato leaf images, including leaf blight, leaf miner, and powdery mildew and the model demonstrated a precision of 67.0%, a mean average precision of 65.6%, and a recall of 61.7%. In addition to the object detection model, the deep learning classification model was trained using a dataset of 3360 tomato leaf images, encompassing healthy leaves as well as leaves affected by diseases namely; leaf blight, leaf miner, and powdery mildew. The developed classification model achieved an accuracy of 99% and a loss of 1% on the test data. Further, an Android mobile application was developed utilizing the same object detection and classification models, to enhance farmer accessibility and convenience for efficient management of tomato crops.

Keywords: Android application, Computer vision, Deep learning, Mobile robot, Tomato leaf diseases

Acknowledgment
This work was financially supported by the Department of Instrumentation and Automation Technology, University of Colombo.

Abstract No: MO-19

Avocado seed and skin - based dyes for treatment of linen fabrics

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This research paper investigates the feasibility and sustainability of using avocado waste as a natural dye for cellulose-based fabrics, specifically focusing on linen materials. Avocado seeds and skins were utilized to develop a cost-effective dyeing technique. Avocado, a globally recognized fruit with substantial presence in Sri Lanka, offers an easily accessible and eco-friendly source of raw materials for dye production. Both dried and fresh avocados can be employed for this purpose. In light of the environmental and health concerns associated with synthetic dyes, exploring eco-friendly alternatives derived from food waste has gained significance. This study delves into the chemical composition of the natural dye, assessing its advantages and distinguishing characteristics between avocado pit and skin extracts. Avocado seeds are rich in the natural mordent "Tannin," facilitating effective fabric dyeing. To achieve our research objectives, various color extraction techniques were examined, along with appropriate mordents, to optimize the dyeing process following established literature procedures. Hydro extraction emerged as the most eco-friendly and cost-effective method for dye extraction. Natural and less harmful mordents such as Soy Milk and Alum were employed to ensure color fastness, while iron mordant was used for color modification. Subsequently, these hydro extraction and encapsulation methods were applied to prepare the dye for linen fabric dyeing. The paper underscores the importance of evaluating the fastness properties of avocado dye on linen materials, as their durability directly affects usability and value. Through hydro extraction and encapsulation techniques, efforts were made to enhance fastness properties. The study's findings indicate a significant improvement in fastness properties after encapsulation, contributing to sustainable fabric dyeing practices. This highlights the potential of food waste as a valuable resource for the textile industry. By substituting harmful synthetic dyes with eco-friendly alternatives derived from avocado waste, this research aims to mitigate the environmental impact of textile production, particularly in regions heavily reliant on the textile industry. Emphasizing the significance of adopting environmentally responsible dyeing practices, this study paves the way for a greener and more sustainable future in fabric dyeing.

Keywords: Sustainability, Smart Material, Natural Dyes, Avocado Dyes

Acknowledgment
This work was supported by the Faculty of Engineering Technology, the Open University of Sri Lanka, under the Faculty Research Grant for Undergraduate Research Projects.

Abstract No: MO-20

Development of robust superhydrophobic plastic sheets using diatomaceous earth

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Superhydrophobicity is the ability of a surface to repel water droplets. Surfaces that exhibit a static water contact angle (WCA) exceeding 150° and a sliding angle less than 10° can be defined as superhydrophobic surfaces. The unique properties of superhydrophobicity include self-cleaning, drag reduction, anti-fouling, anti-corrosion etc. Several methods are employed in developing superhydrophobic surfaces, yet incorporating a superhydrophobic filler is a more convenient method which is utilized in this research. This study discusses a progressive development of a method to enhance the hydrophobicity of plastic substrates using Diatomaceous Earth (DE) as the superhydrophobic filler. In this study, the focus was on developing superhydrophobic plastic substrates with enhanced mechanical durability and stability since one of the primary concerns of superhydrophobic surfaces is their mechanical performance. The fundamental requirements for producing superhydrophobic substrates are nanoscale surface roughness and low surface energy. The nanoscale surface roughness was obtained through DE, whereas low surface energy was attained by treating DE with hexadecyltrimethoxysilane (HDTMS). The surface wettability and morphology were evaluated through WCA measurements and scanning electron microscopy (SEM) analysis, respectively. By using HDTMS to DE ratio of approximately 38% (w/w), superhydrophobic properties were achieved for treated DE with WCA around 160°. In the first approach, treated DE was incorporated into plastic substrates through melt mixing process to achieve the inbuilt hydrophobic property. Incorporation of treated DE into high-density polyethylene through melt mixing process resulted in hydrophobic plastic sheets possessing WCAs of around 99° with treated DE particle loading of 10%. The treated DE amount was not further increased due to the reduction of mechanical properties of the plastic sheet. The hydrophobicity did not reach the expected level. As revealed by SEM and SEM coupled with energy dispersive X-ray analysis, the DE particles had been destroyed and trapped within the plastic matrix during the melt mixing process. Compression molding technique was also employed to fabricate a thin layer of treated DE on the plastic substrates. Yet, it was observed that the adhesion between the DE layer and the plastic substrate was not satisfactory and the WCAs were drastically reduced after removing the loosely bound DE powder of the coating. By utilizing the solvent casting method and a subsequent lamination step, robust superhydrophobic coatings on poly(vinyl chloride), which can be considered as a polar plastic substrate, were successfully developed. The coating consisted of treated DE particles held together by an epoxy resin binder, ensuring both the cohesion of the coating and its robust adhesion to the substrate. The prepared coatings showed a remarkable level of superhydrophobicity, surpassing the threshold WCA of 150° and good mechanical properties.

Keywords: Coatings, Contact angle, Diatomaceous earth, Robust, Superhydrophobic

Acknowledgment
This work was supported by University of Sri Jayewardenepura, Sri Lanka under the research grant ASP/01/RE/SCI/2021/06.

Abstract No: MO-21

An automated machine learning approach to detect ***Leishmania*** parasites: An alternative tool for Leishmaniasis disease diagnosis

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Leishmaniasis is a neglected tropical disease caused by a protozoan parasite that poses a significant threat to human life on a global scale. Leishmaniasis is endemic in 99 countries with more than 12 million people infected. Despite being the primary diagnostic method, microscopy needs technical expertise. Since there is no systematized surveillance programme for Leishmaniasis in Sri Lanka, trained personnel to be involved in disease diagnosis by microscopy is limited and only a few health care institutions have such trained individuals. Therefore, this study aimed to study the feasibility of using an automated machine learning programme to detect *Leishmania* parasites in the microscopic fields. A machine learning model is built on the TensorFlow framework and employs a combination of Convolutional Neural Networks for feature extraction and classification. A total of 150 views of 75 microscopically positive slides for *Leishmania* parasites (amastigotes) were photographed. Slides that were negative for the parasites were also captured in similar numbers. All captures were fed into the model and tested with 25 positive and negative fields. The machine learning model developed in this study detected 94.1% (n=34) negative fields as negative for *Leishmania* parasites. Of the positive fields, 93.3% (n=32) of them were detected as positive for the parasites by the developed model. The model indicated 92% accuracy for the detection of *Leishmania* parasites in the microscopic fields. This level of accuracy can significantly enhance early detection and prompt treatment, potentially reducing the disease burden, complications, and healthcare costs in regions where resources are limited. The model's versatility permits this approach to be adapted for the detection of other parasitic diseases in Sri Lanka which are not common at present. The proposed method would be a better alternative to disease diagnosis in low-resource settings with limited technical expertise. However, it is recommended to validate the model with more sample data to obtain a better accuracy and applicability.

Keywords: Machine learning, Leishmaniasis, Automated Diagnosis, Parasites.

Abstract No: MO-22

Selecting suitable locations to establish a ground solar farm in Trincomalee District in Sri Lanka using GIS

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Renewable energy is energy derived from natural sources that are regenerated at a higher rate than consumed. One of the examples of the most effective renewable energy sources is solar energy, which is derived from the sun. Solar energy can be extracted directly or indirectly for human use. With the rapid growth in energy demand, solar energy has led to an increased interest in power generation. In Sri Lanka, solar energy investments have developed rapidly in recent years. The ground solar farm is one of the solar energy harvesting types for electricity generation, especially at the industrial level. Our main focus is to provide an additional power supply to the National Grid of Sri Lanka, and this study focuses on utilising Geographic Information Systems (GIS) to identify suitable areas for establishing a ground solar farm in the Trincomalee District, Sri Lanka. Trincomalee District has a tropical wet and dry climate with high sunlight. According to that Trincomalee District was selected as the study area by considering solar irradiation and by focusing on the cumulative solar power plant capacity in Sri Lanka. According to the literature review, various factors can be useful for selecting locations for a ground solar farm. Land surface temperature, slope, land use, and proximity to roads were selected as criteria for this case study. The separate criterion maps were generated and they were reclassified according to the requirements, and those were used with Analytical Hierarchical Process (AHP) to find the weights for overlay analysis in GIS. The resulting final factor map shows a land area of 24.47 km^2 for Trincomalee District as highly suitable for establishing a ground solar farm. This case study aims to reduce the overconsumption of natural resources that are used to produce energy and to ensure the protection of the environment through using renewable energy.

Keywords: GIS, Ground solar farm, Suitability analysis, Analytical Hierarchical Process (AHP), Sri Lanka

Abstract No: MO-23

Implementing an Automated Personal Name Authority File for Enhanced Information Retrieval in Sri Lankan Library Online Public Access Catalogues

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In the digital era, managing vast information collections while ensuring seamless access for patrons is a challenge faced by Sri Lankan libraries. A critical aspect that significantly affects information retrieval is the accuracy and consistency of personal names in Online Public Access Catalogs (OPACs). To address this issue, this paper proposes the implementation of an Automated Personal Name Authority File (APNAF) system, which offers a viable solution to enhance information retrieval, improve user experience, and foster an organized and user-friendly OPAC environment. The objectives of implementing APNAF in Sri Lankan libraries encompass enhancing search precision and recall in OPACs, minimizing name-based retrieval errors and confusion, facilitating efficient data maintenance and updates, and promoting standardization and consistency in personal name entries. To conduct the study, an author's name dataset was selected from the National Library of Sri Lanka, one of the largest libraries in the country. The approach utilizes the Jaro-Winkler algorithm to analyze similarities in names, addressing complexities such as variations in names, spelling errors, and differences in word order. The dataset initially contained 77,000 records, which were subsequently refined to 44,000 unique data points. Through a thorough and meticulous examination, we discovered essential patterns, trends, and correlations within the dataset, providing valuable insights that greatly enriched our understanding of the subject matter. The study revealed pronounced similarities in names within multilingual datasets, accompanied by instances of confusion in transliteration. Clear cross-linguistic correlations came to light, notably in cases where Sinhala and English names exhibited shared linguistic components. These shared elements resulted in both visual and phonetic resemblances. The research delineated four distinct iterations of Sinhalese name clusters, which are summarized as follows: name similarity within multilingual datasets, transliteration conventions, cross-linguistic connections, and variations, along with exceptions. Further, our analysis revealed a trade-off between accuracy and recall in duplicate name detection and the Jaro-Winkler algorithm proved effective in identifying despite variations in spelling, typos, or minor differences in naming conventions. To address these challenges, the implementation of the system in Sri Lankan libraries can significantly enhance the efficiency of information retrieval. This system simplifies the process of entering data into the Online Public Access Catalog (OPAC) by facilitating the selection of unique author names for catalog records.

Keywords: OPAC, National Library of Sri Lanka, Personal Name Authority File, Jaro-Winkler algorithm, Library

Abstract No: MO-24

A study of the correlation between local meteorology and atmospheric particulate matter in Kandy and Battaramulla in Sri Lanka

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Air pollution due to particulate matter (PM) remains a significant environmental concern, especially in urban areas. This study examines the relationship between PM concentrations and meteorological parameters of two locations Kandy and Battaramulla, Sri Lanka, during 2020. Hourly data from ambient air quality monitoring stations were analyzed, focusing on $PM_{2.5}$ and PM_{10} levels, along with ambient temperature, solar radiation, precipitation, and wind speed. The Pearson correlation in R software was employed to quantify the linear relationships. In Kandy, $PM_{2.5}$ showed a very weak positive correlation with ambient temperature and solar radiation, and PM_{10} exhibited weak positive correlations with all meteorological parameters except precipitation, indicating that higher levels of observed meteorological factors may be associated with slightly increased $PM_{2.5}$ concentrations. In contrast, $PM_{2.5}$ in Battaramulla showed a weak negative correlation with wind speed, ambient temperature, solar radiation, and precipitation, indicating that higher wind speeds might be associated with slightly lower $PM_{2.5}$ concentrations, while PM_{10} showed weak negative correlations with ambient temperature, solar radiation, and rainfall, implying that higher values of these meteorological parameters might be associated with slightly lower PM_{10} concentrations. These statistically insignificant correlations suggest that meteorological factors have a limited influence on PM concentrations in both locations. Further research and in-depth analyses are recommended to comprehensively understand the complex interactions between PM and local weather patterns to develop effective air quality strategies for the existing PM issues in Kandy and Battaramulla.

Keywords: Air Pollution, Air Quality Monitoring, Meteorological Factors, Particulate Matter (PM), Urban Areas

Abstract No: MO-25

Investigation of gelatin and sodium alginate as gelling agents for emulsion gel polymerization of styrene under reduced temperature

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Throughout the years scientists have investigated different polymerization methods to reduce the required temperature of the polymerization. As a result, emulsion gel polymerization was discovered. This method got attention due to its advantages such as an eco-friendly process, lower consumption of energy, higher yields, ability to provide high molar mass polymers, and the ability to scale up to the industrial level. The general objective was to check the ability of gelatin and sodium alginate as candidates for gelling agents in emulsion gel polymerization of styrene at room temperature. Apart from the general objective, the optimal amounts of gelatin and sodium alginate for emulsion gel polymerization were investigated. The surface morphology of the resultant polymer composite was investigated using a scanning electron microscope (SEM). Four components were used in this polymerization. Styrene was chosen as the monomer and AIBN was the initiator. Cetyltrimethylammonium bromide (CTAB) was used as the surfactant to form an emulsion. Gelatin and sodium alginate were investigated as gelling agents. Calcium chloride was used as a cross-linking agent for sodium alginate samples. The mixture of styrene, AIBN, and gelling agent (gelatin or sodium alginate with calcium chloride) was shaken with a vortex mixer (60s). Then Aqueous solution of CTAB was added and vortexed (60s). Then the samples were kept in a dark for 24 h and then ventilated for another 24 h. Finally, the samples were dried in a desiccator for 24 h. The resultant polymer was extracted to toluene and precipitated in distilled water. Weight conversions were used to determine the optimal gelling agent weight for the polymerization. For gelatin, the optimal gelling agent weight was 0.05 g/ml of styrene and the sample showed an 88.9% polymerization conversion. Sodium alginate's optimal weight was 0.1 g/ml of styrene. The optimal weight ratio between sodium alginate and calcium chloride was found to be 1:2. Sodium alginate resulted an 89.2% of polymerization conversion under the optimum conditions. According to SEM images the Polystyrene/Gelatin composite consisted of a smoother surface with very small pores. Polystyrene/Sodium alginate composite showed box-shaped polystyrene particles. Through this research, we were able to successfully polymerize styrene at room temperature using new gelling agents of gelatin and sodium alginate. As the recommendations for this study, several optimizations and new pathways can be investigated. Such as investigation of the polymerization rate for both sodium alginate and gelatin. Other gelling agents can also be investigated using the emulsion gel technique.

Keywords: Emulsion gel polymerization, Gelatin, Low-temperature polymerization, Polystyrene, Sodium alginate

Acknowledgment
This work was supported by University of Sri Jayewardenepura, Sri Lanka under the research grant ASP/01/RE/SCI/2021/06.

Abstract No: MO-26

Impact of Wastewater Treatment Plant on the Quality of Water in the Canals Passing Through Kurunegala City

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Water scarcity is a growing concern worldwide, leading to the adoption of innovative treatment solutions. Urban stormwater drains collect runoff and wastewater released from many urban entities. Canals passing through Kurunegala city have been a traditional means of irrigation but also serve as stormwater drains collecting polluted water causing public health problems. Communities have complained about commercial establishments, residents, institutions, and hospitals releasing untreated wastewater into these canals. In response, the Greater Kurunegala Sewage Treatment Plant (GKSTP) was commissioned to address the issue in 2018. The GKSTP is not covering the whole city and is not operated up to its maximum capacity (73% of the capacity is operated). This study aimed to investigate the impact of wastewater treatment by the GKSTP on water quality in canals passing through Kurunegala City. Water samples were collected from seven sampling sites along the canals during the dry (DS) and wet (WS) seasons. Physical, and chemical parameters were measured to determine the water quality from each sampling point. The study employed General Linear Model (GLM) to assess the spatial and temporal variations in physicochemical parameters of water. Cluster analysis identified patterns, and Analysis of Similarities evaluated the significance. Distance-based Redundancy Analysis analyzed overall parameter influence on seven locations. The effectiveness of the GKSTP in improving water quality was evaluated using the Water Quality Index (WQI). Physicochemical parameters of water along Kurunegala city canals exhibited notable spatial and temporal variation ($p<0.05$, GLM). The WQI of the canals in 2005 was around 35.2, indicating bad water quality, however, at present, it is 49.4, indicating a significant improvement in water quality ($p<0.05$, ANOVA). However, the current WQI is still not satisfactory as it depicts that the GKSTP has not been able to achieve good water quality ($90>WQI>69$) in the canals. The GKSTP has a positive impact on the water quality of the canals, with significant reductions observed on key indicators of organic pollution and sedimentation, such as BOD_5 and TSS. Improvements have been noted in nitrate levels, indicating a reduction in acidity and nutrient pollution. These findings suggest that the GKSTP is partially effective in removing pollutants from the canals. Unconnected areas need to be connected to the GKSTP to improve the effectiveness of the treatment plant.

Keywords: Pollution, Treatment plant, Urban canal, Wastewater, Water Quality Index

Abstract No: MO-27

GIS based multicriteria analysis for flood hazard assessment: A case study from Walawe River basin, Sri Lanka

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Flood hazard mapping has been recognized as a crucial task supporting disaster management efforts. For the study, the lower reach of the Walawe River, which drains the suburbs of the island's southern region, was selected due to its regular flooding. This study used ArcGIS and remote sensing data, and the river basin extent was extracted from satellite images available for the Walawe River, Sri Lanka. Multi-criteria decision analysis (MCDA) was used in this process. The main criteria evaluated are land use, rainfall data, drainage density, elevation, slope, and soil type around the river basin. These criteria are reclassified into five categories depending on the highest to lowest risk of vulnerability to flood. The Analytical Hierarchical Process (AHP) was used to give the weights for the mentioned criteria, and as the outcome, the weighted overlay map (flood hazard map) was obtained and classified under five categories. According to the results, the flood hazard assessment map shows that 25.74% (646.09 km^2) and 1.92% (48.13km^2) of the study area was under high or very high hazard levels, respectively, with more populated regions, water bodies, and agricultural land, as well as low-lying flat terrain with lower elevations. The Walawe River basin's lower watershed has high and very high flood-prone areas, while the upper catchment has low and very low flood-prone areas, according to the geographical distribution of the flood hazard map. Low and very low flood hazard zones comprised 18.63% of the total area, whereas moderate flood hazard areas comprised most of the basin. According to the current study, this aims to identify areas within the Walawe River basin that are at risk of flooding, to assess the potential impact of floods on people, property and the environment which support the development of flood risk reduction measures and to provide public awareness.

Keywords: Causative Factors, Flood Hazard Mapping, GIS, Multicriteria Analysis, Remote Sensing

Abstract No: MO-28

Spatial distribution of soil and water quality in Eldeniya - East grama niladhari division

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Water is becoming a consequential part of the daily life of humans. Therefore, mapping of soil and water quality parameters is required for regular monitoring of them to provide the necessary evidence to make decisions on managing water and soil quality today and in the future. Furthermore, mapping soil and water quality parameters is necessary for environmental monitoring, agricultural management, land use planning, water resource management, and conservation efforts. This research analyzes soil and water quality parameters in the Eldeniya-East grama niladhari division, Gampaha district. Fifty-six samples of soil and water were collected from the selected area. Water quality parameters pH, conductivity, nitrate content, phosphate content, and hardness were analyzed, and soil quality parameters pH, nitrate content, soil organic matter content, Na^+, K^+, and Ca^{2+} content in the soil were analyzed. Then their spatial distribution was represented as contour maps. pH was analyzed using a pH meter and the pH of water samples lies between 3.79 – 7.18. Except for one, all the other water samples gave acidic pH. Suggesting that Eldeniya-East has almost all acidic water sources. The conductivity of water samples was measured using a conductivity meter and the obtained values lie between 54.0 µS/cm – 403.0 µS/cm. All the samples gave extremely low conductivity values. Water-soluble phosphate was not detected in the water samples. This suggests that water sources within this area are not contaminated with excessive amounts of phosphates. Nitrate content was measured using an ion-selective nitrate electrode and the obtained values lie between 59.5 ppm to 168.0 ppm. According to EPA, this area's water sources have nitrate contents higher than the safe levels for drinking water. The calcium hardness of water samples lies between 0.00 – 59.92 mg CaCO3/L, and Mg^{2+} was not detected. According to Sawyer and McCart's classification, all water samples are categorized as soft water. The pH of the soil samples lies between 3.07 – 6.68 where all are acidic pH values. Considering obtained soil and water pH values, it can be said that the study area has a considerable acidic nature. Nitrate content in soil samples lies between 52.2 – 217.0 ppm and a linear relationship exists between soil nitrate content and the water nitrate content. SOM of soil samples was measured using the Walkley–black method, and SOM lies between 0.000 – 12.930 %. According to the results, this area contains water-soluble calcium in a range of 0 - 2 mg/L, water-soluble sodium in a range of 6 - 18 mg/L, extractable sodium in a range of 1 - 56 mg/L, water-soluble potassium in a range of 1 - 12 mg/L and extractable potassium in a range of 9 – 108 mg/L. This analysis, which has been conducted as a pilot project covering only one grama niladari division can be further extended to map the entire country which then can be used for the continuous investigation of soil and water quality parameters.

Keywords: Mapping, Water, Soil, Samples, Distribution

Abstract No: MO-29

Development of energy briquettes using *Schleichera oleosa* (Ceylon oak) wood, *Oryza sativa* (rice husk, rice straws and rice brain) and *Saccharum officinarum* (bagasse)

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Fossil fuels and firewood are the primary household energy sources in Sri Lanka. However, due to the economic crisis and the increasing inflation, fossil fuels are no longer a preferable choice. The use of firewood also has limitations, such as household air pollution due to the accumulation of smoke and toxic compounds causing immediate health issues. One of the solutions to this problem is the use of charcoal energy briquettes. Charcoal energy briquettes are compressed blocks made from pyrolyzed biomass residues. Burning these briquettes as an energy source, minimizes household air pollution and is energy efficient and cost-effective. Sri Lanka, a tropical agricultural country with significant vegetation growth, has great potential for developing carbonized charcoal briquettes from biomass energy sources such as ceyloan oak, rice husk, rice straws, bagasse and rice brain. In this study, *Schleichera oleosa* wood (Ceylon Oak) was used as the main component of the briquettes, as it was known to have a high calorific value. Ceylon Oak is used in furniture manufacturing, producing a large amount of sawdust waste, and this sawdust could be efficiently utilized to produce briquettes. Further, rice husk, rice straws, and bagasse with high ash content were used as additives to increase the burning time of the briquettes. Rice brain was used as the binding agent. During the study, the mixing ratios of the raw materials, pressure, and moisture content were varied to enhance the efficiency of the briquettes. Biomasses were pyrolyzed (300 °C, 1 h) to produce biochar. Different biochar mixtures (particle size < 2 mm) were compressed under different pressures (10 kPa - 60 kPa) using a newly innovated compressing machine to produce briquettes (OD: 4.15 cm, Height: 3.34 ±0.48 cm). They were dried in an oven (50 °C) by varying the drying time (48 h, 72 h, 86 h, and 110 h) to change the moisture content. For each briquette produced, proximate analyses were carried out by measuring moisture (2% - 75%), volatile matter (20% - 36%), ash (10% - 30%), and fixed carbon content (38% - 70%). Calorific values were estimated based on the proximate analyses. The calorific values measured were in the range of 19,340 kJ kg^{-1} – 27,983 kJ kg^{-1}. Cooking efficiencies calculated were in the range of 2.5 kJ kg^{-1} - 27 kJ kg^{-1} exhibiting the potential of using these briquettes as a household energy source. According to this study, *Schleichera oleosa* and rice brain mixture 3:1 (w/w) ratio, showed the highest heating value and the highest cooking efficiency. The addition of rice husk, rice straw, and bagasse reduced the cooking efficiency of the briquettes. This study can be further extended to optimize other parameters of the briquettes (size, moisture content, compressed pressure and mixing ratios) to further enhance the cooking efficiency and burning time.

Keywords: Sustainable energy, biochar, briquettes, *Schleichera oleosa (Ceylon oak)*, cooking fuel

Acknowledgment
Financial assistance was received from the AHEAD ELTA-ELSE grant promoting undergraduate innovations.

Abstract No: MO-30

Mosquito detection and repellent system using acoustics signals for household use.

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There are over 130 mosquito species in Sri Lanka, and this abundance may be the reason for the spread of several critical diseases. Therefore, an effective mosquito repellent system, including a mosquito detection mechanism, is essential for daily life. Using acoustic signals is a harmless and cost-effective method for detecting and repelling pests compared to other visual or thermal processes. Therefore, this research investigates a novel approach for detecting mosquitoes and creating an effective mosquito-repellent mechanism based on acoustic signals. A system capable of distinguishing mosquitoes from other sound sources based on their unique wing flapping frequency was built and repelling them using specific ultrasonic frequencies was realized. The system consists of several components, including microphones, amplifiers, and filters, tested in both simulations and experiments. The methodology involved in determining the wing flapping frequency of mosquitoes by concentrating mosquitoes in a soundproof container, which was found to be within the 800-900 Hz range, with slight differences between male and female mosquitoes. Additionally, the effect of ultrasound in repelling mosquitoes was explored, discovering an effective frequency range of 42 kHz to 44 kHz. The system was subjected to numerous iterations and improvements to enhance mosquito detection sensitivity and the band of repellent frequencies. The final design includes an instrumentation amplifier for cancelling the noises and a second order Sallen-Key bandpass filter for filtering the flapping frequency of mosquitoes. However, due to the limitations of conventional condenser microphones, the discrepancy between simulations and physical implementations appeared. Further, the interference from surrounding noise caused some complications. Despite these obstacles, the results showed the system's potential in detecting and repelling mosquitoes. The system can be improved further by incorporating more sensitive microphones and filter circuits. By providing power with rechargeable batteries, it can be made portable. The flexibility and adaptability of the system design offer exciting possibilities for future enhancements and optimizations. In conclusion, this research advances the field of mosquito detection and repellence, providing new insights into the potential of acoustic signal processing in pest detection and control. Future improvements to the system could significantly contribute to mitigating the risks associated with mosquito-borne diseases.

Keywords: Acoustic filters, Mosquito detection, Mosquito repellent, Pest control technology, Signal processing

Abstract No: MO-31

Quantification and health risk assessment of cadmium and lead content in skin creams sold in the Sri Lankan market.

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Across history, humans used diverse personal care products with a rising global demand over time. Mineral pigments, frequently employed in colored cosmetics, represent a prominent origin of heavy metal contamination within cosmetic products. Increased exposure to heavy metals can trigger adverse health effects. This study aims to analyze Cd and Pb concentrations in skin creams in Sri Lankan market, as well as to evaluate the health implications linked to metal exposure. Skin creams were collected from 21 brands, comprising whitening (3), face (8), body lotions (7), and baby creams (3) categories. Identities were anonymized with codes (W1-W3, F1-F8, L1-L7, B1-B3). Samples were digested and subjected to metal analysis via Inductively Coupled Plasma Mass Spectrometry (ICP-MS). Potential health risks were assessed by analyzing Hazard Quotient (HQ), Hazard Index (HI), and incremental lifetime cancer risk (ILCR). Cd concentrations ranged from 0.013 ± 0.001 to 0.085 ± 0.011 mg kg-1 (mean: 0.039 ± 0.002 mg kg-1) and Pb levels varied from below the limit of quantification (ND) to 1.066 ± 0.047 mg kg-1 (mean: 0.146 ± 0.006 mg kg-1). The average Cd levels in whitening creams, face creams, body lotions, and baby creams were found to range from 0.064 ± 0.002 (W3) to 0.085 ± 0.011 (W2), 0.013 ± 0.001 (F6) to 0.047 ± 0.002 (F4), 0.026 ± 0.001 (L7) to 0.051 ± 0.001 (L3) and 0.020 ± 0.001 (B3) to 0.055 ± 0.001 (B1) mg kg-1, respectively. In whitening creams, face creams, body lotions, and baby creams, the average Pb levels ranged from 0.343 ± 0.062 (W2) to 1.066 ± 0.047 (W3), from ND in case of F7 and F8 to 0.108 ± 0.001 (F6) mg kg-1, from ND in L2, L3, L4, and L6 to 0.203 ± 0.002 (L5) and from ND in B1 and B2 to 0.026 ± 0.002 (B3) mg kg-1, respectively. All Cd values met Canadian (3 mg kg-1) and Germany (5 mg kg-1) standards while Pb levels stayed below Canadian (10 mg kg-1) and USFDA (20 mg kg-1) thresholds. For Cd, W2 had the highest HQ (2.826 x 10-9), while W3 obtained the highest HQ (0.042 x 10-9) for Pb. No significant health risk was found for any sample, implying minimal consumer impact. Cumulative HI was below one, indicating no adverse effects. Cd and Pb ILCR values ranged from 1.273 x 10-11 to 8.619 x 10-11 for Cd and ND to 15.030 x 10-11 for Pb, highest in W2 and W3 respectively. The analysis of Cd and Pb concentrations in various brands has shown minimal levels, consistently below the limits set by regulatory authorities. Evaluation of health risk indicates that their presence remains within acceptable parameters. While frequent dermal contact is not expected to pose a cancer risk for the studied heavy metals, excessive use could lead to long-term health issues. However, it is recommended to maintain continuous monitoring and the presence of other heavy metals in cosmetics, while strictly adhering to established safety thresholds.

Keywords: Beauty creams, Health risk, Heavy metals, ICP-MS

Abstract No: MO-32

Growth patterns of *Aspergillus sp.* in stored rice during the post-harvest storage and their in-vivo growth control by cinnamon oil-chitosan microcapsules

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Rice (*Oryzae sativa L*.) is the most important staple food crop in Sri Lanka. Inadequate storage conditions for rice can result in fungal infestation, leading to the presence of micotoxin that pose significant health risks to humans. A common storage fungus, *Aspergillus sp.* is responsible for producing Aflatoxins in stored grains. The use of cinnamon leaf oil (CNO) as an antifungal agent has garnered attention due to its low toxicity to mammals, high effectiveness, and wide availability. However, the direct application of CNO presents challenges such as volatilization, degradation of active compounds, and imparting unpleasant taste and odor to food products. To overcome these limitations and achieve controlled release, microencapsulation is an effective technique. Understanding and controlling the growth of aflatoxigenic fungi, specifically *Aspergillus sp.* on stored rice is of paramount importance to ensure food safety. In this study, a comprehensive investigation was conducted to assess the in-vivo growth dynamics of *Aspergillus sp.* colonies over a six-month period during the post-harvest storage. The rice samples were carefully stored in separate poly bags and rice packets to monitor any variations in fungal colonization. Microcapsules (MCs) containing cinnamon leaf oil were prepared by inotropic gelation of chitosan crosslinking with sodium tripolyphosphate (STPP 1%). Monthly observations of *Aspergillus sp.* in rice were performed by growing in potato dextrose agar (PDA) media and subsequent spore quantification was carried out using a haemocytometer. The results demonstrated that the spore counts exhibited slight variations throughout the six-month duration. Notably, the highest spore count of 3.02 x 107 mL-1 was observed in the sixth month, suggesting a potential accumulation of viable spores during prolonged storage. To investigate the efficacy of growth control measures, rice grains were inoculated with the spores of *Aspergillus sp*. and assessed the minimum inhibitory dose (MID) of cinnamon oil loaded chitosan microcapsules (CNO-CS-MCs). Remarkably, the *Aspergillus sp.* fungus exhibited growth when exposed to 1 - 5 mg of cinnamon oil within the microcapsules, indicating their role in facilitating fungal proliferation. However, a noticeable inhibition of fungal growth was observed when the oil dose in MCs was increased to 7.5 mg. And free CNO mixed rice grains showed 100 % growth inhibition of *Aspergillus sp*. at 2 mg of oil (MID). Upon further incubation in PDA media, fungal growth was detected in the 7.5-12.5 mg CNO range. And treatments with 15 mg and higher doses exhibited no fungal growth after incubation in PDA media. Therefore, the minimum lethal dose (MLD) of CNO-loaded chitosan microcapsules against *Aspergillus sp*. was determined to be 15 mg. These findings emphasize the promising potential of CNO-CS microcapsules as a mean to control the growth of aflatoxigenic fungi on stored rice.

Keywords: Chitosan, Cinnamon oil, Microcapsules, Stored rice

Acknowledgment
This work was supported by Research council under the research grant RC/MDRG/2021/01.

Abstract No: MO-33

Unlocking the potential of convolutional neural networks for precise classification of finger pulse waves in diabetic patients and healthy individuals

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Pulse wave analysis (PWA) is a valuable technique for assessing the cardiovascular health of diabetic patients. However, it encounters several challenges, including the complexity of pulse wave signals and the need for standardization and validation of measurement methods. Convolutional Neural Networks (CNNs) play a crucial role in addressing these challenges by offering a robust and accurate approach to classifying pulse wave images. Pulse wave analysis offers a cost-effective, time-efficient, highly accurate, and non-invasive method for diagnosing diabetes-related cardiovascular issues. This study aims to investigate the effectiveness of CNN in classifying finger pulse wave images to accurately distinguish between diabetic and non-diabetic subjects, thus enabling non-invasive diabetes diagnosis. The study's methodology comprises four main steps: data collection, data preprocessing, CNN model development, and model evaluation. Primary data, including finger pulse waves, blood pressure, mean arterial pressure, oxygen saturation, and pulse rate, were acquired from the multipara patient monitor. Subsequently, single pulse wave cycles from 50 healthy individuals and 50 diabetes patients were subjected to preprocessing. The CNN model was developed through data collection, preprocessing, and the creation of its architecture, followed by compilation, training, and evaluation, ultimately achieving a 92% accuracy in classifying pulse wave images for non-invasive diabetes diagnosis. Descriptive statistics were used to summarize participants' demographic and clinical data, revealing no significant differences in age, gender, or body mass index between the two groups. The model's ability to discriminate based on pulse wave images highlights its potential for non-invasive diabetes diagnosis. In order to improve accuracy in future work, increasing the dataset size and conducting hyperparameter tuning will be essential for optimizing the CNN model.

Keywords: Convolutional neural network (CNN), Diabetes diagnosis, Non-invasive screening, Pulse wave analysis (PWA)

Acknowledgment
This work was supported by Research and Publication Division at the University of Kelaniya under the research grant RP/03/02/08/03/2022.

Abstract No: MO-34

Study on the effect of banana peel fiber (BPF) as reinforcement in ABS/BPF composites.

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Concerns about plastic pollution have driven efforts to create unique, imaginative materials that are more biodegradable. As a result, natural fibers have attracted a great deal of attention over the years. These substances are currently widely employed as fillers or reinforcements in a wide range of polymer composites. One of the major challenges of employing natural fibers as fillers in composite materials is their incompatibility with polymeric matrices. In this study fibers derived from banana peel (BPF) were used as reinforcement in an Acrylonitrile Butadiene Styrene (ABS) polymer matrix. Different surface pretreatment methods, such as alkaline treatment, dicumyl peroxide treatment, and CTAB treatment, have been employed to enhance the compatibility between banana peel fibers and ABS polymer matrix. FTIR, XRD, and SEM techniques were used to characterize untreated and treated banana peel fibers. Then, utilizing the melt mixing process and compression molding technique, treated and untreated fibers were incorporated to ABS polymer matrix in order to produce banana peel fiber-ABS (BPF-ABS) composites. Tensile strength, flexural strength (3-point bending), impact strength, Shore D hardness, and water absorption capacity of prepared composite samples were tested according to ASTM standards. Laser cutting technique was used to prepare samples for these tests. Overall, the treated fiber incorporated composites outperformed untreated fiber incorporated composites in terms of mechanical properties. The tensile, flexural, and impact strength tests indicated that the treated banana peel fibers and ABS matrix had good interfacial interactions compared to untreated fiber incorporated composites. Out of the three pretreatment methods used in this study, CTAB treated fiber composites showed better mechanical properties compared to other treatment methods. 10%(wt) CTAB treated fiber composites showed the highest tensile strength value which was 28.348 MPa. This was a 25.37% increase compared to pure ABS sample. 15%(wt) CTAB treated fiber composite showed the highest flexural strength value of 15.55 MPa. This was a 5.07% increment compared to pure ABS sample. 10%(wt) CTAB treated fiber composite showed the highest impact strength value of 33300 Jm^{-1}. The optimal fiber concentration for tensile and impact strength was determined to be 10%(wt), whereas the optimal fiber concentration for flexural strength was 15%(wt). This behavior of optimal fiber concentrations was explained by SEM images of the cross sections of prepared BPF-ABS composites. SEM images of composites with optimal fiber concentrations showed a smaller number of voids and fiber pullouts where as other composites showed enhanced number of voids and fiber pullouts suggesting weaker interfacial bonding. Shore D hardness values of all prepared composites were less than pure ABS sample except for 15%(wt) CTAB treated sample which showed a value of 76.5. Water absorption capacities of treated fiber composites were less than untreated fiber composites and CTAB treated fiber composites showed the least water absorption capacity. It was evident that the CTAB treated fibers can improve the compatibility between natural fibers and polymer matrix, leading to enhanced mechanical properties.

Keywords: Banana peel fiber, Acrylonitrile butadiene styrene, Surface pretreatment, Composites

Abstract No: MO-35

Evaluation of phytochemical profile and *in -vitro* antioxidant activity *Suaeda maritima*

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Suaeda maritima, a halophytic plant species from the family Amaranthaceae, possesses unique adaptations that enable it to thrive in high-salt environments. Halophytes contain various bioactive chemicals, including plant polyphenols, which have garnered interest due to their antioxidant properties. This study aims to investigate how the polyphenolic content and antioxidant activity of extracts change across the polar, mid-polar, and non-polar fractions of crude extracts from *S. maritima*. These extracts are obtained from both the aerial parts and the roots of the plant, which were harvested from Seguwantivu area of Puttalam, Sri Lanka. Each dried and powdered plant part was sequentially extracted into hexane, dichloromethane (DCM), and methanol at ambient temperature using cold maceration. The Antioxidant activity of each concentrated extract was determined by 2,2-diphenyl-1-1-picrylhydrazyl(DPPH) assay, and 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid (ABTS) assay , phenolic content by (TPC) by Folin-Ciocalteau method, flavonoid content (TFC) by aluminum chloride assay and condense tannin content (CTC) by vanillin/HCl method. Six sequential extracts of *S. maritima* (from aerial parts and roots) showed antioxidant activity. The results indicated that *S. maritima* shoot extracts have significant levels of polyphenolic compounds ($p=0.05$), with methanolic extracts exhibiting the highest TPC (31.55±1.54 mg GAE/g dw), TFC (18.41±0.91 mg CE/g dw) and CTC (3.66±0.19 mg CE/g dw). In contrast, root extracts showed lower polyphenolic content (23.69±5.63 mg CE/g dw, methanol extract) but still possessed appreciable antioxidant activity (IC_{50}, $0.40\pm0.07\times10^{-1}$ mg/mL DPPH and IC_{50}, $0.69\pm0.02\times10^{-1}$ mg/mL ABTS). The ABTS assays revealed the radical scavenging ability of the extracts, with the methanolic aerial parts extract exhibiting the most potent antioxidant activity (IC_{50}, $0.17\pm0.01\times10^{-1}$ mg/mL) exhibiting it has more water-soluble antioxidants. Overall, Solvent extracts of the *S. maritima* possess antioxidant properties at varying levels. The fraction of polar compounds in the areal parts of *S. maritima* contains a relatively high amount of phenolic compounds and potent antioxidant properties. Moreover, identifying antioxidant properties from halophytes could contribute significantly to developing of natural antioxidants for combating oxidative stress-related diseases.

Keywords: Antioxidants, Free radicals, Halophytes, Phytochemical profile, Oxidative Stress

Acknowledgment: This research was supported by the Science and Technology Human Resource Development Project, Ministry of Education, Sri Lanka, funded by the Asian Development Bank [grant no. CRG/R2/RJ1].

Abstract No: MO-36

Factors affecting to degenerate clinical samples received for Clinical Biochemistry laboratory at the Medical Research Institute, Sri Lanka

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The quality of a patient's sample collection, handling, storage and transport to the testing laboratory affect the outcome of the diagnostic test. Laboratory testing can be broadly categorized into three phases: pre-analytical, analytical, and post-analytical. Notably, a significant portion, around 70% of laboratory errors originate from the pre-analytical phase, resulting in suboptimal samples. Analysis of factors affecting to degenerate clinical samples will help us to improve the overall quality of samples. This research endeavor aims to pinpoint the contributing factors behind the rejection of unsatisfactory samples within the Clinical Biochemistry Laboratory at M.R.I. Unsatisfactory samples rejected by the clinical biochemistry laboratory, M.R.I., at the reception of the samples from January 2021 to December 2022 have been included in the study. Throughout this period, a total of 31824 samples were received in 2021, and 28544 samples were received in 2022. The total number of samples received by the laboratory during the study period was acquired from the Laboratory Information Management System (L.I.M.S.), and details of rejected samples were extracted from the specimen rejection register. Detailed analysis revealed several factors, such as haemolysis (37.3%), Incomplete details of the request form (22.0%), clotting (12.9%), and insufficient volume (7.1%), as key culprits for unsatisfactory samples. Notably, the prevalence of pre-analytical errors resulting in sample rejection within the biochemistry laboratory at M.R.I. during 2022 is lower compared to 2021 (0.75% in 2021 and 0.66% in 2022). Specifically, haemolysis emerged as the primary concern, constituting 37.3% of total rejections in 2021 and 29.3% of total rejections in 2022 during the pre-analytical phase. HbA1C test samples exhibited the highest percentage of rejections, 30.7% and 46.6% respectively in both years. In conclusion, haemolysis stands out as a primary error within the pre-analytical phase. The findings of this study demonstrate the progressive mitigation of pre-analytical errors, with a noticeable enhancement in 2022 relative to 2021. Haemolysis may be due to errors in phlebotomy, sample storage, and transportation. Recommendations include analysing the root causes of haemolysis and providing additional training to hospital staff to decrease sample rejection rates attributed to pre-analytical errors.

Keywords: Clinical Biochemistry Laboratory, Haemolysis, Pre-analytical errors, Unsatisfactory samples

Abstract No: MO-37

Development of herbal tea using pomegranate peel powder from Sri Lankan pomegranate cultivars

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The antioxidant potential of the pomegranate peel of Sri Lankan pomegranate cultivars was well established in our previous work. Since its high antioxidant potential is well correlated with its anticancer properties, the possibility of developing an herbal tea using pomegranate peel powder (PPP) was targeted in the study. Dried pomegranate peel powder (PPP) from *Kalpitiya hybrid (K)*, *Daya (D)* and *Nimal*i (N) cultivars were packed in tea bags (Tb) and sachet packets (Ts) under aseptic condition at room temperature in a covered box for 24 weeks. Tea samples were prepared in two ways: by dipping tea bag (Tb) in hot water (tea samples Kw, Dw and Nw) and by directly adding peel powder in sachet packet (Ts) into hot water (samples Kws, Dws and Nws). Antioxidant capacity and the pH values of the prepared tea samples were monitored at every 3-week interval until the 24th week. Sensory evaluations were done twice, initially and after twelve weeks. Observed total phenolic content (TPC) (mg GAE/ g sample), total flavonoid content (TFC) (mg CHE/ g sample) and ferric reducing antioxidant power (PFRAP) (mmol AAE/ g sample) values were higher in Ts than in Tb. Observed TPC values of Kw, Dw and Nw slowly declined by ~73%, 59% and 66% ,respectively through 24-week period. Reduction of TFC values of Kw, Dw and Nw through 24-week period were approximately 46%, 49% and 52%, respectively. PFRAP values of Kw, Dw and Nw also slowly declined by approximately 65%, 66% and 60%, respectively, through the tested period. Reduction of TPC values for Kws, Dws and Nws were observed as ~40%~ 23% and ~6%, respectively. TFC values of Kws and Dws also slowly declined by ~ 27% and ~20%, respectively. Reduction of PFRAP values of Kws, Dws and Nws were observed as 25%, 35% and 30%, respectively. All these findings indicated that the decline in TPC, TFC and FRAP values through the 24-week period is less in Kws, Dws and Nws than in Kw, Dw and Nw. Tb had higher pH values than Ts. Pomegranate has been used widely by many peoples for more than thousand years. Microbial contamination even after six months was significantly below the countable level. It is below than 30 colonies. Hence, herbal tea preparations can be recommended as safe for consumption even at 6th month. All these findings suggest that antioxidant power of Ts is much higher than that of Tb and the declining antioxidant potential is considerably less in Ts over the 6 month period. Overall consumer acceptability of the tea samples was also at a moderate level.

Keywords: Pomegranate, Antioxidant potential, Herbal tea, Sensory evaluation, consumer acceptability

Abstract No: MO-38

Utilization of Cinnamon (*Cinnamomum verum*) and Turmeric (*Curcuma longa*) to develop novel low glycemic index bread products

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Type II diabetes is a major healthcare problem in the world affecting almost all households and economies. Diet is a crucial factor in the etiology of Type II diabetes and therefore, dietary interventions can be used effectively to prevent and manage the disease. Bread is a staple among all communities which is high in carbohydrates and glycaemic index. Regular consumption of high-glycaemic foods can lead to the onset and development of Type II diabetes. Hence, innovating low-glycaemic indexed bread products is a timely intervention. The study aimed to develop novel low-glycaemic bread products incorporating minuscule amounts of Cinnamon (*Cinnamomum verum*) and Turmeric (*Curcuma longa*) powder without affecting palatability and sensory properties. Initially, breads were formulated with different percentages of Cinnamon and Turmeric powder and separate sensory evaluations were carried out to select the best ones according to sensory perceptions. A semi-trained sensory panel consisting of 30 panellists was used for sensory evaluations and products were evaluated for their Appearance, Aroma, Texture, Taste, and Overall acceptability. Statistically selected best bread products proceeded to human study to calculate the glycaemic index along with a control. Twelve healthy adults were selected for the study on a voluntary basis and finger prick blood samples were drawn in a 2-hour time window, upon ingestion of test foods. Glycaemic index values were calculated using D-glucose as a standard. Calculated glycaemic index values were 57.1±14.94, 45.06±12.34, and 42.98±13.9 for control bread, Cinnamon bread, and Turmeric bread respectively. Thus, it could be concluded that the incorporation of Cinnamon powder and Turmeric powder in minuscule amounts has hindered the glycaemic impact of wheat bread reducing the glycaemic index from the 'medium GI (56-69)' to low GI (≤55) category. The study provides future insights into reducing the glycaemic impact of a diet incorporating functional ingredients. Future research is needed to explore whether the addition of antidiabetic plant ingredients could reduce the glycaemic impact of other high glycaemic foods. These novel products will be greatly beneficial to the diabetic community and the general public and will be highly marketable.

Keywords: Diabetes, Bread, Low glycemic, Cinnamon, Turmeric

Acknowledgment
This work was supported by the International Foundation of Science, Sweden and the Research Council, University of Sri Jayewardenepura under the research grant 1-3-E-6463-1 and Asp/01/RE/SCI/2021/13 respectively.

Abstract No: MO-39

Determination of color characteristics, fatty acid composition and heavy metal in purified shark liver oil.

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Shark liver oil (SLO) is a promising source of fatty acids (FAs) particularly of Omega-3 polyunsaturated FAs including, Eicosapentaenoic acid (EPA- cis-5, 8, 11, 14, 17-eicosapentaenoic acid) and Docosahexaenoic acid (DHA- cis-4, 7, 10, 13, 16, 19-docosahexaenoic acid). SLO as a dietary supplement is one of the best options to overcome health-related problems that arise due to imbalance and insufficient levels of omega-3 FAs. The objectives of this research were to extract and purify omega-3 rich oils from shark livers by traditional method and determine color characteristics, fatty acid composition (FAC), and heavy metals (As, Cd, Pb, and Hg) during purification. SLO was extracted using the conventional heat extraction method. Purification of crude SLO (CSLO) was done using a semi-refining which included, degumming, neutralization, and bleaching to produce purified SLO (PSLO). The color of the SLO was determined using a Chromameter and FAC was determined by Gas Chromatography - Mass Spectrometry. The heavy metals in SLO were determined using Inductively Coupled Plasma-Mass Spectrophotometry after microwave digestion. Both chroma value and hue angle were enhanced during purification, ranging from 15.15 to 35.18 and from 25.17 to 87.68, after each step of purification respectively. Moreover, the total color difference was significantly increased ($p < 0.05$) in every step of purification, with values of 17.02, 30.78, and 39.17, respectively. During purification, the contents of saturated FAs and monounsaturated FAs significantly increased ($p < 0.05$) from 117.63 to 141.53 mg g^{-1} and from 78.91 to 117.53 mg g^{-1}, respectively w hile, polyunsaturated FAs levels significantly decreased ($p < 0.05$) from 141.95 mg g^{-1} in CSLO to 131.09 mg g^{-1} in PSLO, respectively. The omega-3 fatty acids significantly decreased ($p < 0.05$) from 96.35 to 83.83 mg g^{-1} and the EPA+DHA level significantly decreased ($p < 0.05$) from 85.58 to 72.35 mg g^{-1} in PSLO compared to CSLO. The As levels decreased during purification from 8.749, 0.348, and 0.006 mg kg^{-1}, respectively. As was not detected (ND) in PSLO. Cd was ND in any SLO. Pb was recorded only in CSLO with a level of 0.225 mg kg^{-1}. Hg levels of CSLO and PSLO were found to be 0.292 and 0.135 mg kg^{-1}, respectively. SLO purification enhanced color characteristics with lowering of heavy metal contents. Moreover, it can be concluded that the purified SLO is a promising rich source of omega-3, enabling the potential for the development of omega-3 dietary supplements.

Keywords: Color characteristics, Heavy metals, Omega-3, Purification, Shark liver oil

Acknowledgement
This work was supported by AHEAD RIC Project under the research grant "Encapsulation of Omega -3 fish oil from Sri Lankan Fishes and Development of Omega -3 Fortified Foods" of Faculty of Applied Sciences, Rajarata University of Sri Lanka, Mihintale is acknowledged.

Abstract No: MO-40

Investigation of Antioxidant and Anti-diabetic Activities of *Antidesma alexiteria*

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Natural products have historically played an important role in drug development and continue to be a source of innovative lead compounds or pharmacophores for medicinal chemistry. Natural bioactive compounds are quite intricate in nature, with a highly rigid structure in which the compound is either locked into the active conformation or confined to a few numbers of conformations. Hence has the potential to produce exceptional target potency and selectivity. The complexities of many natural chemicals make the commercial synthesis and the development of analogs of natural products impossible leading to the prevalent use of natural products in the field of medicine for the treatment of diseases.The *Antidesma alexiteria* belonging to the family Phyllanthaceae is an endemic plant to Sri Lanka with an underrated medicinal value. Even though previous studies have proven the use of *Antidesma alexiteria* leaves as an antidote for snake bites and the use of roots to treat dysentery most of its bioactivities are unknown. The present work aims to evaluate the antioxidant and anti-diabetic activities of the aqueous extract of *Antidesma alexiteria* fruit obtained by freeze-drying the filtered whole *Antidesma alexiteria* fruit blended with water including the total phenolic and total flavonoid contents. The antioxidant activity of the aqueous extract was assessed using the 2-diphenyl-1-picrylhydrazyl (DPPH) assay and observed IC_{50} value of 0.038 ± 0.010 mg/mL confirming the presence of many active phenolic compounds with free radical scavenging potency. The aqueous extract of the fruit showed better results for the alpha-amylase inhibitory assay with an IC_{50} value of 0.16 ± 0.02 mg/mL which was carried out to evaluate the anti-diabetic activity of the plant. The observed results prove the availability of bioactive compounds that can be isolated from the complex mixture of the extract using bioassay-guided chromatographic techniques and further evaluated to identify the structures of the bioactive compounds that can be utilized in the drug discovery process.

Keywords: *Antidesma alexiteria,* Anti-oxidant activity, Anti-diabetic activity.

Abstract No: MO-41

Study of synergistic bioactivities of leaves of *Coffea arabica* with Copper oxide nanoparticles

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Synergistic bioactivities are the combined actions of two or more substances or compounds that produce a more substantial biological reaction in contrast to their individual effects. When these chemicals interact, their separate effects are amplified or enhanced, producing a more potent result. In this work, leaves of *Coffea arabica* are combined with copper oxide nanoparticles (CuO NPs) to examine the plants' complementary biological activity. *Coffea arabica* leaves were sequentially extracted via maceration with hexane and methanol solvents, and the resulting extract was stored until further use. The methanol extract was used to examine the bioactivities. CuO NPs were synthesized using a chemical synthesis method. UV-visible spectroscopy and Fourier-transform infrared were used to characterize the produced CuO NPs. Determination of total phenolic and flavonoid contents was done and the anti-diabetic activity was examined using α-amylase inhibitory assay, while the anti-oxidant capacity was assessed through DPPH radical scavenging assay. The anti-diabetic, and anti-oxidant effects of the leaf extract and CuO NPs were assessed to determine their synergistic bioactivities. The findings show that the methanol extract of the leaves alone displays good bioactivity in each of the categories where the IC_{50} values of 8.91± 0.01 µg/mL and 171.62± 0.01 µg/mL were observed for anti-oxidant and anti-diabetic activities respectively. Similar to this, the CuO NPs alone show notable bioactivity for anti-oxidant activity where the observed IC_{50} value was 456.15± 0.01 µg/mL yet they do not manifest a notable influence on anti-diabetic activity. However, when copper oxide nanoparticles and the plant extract were combined, strong anti-diabetic effects were seen with an IC_{50} value of 85.25± 0.02 µg/mL, suggesting a potential joint application for the treatment of diabetes through synergistic bioactive interactions. Copper oxide nanoparticles combined with *Coffea arabica* leaves increased antioxidant activity in comparison to individual CuO nanoparticles giving an IC_{50} value of 172.18± 0.01 µg/mL but could not match the natural potency of *Coffea arabica* leaves, indicating a non-amplifying, synergistic interaction. According to this research, combining CuO NPs with *Coffea arabica* leaf extract may be useful for producing bioactive molecules for use in the pharmaceutical and nutraceutical industries. These discoveries help us to better understand how natural resources are used and to create innovative bioactive formulations that are more effective at treating diabetes, and oxidative stress by further improvement. More research is required to fully understand the underlying mechanisms and assess this synergistic combination's toxicity and safety profiles. This research not only advances our comprehension of synergistic bioactivity but also sets the stage for pioneering applications in the realm of therapeutics, bridging the realms of botanical wisdom and cutting-edge nanoscience.

Keywords: *Coffea arabica*, Copper oxide nanoparticles, Synergistic, Anti-oxidant, Anti-diabetic

Abstract No: MO-42

Investigation of antioxidant and antityrosinase activity of *Bauhinia kockiana* and *Cocos nucifera var. aurantiaca*

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Tyrosinase is a widely distributed enzyme in the body that plays an important role in melanogenesis. An increase in melanin synthesis can lead to many skin disorders. This research has been conducted on two different plant varieties that can be commonly found in Sri Lanka, *Bauhinia kockiana* and *Cocos nucifera var aurantiaca,* more commonly known as King Coconut, to investigate their antioxidant and antityrosinase activities. *Bauhinia kockiana* was extracted by hot extraction method (Soxhlet extraction) using methanol as the solvent, and the King Coconut water sample was freeze-dried. The antioxidant activity of the samples was analyzed using the DPPH radical scavenging assay, while the enzyme-based tyrosinase inhibition assay was conducted to evaluate the antityrosinase activity, where *Agaricus bisporus* was used to extract the enzyme. *Bauhinia kockiana* (flowers and buds) demonstrated a significant amount of antioxidant activity (IC_{50}: 28.73 ± 1.60 μg/mL) against the standard ascorbic acid (IC_{50}: 38.37 ± 1.18 μg/mL). Both the samples revealed relative antityrosinase activity using L-DOPA as the substrate (IC_{50}:128.70 ± 1.22 μg/mL; *B. kockiana*, 274.45 ± 1.23 μg/mL; *Cocos nucifera var aurantiaca* water sample) against Kojic acid, which was used as the positive standard (IC_{50}: 49.47 ± 1.12 μg/mL). The Soxhlet extraction of *Bauhinia kockiana* indicated considerable antityrosinase activity and according to the results obtained, it can be said that both plant types show moderate antityrosinase activity, and *Bauhinia kockiana* indicates significant antioxidant properties. Further studies on both varieties should be carried out to identify their principal bioactive compounds, which are responsible for the respective bioactivities. To the best of our knowledge, this is the first research to be done on the hot extraction of *Bauhinia kockiana* and the water sample of *Cocos nucifera var aurantiaca* on antioxidant and antityrosinase activities.

Keywords: Antioxidant activity, *Bauhinia kockiana*, King Coconut water, Tyrosinase inhibition

Abstract No: MO-43

Green synthesis of ZnO/CuO nanocomposite using juice extracts of *Citrus limon* and the evaluation of its antibacterial activity.

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The green synthesis of nanoparticles and nanocomposites has received a great deal of interest due to the fact that it is a low-cost, easily scalable, non-toxic, and environmentally friendly method of synthesis. Green synthesis of nanoparticles and nanocomposites, as opposed to chemical synthesis, requires the use of fungus, yeast, actinomycetes, bacteria, and plants. This research focuses on the green synthesis of a 10% ZnO/CuO nanocomposite (ZnO:CuO ratio; 90:10) utilizing *Citrus limon*, a plant that contains citric acid, which functions as a good capping and stabilizing agent. This study compares the antibacterial activity of the synthesized nanocomposite to that of ZnO and CuO nanoparticles. The produced nanocomposite was characterized using a variety of methods. UV-Visible spectroscopy to confirm the formation of the ZnO/CuO nanocomposite, FTIR (Fourier Transform Infrared) spectroscopy for the identification of functional groups present, and SEM (Scanning Electron Microscope) analysis for the investigation of the surface morphology of the nanocomposite were used as the characterization techniques. Antibacterial activity for the synthesized nanocomposite was done using *E. coli* and *S. aureus* bacteria as test organisms, which are gram-negative and gram-positive bacteria, respectively. The ZnO/CuO nanocomposite showed promising antibacterial activity against the tested bacterial strains. The nanocomposite showed inhibitory action against *E. coli* at a concentration of 10 mg/mL, while for *S. aureus*, the nanocomposite showed inhibitory action at concentrations of 5 mg/mL and 10 mg/mL. In comparison, the nanocomposite showed a better inhibitory action against *S. aureus* than against *E. coli*. The comparison done between the nanoparticles and the nanocomposite confirmed that the nanocomposite showed similar or even higher antibacterial activity towards the tested bacteria. As a result, for the first time, this work reveals the green synthesis of ZnO/CuO nanocomposite using *Citrus limon* and its role as an antibacterial agent.

Keywords: Antibacterial activity, Green synthesis, Nanocomposite

Abstract No: MO-44

Evaluation of anti-tyrosinase activity and antioxidant activity in the leaf extract of *Senna auriculata* (L.) Roxb. and the flower petal extract of *Couroupita guianensis* Aubl

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Discovering natural products with the ability to inhibit melanogenesis has become a major area of interest in both cosmetic and pharmaceutical research. The demand for such products stems from the drawbacks associated with commercially available synthetic tyrosinase inhibitors, which often exhibit high toxicity and are known to cause adverse side effects. As a result, researchers have turned their attention towards exploring natural sources for safer and more effective alternatives. This study focuses on the anti-tyrosinase activity of the ethanolic extract of leaves of *Senna auriculata* and the ethanolic extract of flower petals of *Couroupita guianensis*. The skin whitening potential of the extracts was measured by conducting an in-vitro anti-tyrosinase assay. In addition, DPPH assay was used to measure the antioxidant activity of the extracts. A topical formulation was developed using the ethanolic extract of the flower petals of *Couroupita guianensis* and its tyrosinase inhibitory potential was further investigated. The ethanolic extract of *Couroupita guianensis* was found to have a tyrosinase inhibitory activity with an IC_{50} of 1296 mg/L compared to kojic acid (standard), which had an IC_{50} value of 79 mg/L. However, the ethanolic extract of *Senna auriculata* leaves did not show any tyrosinase inhibitory or activating properties. In addition, in the DPPH assay, ascorbic acid (standard) had an EC_{50} value of 41 mg/L, while the ethanolic extract of *Senna auriculata* showed more potent antioxidant activity with an EC_{50} value of 85 mg/L, in comparison to the ethanolic extract of *Couroupita guianensis* which had an EC_{50} of 623 mg/L. The formulation prepared with the flower petal extract of *Couroupita guianensis* showed moderate tyrosinase inhibition with an IC_{50} value of 6250 mg/L, in contrast the positive control showed an IC_{50} value of 1541 mg/L. The findings of this study reveal that there is a tyrosinase inhibitory potential in the flower petal extract of *Couroupita guianensis* and it offers a promising avenue for the development of a potential skin lightening agent in the cosmetic industry.

Keywords: *Couroupita guianensis*, Enzyme activity, *Senna auriculata*, Topical formulation, Tyrosinase inhibitors

Abstract No: MO-45

Determination of Antioxidant Activity of the Aqueous Extract of Corm of *Musa paradisiaca L.*

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Most often grown in tropical and subtropical regions, *Musa paradisiaca L.* is renowned for its excellent nutritional content. Corm of *Musa paradisiaca* is known to be used in treating many diseases in traditional medicine in Sri Lanka. In this study the antioxidant properties of the aqueous extract which was prepared according to the method preparing decoction ("Kasaya") was evaluated using the (DPPH) free radical scavenging assay. Antioxidant-rich decoction which contains six therapeutic herbs such as *Musa paradisiaca L., Sida cordofolia L., Phyllanthus emblem L., Santalum album L., Tribulus terrestris L.,* and *Salacia reticulata L*. are used to make the decoction. These plants already contain antioxidant properties in certain of their parts. IC_{50} values calculated for the standard, aqueous extract and decoction were 0.052±0.012 mg/mL, 0.096±0.015 mg/mL and 0.056±0.111 mg/mL respectively. At higher concentrations, the percentage free radical scavenging activity in the aqueous plant extract and the decoction displayed similar values, but at lower concentrations, the free radical scavenging activity of the decoction was noticeably higher than that of the corm of Musa paradisiaca's aqueous extract. In addition, total phenolic content and total flavonoid content of both the aqueous extract and the decoction were examined compared with the respective standards. The Folin-Ciocalteu method is used to calculate the total phenolic content in the extracts as Gallic acid equivalents (GAE). The phenolic content of the Aqueous extract and decoction showed as 23.80±0.06 mg GAE/g and 56.04 ±0.07 mg GAE/g respectively. The decoction has a noticeably higher total phenolic content than the aqueous extract. The amount of total flavonoids in the extracts was measured using Quercetin equivalents (QE). The flavonoid content of the aqueous plant extract resulted in 52.39± 0.06 mg QE/g and the decoction resulted as 76.04±0.07 mg QE/g. In comparison, the flavonoid content of the decoction was significantly higher than that of the aqueous plant extract.

Keywords: Antioxidant activity, Total flavonoid content, Total phenolic extract, *Musa paradisiaca L.*

Abstract No: MO-46

Formulation and evaluation of the anti-inflammatory activity of an herbal cream utilizing *Curcuma longa L.*(Turmeric) and *Elaeocarpus serratus L.(*Ceylon olive)

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The utilization of herbal remedies in skin care formulations has gained considerable attention due to their natural origin and potential therapeutic benefits. *Elaeocarpus serratus L.*(Ceylon olive) and *Curcuma longa L.* (Turmeric) are well known for their medicinal and cosmetic properties. However, there is a lack of research on the formulation and evaluation of herbal cream using Ceylon olive and Turmeric. This study was focused on harnessing the therapeutic potential of Ceylon olive and turmeric paste made with aloe vera gel in the formulation of an optimized herbal cream for improved skin care. The methodology involved the preparation of samples, including the drying and grinding of Ceylon olive leaves and turmeric rhizomes. Aloe vera gel was extracted from *Aloe barbadensis* leaves. Aloe vera gel was mixed with the same amount of powdered turmeric and Ceylon olive in 1:1, 1:2 and 2:1 ratios to prepare the paste. The anti-inflammatory activity of the pastes was evaluated using the Human Red Blood Cell (HRBC) membrane stabilization assay. Based on the findings, turmeric: Ceylon olive (2:1) ratio was selected for the formulation of different batches of cream by optimizing the polyethylene glycol 4000, glycerin and methyl paraben amounts. Color, odor, state, consistency, pH, washability, and phase separation parameters of the cream formulations were evaluated. The results of the HRBC membrane stabilization assay indicated that turmeric paste exhibited the lowest IC_{50} value of 322.60±7.80 µg/mL and the highest percentage inhibition whereas Ceylon olive paste showed an IC_{50} of 436.87 µg/ml. The combination of turmeric and Ceylon olive at a 2:1 ratio showed the highest inhibitory effect and the lowest IC_{50} value 283.59±5.93 µg/ml. Suggesting a stronger inhibitory effect compared to both Ceylon olive and turmeric paste alone and turmeric: Ceylon olive, 1:1 and 2:1 ratio pastes. Among formulated cream batches, the formulation (F2) was showed the lowest IC_{50} 132.15±3.48 µg/ml value and highest percentage inhibition of 98.60±0.98% at 1000 mg/ml concentration whereas standard acetyl salicylic acid showed an IC_{50} of 533.23±23.91 µg/ml only. F1 and F2 formulations showed higher anti-inflammatory effect than standard anti-inflammatory compound acetyl salicylic acid. The study concludes that turmeric and Ceylon olive paste showed significant anti-inflammatory activity, with potential synergistic effects when combined in 2:1 ratio. The formulated herbal creams, particularly the F1 and F2 formulations, demonstrated higher inhibitory effects and could serve as highly effective in skincare formulations. However, further optimization is recommended for the F3 and F4 formulations, as they exhibited lower inhibitory effects. The findings of this study provide valuable insights for the development of herbal creams with enhanced therapeutic properties for various skin conditions and offer more natural and safer alternatives in skincare solutions. It has significant implications in both traditional medicine and modern healthcare for the effective treatment of anti-inflammatory conditions.

Keywords: Anti-inflammatory activity, *Elaeocarpus serratus* (Ceylon olive), *Curcuma longa* (Turmeric), Herbal cream, Skin care

Abstract No: MO-47

Evaluation of *Helicobacter pylori* urease inhibitory activity of (*E*)-1-(4-methoxybenzylidene)-2-phenylhydrazine

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Helicobacter pylori attacks and subsequently damages the stomach and duodenum of humans. It secretes the urease enzyme, which catalyzes urea hydrolysis, producing ammonia in the stomach and creating a suitable pH environment for the bacterium to survive and colonize. Though, several therapies and medications are available to treat H. *pylori*, they have several inherent problems, including allergies, severe complications, associated adverse effects, the emergence of antimicrobial resistance, and a high cost. Therefore, the discovery of new urease inhibitors with no toxicity, fewer undesirable side effects, and better stability is highly demanded. In this study, a hydrazone derivative, (*E*)-1-(4-methoxybenzylidene)-2-phenylhydrazine was evaluated for its potential to act against *Helicobacter pylori*. Hydrazones are a significant class of biologically active drug molecules, drawing attention from medicinal chemists due to their diverse pharmacological properties. Researchers are actively synthesizing these compounds as potential drugs to combat diseases with minimal toxicity and maximal efficacy. (*E*)-1-(4-methoxybenzylidene)-2-phenylhydrazine was successfully synthesized using a condensation reaction with 4-methoxybenzaldehyde and phenylhydrazine and characterized by FT-IR, ^{1}H NMR, and ^{13}C NMR spectroscopy. The anti-urease action of the compound was analyzed using a modified Berthelot reaction assay, which is a well-established colorimetric method for the determination of ammonia. (*E*)-1-(4-methoxybenzylidene)-2-phenylhydrazine showed inhibitory activity of 12.089±0.0008 μg/mL against urease enzyme rather than standard thiourea (4.885±0.0007 μg/mL). In addition, an in-silico study was carried out to analyze the binding interactions of (*E*)-1-(4-methoxybenzylidene)-2-phenylhydrazine with the active site (two nickel atoms) of the urease enzyme of *Helicobacter pylori*. In-silico studies showed that (*E*)-1-(4-methoxybenzylidene)-2-phenylhydrazine interacts with H. *pylori* urease with a high binding affinity (-5.3 kcal/mol), compared to thiourea (-3.3 kcal/mol). Therefore, it can be concluded that further structural optimization of (*E*)-1-(4-methoxybenzylidene)-2-phenylhydrazine will result in potent drug candidates to work against *Helicobacter pylori*.

Keywords: Berthelot reaction, Hammett correlation, Hydrazone, *Helicobacter pylori*, Thiourea

Abstract No: BP-01

Determination of *Staphylococcus* spp. present as contaminants on public door handles of an institute and analysis of their antibiogram

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Staphylococcus are potential pathogens that cause a range of infections, ranging from mild abscesses to severe septicemia. The objective of this study was to identify *Staphylococcus* present as surface contaminants and to analyze their antibiogram. KAATSU International University's door knobs were sampled using cotton swabs that had been dipped in peptone water and incubated it for 18-24 hours at $37C^0$. Incubated samples were inoculated on mannitol salt agar plates and incubated for 24 hours at 37°C. Gram staining and biochemical tests such as catalase, coagulase were carried out for further identification of the isolates. The disc diffusion method was used for antibiotic sensitivity testing (ABST) following the guidelines of the Clinical and Laboratory Standards Institute (CLSI). For coagulase-positive isolates, cefoxitin (30 g), erythromycin (10 g), gentamicin (10 g), vancomycin (30 g), and oxacillin (1 µg) were used. Novobiocin (5 mg), erythromycin (10 mg), gentamicin (10 mg), and vancomycin (30 mg) were utilized for coagulase-negative isolates. All 37 door handle samples were collected; 91.89% (n =31) were pure growth samples. Out of those samples, 64.86% (n = 24) were identified as Coagulase positive *Staphylococcus aureus* and 18.91% (n = 7) were identified as coagulase negative *Staphylococcus*. Out of 24 samples, 24.16% (n = 7) isolates were found to be Methicillin resistant *Staphylococcus aureus* (MRSA) strains. Rates of MRSA isolates showed resistance to erythromycin 100% (n = 7) and Oxacillin 14.28%. In (CoNS) coagulase negative *Staphylococcus* 71.42% (n = 5) were identified as *Staphylococcus epidermidis*, and 28.57% (n = 2) were *Staphylococcus saprophyticus*. Coagulase negative *Staphylococcus* showed 100% sensitivity to vancomycin, gentamycin (10 ug), and oxacillin, and 42.86% (n = 4) of the isolates showed resistance to erythromycin. *Staphylococcus aureus* with a considerable rate of MRSA was discovered in this investigation. [Contaminated door handles can be a source of transmission of MRSA.] This research can be used to find effective disinfectants and proper cleaning techniques to minimize the spread of Staphylococcus through door handles.

Keywords: Door handles, Methicillin resistant *Staphylococcus aureus*, Coagulase negative, Coagulase positive, Antibiotic resistance.

Acknowledgment: KAATSU International University (KIU)

Abstract No: BP-02

Investigation of a suitable formulation for *Trichoderma harzianum* in different compositions of solid carrier materials at two temperatures

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In sustainable agriculture, the application of *Trichoderma* spp. is a widely accepted, eco-friendly method. But, in the commercialization process, the effectiveness of *Trichoderma* spp. as a biological control agent, plant growth promoter, and as a decomposing agent affects the selection of the carrier material and the formulationprocedure. The present investigation was carried out in an attempt to develop an effective organic carrier material using abundant natural solid materials in which the viability and the effectiveness of *T. harzianum* could be maintained for a sufficient duration at an optimum temperature for product stabilization. Previously isolated and identified *T. harzianum* (KT852821.1), which can enhance the growth of many crops (e.g.: *Pisum sativum, Cucumis sativus, Solanum lycopersicum,* and *Tulipa gesneriana*), was selected for the present investigation. Five carrier formulations were made using different compositions of compost, straw, clay, and cow urine. Inocula taken from pure cultures of *T. harzianum* grown on PDA media were introduced separately into sterilized polypropylene bags containing different proportionsof carrier materials. They were then incubated at 25°C for 7 days and then stored at room temperature (28°C) and in the refrigerator (4°C) for 12 months. Viability was determined at frequent intervals of 2, 6, 9, and 12 months for the formulations kept at 28°C and 4°C separately. Colony-forming units per gram of substrate were calculated following the dilution plate method in 10 replications for each formulation. Among the five different formulations used for formulating *T. harzianum*, the formulationconsisting of compost 50%, straw 25%, clay 12.5%, and cow urine 12.5% (V/W) stored at 4°C for a 12-month time period, proved to be significantly the most effective composition for the commercialization of *T. harzianum*, which gave a colony count of 6.99 log CFU/g whereas the other formulations provided the values of 6.36 log CFU/g, 6.26 log CFU/g, 6.91 log CFU/g, and 6.45 log CFU/g. The present investigation highlighted the significance of using the formulation consisting of compost 50%, straw 25%, clay 12.5%, and cow urine 12.5% (V/W) to develop *T. harzianum* as a commercialproduct.

Keywords: Formulations, Optimum temperature, Solid carrier material, *Trichoderma harzianum*, Viability.

Acknowledgment
This work was supported by University research grant under the research grant no:RP/03/02/01/03/2020 of the University of Kelaniya, Sri Lanka.

Abstract No: BP-03

A pilot study on quality parameters of commercially available black tea in Sri Lanka

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Tea is the most popular, widely consumed beverage next to water in the world. Tea is vital for the Sri Lankan economy as a main source of foreign exchange earnings and employment provider. 'Ceylon Tea' is considered the best quality tea in the world market. It is important to ensure maintenance of the high quality to sustain the reputation of 'Ceylon Tea'. Although adequate quality assurance measures are in place for tea exported, less attention is given to the tea in the local market. Therefore, this study was carried out to find the quality aspects of black tea available in the Sri Lankan market. Most popular branded tea samples available in the local market were selected through a survey while loose tea samples were randomly selected. To evaluate the quality of tea samples, the parameters of total ash, water-soluble ash, acid-insoluble ash, alkalinity of water-soluble ash, crude fibre and total polyphenol content were determined based on the methods recommended in the international standard ISO 3720:2011 – Black tea – Definition and basic requirements. In addition, antioxidant activity and total flavonoid content (TFC) were evaluated by DPPH (2,2-Diphenyl-l-picrylhydrazyl) assay and aluminium chloride colorimetric assay respectively. According to the results, percent mass fraction of total ash, water-soluble ash, acid-insoluble ash, alkalinity of water-soluble ash, crude fibre and total polyphenol content of tea samples varied in the ranges between 5.21% - 6.95%, 57.60% - 69.35%, 0.004% - 1.365%, 1.85% - 2.28%, 10.78% -18.95%, and 23.29% -44.76% respectively. The antioxidant activity/ IC_{50} value of tea samples varied in the range of 32.91 - 49.06 µg/mL and the TFC of tea samples varied in the range of 399.82 - 659.12 µg/mL. Overall, with the limited number of samples tested, all branded tea samples satisfied the requirements of ISO parameters but two loose tea samples deviated from ISO requirements. In one sample acid insoluble ash was 1.37% and in another sample crude fiber content was 18.95%. Both were higher than the minimum ISO requirement. Results of the study indicate that analyzed branded tea meets the ISO quality requirements while some loose tea samples did not meet the quality requirements. Antioxidant activity and the total flavonoid content of branded and loose tea samples were almost similar. More stringent testing of tea in the local market, paying special attention to loose tea, is recommended to ensure the maintenance of high quality and the image of Ceylon tea.

Keywords: Antioxidants, Black tea, Ceylon tea, Flavonoid, ISO

Abstract No: BP-04

In silico comparison of hypocholesterolemic effect of orally administered phytochemicals from five different plants on humans

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High cholesterol level in the blood is a significant burden that provokes plaque formation in blood vessels which eventually leads to atherosclerotic cardiovascular disease. Currently, statin drugs are widely used to treat hypercholesterolemia. However, long-term statin therapy is known to be associated with adverse effects such as myalgia, rhabdomyolysis, statin-induced myopathy along with other risk factors such as alcohol abuse and hypothyroidism. Due to this reason, plant-based therapies have been tested for decades as a replacement for statin drugs and some of the phytochemicals have been identified to be effective in treating hypercholesterolemia. The utmost goal of this study is to compare major phytochemicals (S-allyl cysteine, Mahanimbine, β-sitosterol, Stigmasterol, Diosgenin and Curcumin) present in five commonly known plants that possess cholesterol-lowering abilities, by using *in silico* approaches. The most effective cholesterol-reducing drug, rosuvastatin has been used as the positive control. Molinspiration software has been used to monitor vital molecular properties and the pkCSM (Small-molecule pharmacokinetics prediction) tool to estimate the toxicity and the pharmacokinetic properties. Lipinski's and Veber's rules were applied to Molinspiration results to discover the oral bioavailability of the phytochemicals. The results of Molinspiration showed that all the phytochemicals have good oral bioactivity as the phytochemicals obeyed Lipinski's and Veber's rule including moderately active and active bioactivity scores for enzyme inhibition in S-allyl cysteine and other phytochemicals respectively. In addition to that, the predictions from the pkCSM tool indicated that Mahanimbine can be associated with hepatotoxicity and mutagenic effects when compared with other phytochemicals and rosuvastatin. However, except S-allyl cysteine from garlic, all the phytochemicals including rosuvastatin drug were identified to be P450 enzyme inhibitors which emphasised that adverse drug-drug interactions can be present with these phytochemicals and rosuvastatin. As the conclusion from *in silico* predictions, S-allyl cysteine was identified as the most effective drug-like agent with minor drawbacks. Anyhow, since all the phytochemicals showed good oral bioactivity, pharmacokinetic properties (except Mahanimbine) with few anomalies and elevated lipophilicity (except S-allyl cysteine which is hydrophilic and Curcumin which has reduced lipophilicity), further *in vivo* and *in vitro* trials under optimised conditions should be undertaken to confirm the effect of the phytochemicals to be used as a cholesterol-lowering drug in hypercholesterolemia patients.

Keywords: Molinspiration, pkCSM, Rosuvastatin, Hypocholesterolemic effect

Acknowledgement
This work was supported by the Oxford Brookes University- United Kingdom and the British College of Applied Studies- Sri Lanka.

Abstract No: BP-05

Sea moss as an alternative gelling agent to develop a cost-effective *in vitro* culture medium for the propagation of *Phalaenopsis* cv. Pink lip

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Genus *Phalaenopsis* is an ornamental orchid with the greatest commercial importance in the world floriculture industry. The propagation of *Phalaenopsis* is difficult by conventional breeding due to delayed flowering and uneven characteristics of flowers. Therefore, conventional *Phalaenopsis* cultivation is ineffective for large-scale production. At present, the tissue culture technique is extensively used for the mass propagation of *Phalaenopsis.* Tissue-cultured plants are more expensive than traditionally propagated plants due to the high cost of the chemicals used for the preparation of tissue culture media. Agar is widely used as a gelling agent and the most expensive ingredient in the preparation of tissue culture media. Developing a cost-effective *in-vitro* culture media using low-cost components is one strategy to reduce the production costs of tissue-cultured plants. The use of alternative gelling agents to replace the agar can highly contribute to reducing the cost of *in-vitro* culture media in tissue culture than other components. The main component of sea moss is carrageenan, a gelatinous substance used to thicken or as a solidifying agent. The ability of carrageenan-based hydrogels to produce thermos-reversible gels and viscous solutions makes them a desirable option for extensive use as a gelling agent. The objective of the present research was to assess the performance of sea moss as an alternative gelling agent to determine the effectiveness for *in vitro* propagation of Protocrom-like bodies (PLBs) of *Phalaenopsis* cv. Pink lip. Growth performance of PLBs of *Phalaenopsis* cv. Pink lip was used to assess the effect of sea moss as an alternative gelling agent. PLBs (0.020g) were transferred to ½ MS medium containing agar as a gelling agent, and ½ MS medium containing sea moss as a gelling agent. Cultures were maintained for four months and the growth performance of PLBs was evaluated, with fresh weight as a parameter at 30 days intervals. There was no significant difference observed in the mean fresh weight of PLBs throughout the four-month period, incubation in ½ MS medium containing agar, and medium containing sea moss as an alternative gelling agent. Moreover, there was no significant difference between the contamination percentages of the agar-containing medium and sea moss-containing medium. According to the cost calculation, the cost reduction resulting in the medium with sea moss as an alternative gelling agent was 79.81% compared to the conventional agar as the gelling agent. In conclusion, the application of sea moss as a gelling agent in tissue culture media can be utilized to achieve the optimum benefits for in vitro propagation of PLBs of *Phalaenopsis* cv. Pink lip. Based on the findings, sea moss can be recommended as a cost-effective alternative gelling agent for the propagation of *Phalaenopsis* cv. Pink lip using protocorm-like bodies.

Keywords: Alternative gelling agent; Cost effective medium; *Phalaenopsis*; Protocorm Like Bodies (PLB); Sea moss

Acknowledgment
This work was supported by the Sri Lanka Council for Agricultural Research Policy under the research grant Number NARP/21/UK/SC/01**.**

Abstract No: BP-06

Preliminary study of antioxidant and anti-inflammatory properties of mistletoe (*Dendrophthoe falcata*) on mango host plant (*Mangifera indica*).

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Dendrophthoe falcata is a common mistletoe plant that has widespread use in Sri Lankan traditional medicines. With the escalating incidence of cancer, asthma, and chronic inflammatory ailments among patients, the exploration of natural remedies in developing nations has become increasingly important. Despite existing research focusing on the chemical composition and biological activities of mistletoe plants in general, a critical gap exists in understanding the specific anti-inflammatory and antioxidant properties of *Dendrophthoe falcata* when it thrives on its particular host, *Mangifera indica*. This preliminary study aims to investigate the antioxidant and anti-inflammatory properties of mistletoe, *Dendrophthoe falcata* leaves grown on the host, *Mangifera indica* in Sri Lanka. The methanolic extracts of De*ndrophthoe falcata* and *Mangifera indica* leaf samples were prepared using the cold extraction method. The antioxidant activity was assessed through the Folin-Ciocalteu assay, ammonium colourimetric method, 2,2-diphenylpicrylhydrazyl (DPPH) assay, and ferric-reducing power assays. Anti-inflammatory action was evaluated using heat-induced hemolysis and albumin denaturation assays. Pearson's correlation test was performed to determine whether there is a linear relationship between total phenolic content (TPC), total flavonoid content (TFC), and antioxidant activity, anti-inflammatory properties of De*ndrophthoe falcata* and *Mangifera indica*. A two-sample t-test was done to compare the results of TPC and anti-inflammatory and antioxidant properties of *Dendrophthoe falcata* and *Mangifera indica* to identify whether these values of mistletoe significantly vary from the host. TPC and TFC of mistletoe were determined to be 1531.0 ± 44.3 mg of gallic acid equivalents per g of extract and 210.7 ± 15.9 mg of catechin equivalents per g of extract through Folin-Ciocalteu assay, ammonium colourimetric method respectively. Mistletoe exhibited an IC_{50} of 239.70 ± 27.99 µg/mL for DPPH scavenging activity and an EC_{50} of 6921.0 ± 2419.0 µg/mL for ferric-reducing power. Additionally, mistletoe demonstrated an IC_{50} of 554.1 ± 42.4 µg/mL for antihemolytic activity and 0.45 ± 0.05 mg/mL for protection against albumin denaturation. Pearson's correlation analysis revealed that phenols contribute to antioxidant activities. Furthermore, the presence of phenols and flavonoids contributed to the anti-inflammatory properties. A t-test comparison between mistletoe and its host plant for bioactive compounds, antioxidants, and anti-inflammatory properties indicated that mistletoe's bioactive compounds and their antioxidant and anti-inflammatory properties are significantly different from host plants. *Dendrophthoe falcata* leaves emerge as a promising source of anti-inflammatory and antioxidant properties. This avenue of study bears substantial potential for unlocking novel therapeutic benefits and can be further pursued by determining the chemical structure of the specific bioactive compounds responsible for anti-inflammatory and antioxidant properties.

Keywords: Anti-inflammatory, Antioxidant, *Dendrophthoe falcata*, *Mangifera indica*

Abstract No: BP-07

Comparison of total chlorophyll, carotene and phenolic contents between species/varieties of Sri Lankan green leafy vegetables *Sesbania grandiflora, Centella asiatica* and *Ipomea aquatica*

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Green Leafy Vegetables (GLVs) are rich sources of phytochemicals which are beneficial to reduce chronic non-communicable diseases due to their therapeutic properties such as antioxidant activity. Among numerous dietary supplements of phytochemicals, GLVs are under spotlight as they are rich sources of phenolics and natural pigments including chlorophylls and carotenoids. Availability and the amount of these phytochemicals may vary depending on many factors including the variety of GLVs. The aim of this study is to quantitatively analyze the phytochemical contents; total phenol, chlorophyll and carotene among 3 selected GLV species and 2 varieties of each, *Sesbania grandiflora, Centella asiatica* and *Ipomea aquatica*. Each home garden grow variety was acquired from same geographical location which have similar growth conditions. Edible parts of each sample were well washed, air dried at room temperature under shade, and oven dried at 45 ºC to obtain a constant weight. Dried samples were ground and tests were carried out using homogenous sample powder. Total chlorophyll and carotene contents were determined by measuring the absorbance (at the wavelengths of 470 nm, 645 nm and 662 nm) of methanolic extracts and using formulas. Total chlorophyll content in leafy vegetables ranged from 13.75 to 35.56 μg/g dry weight of the sample. The highest chlorophyll content was observed in *S. grandiflora* variety 1 (V1), whereas the lowest chlorophyll content was observed in *I. aquatica* variety 2 (V2). The carotene content of studied leaf samples was within the range of 1.08 to 3.89 mg/g dry weight of the sample. *S. grandiflora* V1 had the highest carotene content whereas the lowest carotene content was observed in *C. asiatica* V1. Total Phenolic Content (TPC) was determined by the Folin-Ciocalteu method by measuring the absorbance at 760 nm using the methanolic extracts of leaf samples. TPC were within the range of 3.62 to 18.19 mg GAE/g dry weight of the sample. *S. grandiflora* V1, leaves showed the highest TPC as 18.19 mg GAE/g dry weight of the sample and the lowest TPC was observed in *C. asiatica* V2 as 3.62 mg GAE/g dry weight of the sample. The results were analyzed in one-way analysis of variance ANOVA test, which showed a statistically significant difference between species/varieties ($p<0.05$). The Tukey post hoc test showed that the 2 varieties in each species showed statistically significant differences in each aspect ($p<0.05$) (The standard alpha level = 0.05). Overall, *S. grandiflora* V1 showed the highest amount of phenolic, chlorophyll and carotene contents. These results suggest total phenolic, chlorophyll and carotene contents may vary depending on the variety of GLV. This study can be used to refine GLV selection processes in agriculture and advance their applications within the food industry, paving the way for enhanced nutritional and health benefits.

Keywords: Green leafy vegetables, Phytochemicals, Variety

Acknowledgment
We greatly acknowledge the financial support provided by the University of Sri Jayewardenepura (Research Grant ASP/01/RE/TEC/2022/61).

Abstract No: BP-08

Sea mosses as an alternative solidifying agent for *in vitro* micropropagation of Dendrobium cv. "Big Jumbo White"

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Agar is a commonly added agar is not used as a gelling agent but as a solidifying agent to culture media as solidifying agent. However, agar is an expensive ingredient in the preparation of *in vitro* media and finding alternative sources as solidifying agents would be beneficial to small scale tissue culture production. Sea moss derived from algal species would be a potential source for serving as gelling agent. Therefore, the present study was conducted with the objective of developing a cost-effective in vitro medium for micropropagation of Dendrobium cv. "Big Jumbo White" using sea moss as an alternative gelling agent. Seeds of Dendrobium cv. "Big Jumbo White" were cultured using full-strength of Murashige and Skoog (MS) basal medium for 45 days under in vitro conditions. The initiated Protocorm Like Bodies (PLBs) were separated and used to assess the effectiveness of agar and sea moss as gelling agent on organogenesis. Media series, supplemented with plant growth regulators (PGRs); BAP (2.0 mg/L) and NAA (0.5 mg/L), sea moss; 4.5g/L (T1), 7.0 g/L (T2), 9.5 g/L (T3), 12.0 g/L (T4), 14.5 g/L T5, and agar as conventional gelling agent [8g/L (T6)]. After 60 days of incubation 1g of PLBs were placed to produce plantlets of Dendrobium cv. "Big Jumbo White", then were transferred to six different MS media. Agar (8g/L) was used as the control. The highest shoot regeneration (12 cm) was observed in the MS medium containing 12g/L of sea moss. The data were analyzed using the ANOVA and there was no significant difference between sea moss (12g/L) gelling agent and agar (8g/L). According to the findings, MS medium containing sea moss as the gelling agent was successful in the regeneration of shoots from seed culturing of Dendrobium cv. "Big White Jumbo". Furthermore, *in vitro* tissue culture media prepared using sea moss compared with agar has shown a 81 % of cost reduction. In conclusion, sea moss can be recommended as a suitable gelling agent for in vitro shoot generation of Dendrobium cv. "Big Jumbo White".

Keywords: Alternative gelling agent; Dendrobium cv. "Big Jumbo White"; In vitro media, PGRs; Sea moss

Abstract No: BP-09

Analysis of phytochemicals and antioxidant properties of *Dendrophthoe falcata* and *Mangifera indica* plant leaf extracts

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Dendrophthoe falcata, a common mistletoe plant, used in traditional medicine has not been adequately studied for the identification of compounds with biological activities. Phytochemical screenings allow the identification of chemical constituents with potential medicinal properties. These bioactive compounds hold promise as starting material for development of drugs. In Sri Lanka *Dendrophthoe falcata* is abundantly seen in *Mangifera indica.* The aim of the study is to quantify selected phytochemicals and the antioxidant properties in *Dendrophthoe falcata* and *Mangifera indica* (host tree) leaf extracts. The best extraction solvent was determined by cold extraction among methanol, ethanol, acetone, dichloromethane and water. Tannins content was determined using colorimetry with gallic acid as the standard. Alkaloids content was determined by a gravimetric method using acetic acid and ammonium hydroxide. *In vitro* DPPH (1, 1-diphenyl- 2- picryl-hydrazyl) radical scavenging activity, total phenolic content (TPC), total flavonoid content (TFC) and ferric reducing power assay (FRAP) were used to evaluate the antioxidant activity of plant leaf extracts. The TPC and TFC were determined by using Folin-Ciocâlteu colorimetric and aluminum chloride methods, respectively. The FRAP value was determined using colorimetry with ascorbic acid as the standard. Methanol had the highest extraction yield (25.20±4.34% w/w) compared to other solvents. Highest alkaloid content was observed in *Dendrophthoe falcata* leaf extract (DFLE) (31.32±2.59 % w/w). Highest tannin content (51.64±1.72 µg GAE/mL) was observed in *Mangifera indica* leaf extract (MILE). It was found that the DFLE demonstrated potent antioxidant activity compared to the half maximal inhibitory concentration of MILE calculated using DPPH assay (IC_{50} of DFLE 760.60±145.02µg/mL). DFLE had the highest TPC value (527.82±9.05 µg GAE/mL) and highest TFC value (399.70±13.95 µg CAE/mL). The maximum ferric reducing power was shown by DFLE (111.51±0.76 µg AAE/mL). The results suggested that the medicinal potential of DFLE is higher than MILE. Classes of compounds identified in *Dendrophthoe falcata* should be further studied to identify potentially beneficial compounds.

Keywords: Alkaloid, Antioxidant, Flavonoid, Phenolic, Phytochemical.

Abstract No: BP-10

Assessment of phenolics in selected *Phalaenopsis* cultivars

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Orchidaceae ranks as the second-largest family of flowering plants. *Phalaenopsis* species belong to the family Orchidaceae are highly prevalent and commercially significant. Because of the floricultural significance, range of cultivars and hybrids resulted by performing crosses using parents with desirable characters, beneficial to the floriculture industry. Phytochemicals play an important role in plant defense mechanisms and dispersal mechanisms. They are unique to specific plants and parts of plants and usually increase in abundance during stressful events. The main groups of phenolic compounds include flavonoids, phenolic acids, tannins, and lignan compounds. Flavonoids are naturally occurring compounds and possess distinctive biological activity with high antioxidant capability. This study was conducted to quantify the total phenolic content, and total flavonoid content of six different *Phalaenopsis* cultivars to select parental materials with promising characters which are essential for plants to cope with stress in relation to plant physiology. Six self-pollinated *Phalaenopsis* cultivars were selected based on the color, shape, and overall attractiveness of the flowers to represent different colors and pigmentation patterns and maintained in the greenhouse. Total phenolic content and flavonoid content were quantified using methanolic extracts of known weight of leaves and roots following the standard methods used in the phytochemical analysis. According to the obtained data, Purple-colored *Phalaenopsis* cv. Queen Beer 'Mantefon' root extract recorded the highest flavonoid content (5.50± 0.01 mg QE g^{-1} DW) and yellow-colored *Phalaenopsis* cv. Golden Sands 'Canary' leaf extract recorded the highest phenolic content (335.77± 0.02 mg GAE g^{-1} DW). The highest phenolic and flavonoid content in a plant could contribute for developing the potential for high antioxidant activity. Therefore, these cultivars which have the most favorable characteristics than other studied cultivars can be used as parental material in future quality improvement and plant breeding programs.

Keywords: Orchidaceae family, *Phalaenopsis* cultivars, Phenolic content, Flavonoid content

Acknowledgment
This work was supported by the National Agricultural Research Plan (NARP) of Sri Lanka under the research grant NARP/21/UK/SC/01.

Abstract No: BP-11

Inhibition of discoloration of fruit and vegetable juices by coconut paring residual extract

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Consumption of fruits and vegetables are positively associated with various health effects and prevention of diseases, due to the presence of polyphenols, vitamins and minerals. Drinking fruit and vegetable juices has become an efficient and convenient way to increase the consumption of fruits and vegetables. Various color pigments, such as carotenoids and betalains, are abundantly present in fruits and vegetables, providing them their unique colorations. These respective colors are generated by conjugated π-bond systems. As a result of being exposed to oxidizing species or free radicals, or exposure to light, thermal pasteurization, storage temperature and pH, these conjugated systems can be subjected to changes. These changes may result in discoloration of fruit and vegetable juices. Antioxidants exhibit the ability to scavenge free radicals. Therefore, antioxidants can prevent the discoloration caused by the action of free radicals. Synthetic antioxidants such as Butylated hydroxytoluene (BHT) and beta hydroxy acids (BHA) are commonly used as stabilizers in the food industry. However, they have been identified to be carcinogenic in some organisms. They also have high volatility and greater decomposition rates at high temperatures. Therefore, the use of synthetic antioxidants in food industry have been restricted in some countries. Coconut paring residual extract (CPRE) has been proved to exhibit radical scavenging and antioxidant activity due to the presence of polyphenols. In this study, CPRE was utilized as a natural alternative to synthetic antioxidants to inhibit discoloration of fruit and vegetable juices. In the β-carotene-linoleate-bleaching test, CPRE (50 µg/mL) showed a discoloration percentage of 9.49±0.0021% of initial color intensity, while the blank showed 54.99±0.0025% discoloration after 3 hours. Several fruit and vegetable juice extracts exhibited an inhibition of their discoloration by CPRE. Watermelon, papaya, tomato, carrot, beetroot, mango and a mixed fruit juice (with banana, papaya, orange and mango) were tested here. The results of this study suggest that CPRE can be used as an effective stabilizer in food industry.

Keywords: Antioxidants, β-carotene-linoleate-bleaching test, Coconut paring residual extract, Fruit and vegetable juices, Phenolic content.

Abstract No: BP-12

Impact of threshing, blanching, and drying on piperine content in "black pepper" (*Piper nigrum* L.)

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All spices exported from Sri Lanka are tropical aromatics used in human foods for flavoring. Among them, black pepper is valued for its distinct biting quality attributed to the alkaloid, piperine. The amount of piperine content can be influenced by alterations in conditions of the black pepper processing chain. Therefore, the study aimed to find the variation in piperine content in black pepper via the facilitation of different threshing methods and processing procedures in the black pepper processing chain. Three types of threshing methods (Hand threshing, foot threshing and machine threshing), two types of blanching (Blanching and without blanching) and two types of drying methods (Sun drying and mechanical drying) were used as treatments and the piperine content in black pepper was determined by spectrophotometrically. Piperine content was measured in triplicate samples after solar drying and mechanical drying. According to the results, there was no significant difference ($p>0.5$) in the threshing method for piperine content. However, the majority of the black pepper samples showed that there was a significant difference in piperine content in blanched samples than the un-blanched samples implying that the piperine percentage increases with the increase in blanching. Further, piperine content was significantly lower ($p<0.5$), in machine-dried samples compared to the sun-dried samples, due to the higher vaporization of piperine caused by higher temperature. Therefore, sun drying and blanching can be considered as the best practices in the processing chain of the higher piperine content for black pepper.

Keywords: Black pepper, Piperine content, Sun drying and blanching

Abstract No: PP-01

Ionic conductivity of novel solid polymer electrolyte based on polyethylene oxide (PEO) and magnesium pyrophosphate ($Mg_2P_2O_7$)

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Lithium-ion batteries were hailed as a breakthrough solution for energy storage, revolutionizing portable electronics, electric vehicles, and other applications. However, as their implementation expanded, certain drawbacks came to light. Issues such as limited energy density, safety concerns, and the scarcity and high cost of lithium resources highlighted the need for a replacement. Researchers turned their attention to alternative materials, with sodium being a promising candidate due to its abundance. However, its high reactivity posed significant challenges. The search for a viable alternative led scientists to explore magnesium-based electrolytes. Lithium and magnesium are almost similar in ionic radii, presenting an exciting opportunity for further research. In this Investigation, the focus was on synthesizing and characterizing a novel magnesium ion-based solid polymer electrolyte. Polyethene oxide (PEO) was chosen as the polymer host, and magnesium pyrophosphate ($Mg_2P_2O_7$) as the dopant salt. By varying the amount of salt while keeping the same amount of PEO, five different types of electrolytes were made: $PEO_5Mg_2P_2O_7$, $PEO_{10}Mg_2P_2O_7$, $PEO_{15}Mg_2P_2O_7$, $PEO_{20}Mg_2P_2O_7$, and $PEO_{25}Mg_2P_2O_7$. The hot-pressed technique was used to fabricate the solid polymer electrolytes, and the resulting materials were characterized in the frequency range of 1Hz to 1 MHz using the Gamry framework version 6.11. Arrhenius plots were derived from Nyquist plots to study the conductivity variation with temperature. The temperature range for the study spanned from 25°C to 100°C. The characterization results revealed that among the different electrolyte samples, $PEO_{10}Mg_2P_2O_7$ demonstrated the highest electrical conductivity of 5.0×10^{-6} Scm^{-1} at 50°C. This temperature was selected since the melting point of PEO is 64 °C. This value of conductivity is comparatively lower than most existing magnesium ion-based solid polymer electrolytes. The results from this study pave the way for further investigations and improvements. Incorporating fillers could enhance the conductivity of the electrolyte material and improve its overall performance. Such advancements may yield even more promising results, making magnesium-based solid polymer electrolytes viable candidates for solid-state batteries. Alternatively, a gel polymer might give a more promising result than a solid polymer.

Keywords: Arrhenius plot, Ionic conductivity, $Mg_2P_2O_7$, Nyquist plot, PEO

Abstract No: PP-02

Computational investigation of novel Curcumin derivatives as anti -Tuberculosis agents

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Tuberculosis (TB) remains a major global health burden, necessitating the development of novel and effective anti-TB drugs. Curcumin a naturally occurring compound found in turmeric has shown potential as an antimicrobial agent, including activity against *Mycobacterium tuberculosis* the causative agent of TB. In this computational study, the potential of natural derivatives of curcumin as anti-TB drugs was investigated using molecular docking studies and molecular dynamics (MD) simulations. Bedaquiline was used as the reference drug. Using Auto Dock 4.2, molecular docking studies were performed to predict the binding affinities and binding modes of a library of curcumin derivatives with the selected TB targets. The outcomes of the molecular docking studies showed that numerous curcumin derivatives have high affinity for the targeted proteins: Decaprenylphosphoryl-β-D-ribose oxidase protein, Dihydrofolate reductase protein, Enoyl- {acyl-carrier protein} reductase (NADH) protein, InhA 4,3-oxoacyl-(Acyl-carrier-protein) reductase protein, Pantothenatekinaseprotein, UDP-N-Acetylmuramoyl-L-Alanyl-D-Glutamate-2,6 Diaminopimelateligase protein. Insights into prospective curcumin derivatives' modes of action as long-term control drugs were offered by the docking scores and interaction profiles. The key interactions influencing the binding process were also understood by investigation of the binding modes. The stability and dynamic behaviour of the chosen curcumin derivatives in complex with the TB targets were examined using MD simulations. These simulations allowed for the long-term study of conformational changes, flexibility, and stability of the derivatives of curcumin within the binding pockets of TB targets. Understanding the dynamic behaviour and interactions of the curcumin derivatives with TB targets was made possible by MD simulations. Root mean square deviation (RMSD) and root mean square fluctuation (RMSF) are two metrics used to assess stability. The results of the docking were supplemented by information from the MD simulations, providing a thorough insight into the binding modes and stability of the curcumin derivatives. By estimating binding affinities through the use of Auto Dock's advanced scoring methods, it was possible to calculate binding free energies and it revealed that all derivatives except one have good binding affinities with the studied proteins. It helped to reveal that the studied natural derivatives clarify the relative potency and selectivity of the derivatives for the tuberculosis targets. In conclusion, the computational findings of this study suggest that natural derivatives of curcumin hold promise as anti-TB drugs. These findings provide a basis for further experimental investigations and optimization of the identified curcumin derivatives as potential candidates for the development of novel anti-TB drugs.

Keywords: Tuberculosis, Curcumin, Derivatives, Molecular docking, Molecular dynamics simulation

Abstract No: PP-03

Comparison of different methods for generating SPWM signal for the development of a pure Sine wave inverter

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An inverter is an electronic device which is used for converting Direct Current (DC) to Alternating Current (AC) because AC is the predominant form of electrical power used in homes, businesses, and most electrical appliances. Inverters can be categorized based on the type of waveform that they produce, such as Pure Sine Wave Inverters, Modified Square Wave Inverters and Square Wave Inverters. This paper discusses the development of a Pure Sine Wave Inverter with an output voltage of 230 V_{RMS} and a frequency of 50 Hz using the Sinusoidal Pulse Width Modulation (SPWM) technique. Three SPWM signal generation methods, including analogue comparator, microcontroller, and SPWM driver module methods, were tested. This study presents a method to obtain a 230 V_{RMS}, 50 Hz output sine wave in three steps. The first step involves the generation of an SPWM signal with frequency control, utilizing the DC source supply. The analogue comparator method uses op-amps as the analogue comparator. Then, it compares a reference sinusoidal wave with a high-frequency (in kHz range) carrier triangular wave. The output of the op-amp comparator is SPWM. The frequency of this reference sinusoidal wave is chosen based on the required inverter output frequency (50 Hz). In that process, the comparator gives out a pulse when the voltage of the sine waveform is greater than the triangular voltage, and this pulse is used to trigger the respective inverter switches. When designing a circuit that involves op-amps, the slew rate of the op-amp is a critical consideration. To generate an SPWM signal using an ATmega328p microcontroller, the microcontroller was used to generate a series of PWM signals by digital high and digital low. The corresponding time of each pulse's delay is added using the microsecond function. Increasing and decreasing duty cycle, and then a series of PWM signals. As the pure sine wave inverter SPWM driver module EGS002 was used and, that method was the more accurate method, and a clean SPWM signal was generated with less harmonics. Although this type of inverter board has more features, the circuitry was not complex because of the module. Secondly, we employ the MOSFET H-bridge stage to obtain the desired sine wave output. Finally, the third step focuses on supplying a high DC voltage to the H-bridge circuit, which the DC-DC PWM boost converter generates. Several circuit protections were included to ensure the device's safety and reliability. In the process of SPWM generation, although in the analogue comparator method, op-amps offer a low-cost option, a microcontroller is favoured for its superior precision and ability to handle high-power applications effectively. However, the EGS002 module stands out as the preferred method due to its user-friendly nature, comprehensive protection features, and ability to provide valuable feedback, making it a more economically efficient choice in the overall design.

Keywords: Analogue Comparator, Boost Converter, EGS002 Module, H-bridge, Pure Sine Wave, SPWM Signal

Abstract No: PP-04

Spatial and temporal variations in total iron concentration in the Kalatuwawa reservoir: a comparative analysis of different depths

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The aim of this study is to investigate the distribution of total iron concentration at different depths of the reservoir (near intake well) and its implications for water treatment at the Kalatuwawa Water Treatment Plant. Two sampling rounds were conducted using a depth sampler to collect water samples from six specific depths below the spillway: 10 ft, 15 ft, 20 ft, 25 ft, 30 ft, and 35 ft. The total iron concentration was determined using the APHA 3500 Fe-B test method. The results obtained on June 27, 2023, revealed varying total iron concentrations across the different depths. The concentration increased progressively with depth, ranging from 0.4 ppm at 10 ft to 1.26 ppm at 35 ft. On July 6, 2023, during the subsequent sampling round, the total iron concentrations exhibited slight fluctuations compared to the previous round, ranging from 0.36 ppm at 10 ft to 1.52 ppm at 35 ft. These findings highlight the spatial variation in total iron concentration within the Kalatuwawa reservoir, with higher concentrations observed at greater depths. The study emphasizes the importance of tailored treatment strategies to effectively remove or mitigate iron-related issues faced by the Kalatuwawa Water Treatment Plant. The identified variations in total iron concentration underscore the challenges in maintaining water quality and treatment efficiency. Further investigation is warranted to determine the sources and mechanisms influencing total iron concentration in the reservoir. The knowledge gained from this study will aid in the development of targeted treatment approaches to ensure the production of safe and high-quality drinking water for the surrounding communities.

Keywords: Kalatuwawa Reservoir, Spatial Variation, Total Iron Concentration, Temporal Variation, Water Treatment, Water Quality**.**

Abstract No: PP-05

Enhancement of physical properties of red clay based superior quality cookware.

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Red clay-based cookware has been used for centuries mainly due to its aesthetic appearance, eco-friendliness as well as the ability to enhance the quality and taste of foods. However, at present, cookware manufacturers can't stay in business without freshcutting-edge properties because the growing demand for superior quality cookware that not only performs well but also has enhanced physical properties such as durability, resistance to cracking, and improved thermal shock resistance. As a remediation, the present study explores various techniques that can be employed to enhance the physical properties of red clay-based cookware, by adding reinforcing materials (Ball clay, Quartz, and Feldspar), varying firing temperatures, and advanced-manufacturing techniques like casting clay methods. Eight samples with different compositions were prepared using red clay, four different weight percentages were chosen for each clay type from 15 wt.%, 20 wt.%, 25wt.%, and 30 wt.% in Colombo and Beliattha samples. Their physical properties such as density of a casing clay slip, drying or firing shrinkage, loss on ignition, water absorption, modulus of rupture (MOR), and thermal shock resistance were investigated with repetition. Among the prepared samples, low shrinkage was observed in each clay type resulting reduced risk of defects from warping and cracking. Colombo clay is more suitable inthat respect. Due to higher MOR value, Beliatta clay has higher strength, durability, andstronger thermal shock resistance as well. Low water absorption was shown by Beliatta clay, indicating a more solid and impermeable structure, making the cookware lessprone to discoloration, cracking, or degradation. Therefore, Beliatta clay is more suitable than Colombo clay to fabricate cookware. Overall, it was found that different compositions of red clay could be successfully incorporated to improve the properties of clay-based cookware. This study demonstrates that enhancement of the MOR value, low water absorption and low shrinkage for cookware manufacturers, researchers, and enthusiasts who are interested in improving the quality and performance of red clay-based cookware.

Keywords: Cookware, Loss on ignition, Modulus of rupture (MOR), Red clay, Shrinkage

Acknowledgment
This work was supported by ITI under the research grant TG/21/192.

Abstract No: MP-01

Identification of soil erosion prone areas in Matale district in Sri Lanka using RUSLE model and bare soil index

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The Matale District is situated in the Central Province of Sri Lanka. It is roughly 1,993 km^2 in size and is in the foothills of the central mountain range. Matale District is vulnerable to soil erosion, which causes serious problems for the local environment and agricultural activities. Soil erosion in Matale District is primarily caused by several factors, including rainfall, land use, slope, soil type and conservation practices. This study aims to assess the soil erosion vulnerability in Matale District, Sri Lanka, utilizing the Revised Universal Soil Loss Equation (RUSLE) model and Bare Soil Index (BSI). RUSLE Model, a Digital Elevation Model (15 * 15m), rainfall data, land use and land cover, soil maps, and cropping parameters were used to evaluate the severity of erosion throughout the Matale district. The RUSLE model was calibrated and utilized to determine the rates of soil erosion considering rainfall erosivity, soil erodibility, slope length and steepness, cover management, and conservation practices. Furthermore, the BSI was calculated using remote sensing techniques. The results of the study indicated that soil erosion vulnerability in Matale District varied significantly. The estimated annual average soil loss varied from 0 to 731.71t ha^{-1} yr^{-1}. Improved land management practices and forest cover were associated with lower rates of soil erosion, whereas steep slopes, poor vegetation cover, and intense land use practices were associated with higher rates. The BSI map further explains the soil erosion risk map. When comparing the BSI map with the soil erosion risk map, most of the areas with bare soil are prone to erosion. Paddy-cultivated areas, scrub lands, chena and other cultivated areas are prone to experience high levels of soil erosion when considering a land use map. The Red Yellow podzolic soil, Reddish Brown Earths, immature Brown Loams, Erosional remnants steep rock land, and various lithosols soil types are found in areas with severe soil erosion when comparing the soil and Soil Erosion Risk Maps. When comparing a slope map to a soil erosion risk map, areas with a high percentage of slope indicate high soil erosion. Areas with a low percentage of slope on a soil erosion risk map indicate less erosion. Based on the results, recommendations for soil conservation and sustainable land management strategies in the identified vulnerable areas in the Matale district include measures such as afforestation, contour farming, terracing, conservation agriculture practices, and education and awareness programs. This study contributes to understanding soil erosion vulnerability in Matale District and provides a foundation for further research and initiatives focused on sustainable land management and environmental conservation. Proper soil conservation practices should be implemented to safeguard natural resources, improve agricultural productivity, and assure long-term sustainability.

Keywords: Soil Erosion, RUSLE, Bare Soil Index, Matale district

Acknowledgment
This work was supported by University of Kelaniya.

Abstract No: MP-02

Evaluating the nutritional compositions of king coconut husk waste (KCHW) biochar and ash: as feasible soil conditioners for coconut plantations

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King Coconut Water exports have swiftly surged, making it a prominent sector in Sri Lanka's exports. However, this rapid growth has led to increased husk waste generation, prompting the search for eco-friendly disposal solutions. This study aimed to comprehensively assess the nutritional composition of King Coconut Husk Waste (KCHW) ash and biochar produced at varying temperatures. Employing a muffle furnace, biochar and ash from the husk were produced. Biochar was generated at temperatures of 300 °C, 400 °C, and 500 °C for 1-hour period, while ash was produced at temperatures of 400 °C, 500 °C, and 600 °C for 4 hours, as chosen pyrolysis conditions. The research outcomes underscore the significant influence of pyrolysis temperature on the chemical characteristics of both biochar and ash. Even though higher conversion efficacy was achieved at 300 °C for biochar (58.87 %) and at 400 °C for ash (9.73 %). The partially burnt feedstock was observed under 300 °C during biochar production. Notably, biochar produced at 300 °C exhibited the highest levels of total nitrogen (1.99%) and available phosphorus (0.50 %). At 400 °C, biochar showcased elevated levels of available nitrogen (0.08 %) and total magnesium (0.41 %). Biochar derived at 500 °C displayed the most pronounced content of total phosphorus (0.47 %), potassium (3.33 %), calcium (1.16 %), along with the highest available potassium (2.93 %), calcium (0.38 %), and magnesium (0.24%) levels. Ash produced at 500 °C exhibited the highest proportions of total potassium, calcium, and magnesium (16.16 %, 3.11%, and 1.78 %, respectively), alongside elevated levels of available potassium (12.40 %) and magnesium (1.87 %). Similarly, ash generated at 600 °C demonstrated the highest percentages of total (2.47 %) and available (2.27 %) phosphorus. Noteworthy is the finding that 400 °C yielded the highest levels of total nitrogen (2.27 %), available nitrogen (0.07 %), and magnesium (0.45 %). Furthermore, biochar produced at 300 °C manifested the highest fixed carbon and moisture content, while ash generated at 400 °C exhibited the highest fixed carbon content. Trace nutrient concentrations were most pronounced in the ash. The maximum electrical conductivity (EC) values were recorded at 600 °C (17.12 µS/cm) for ash and at 500 °C (2.31 µS/cm) for biochar. In conclusion, based on the investigation, it has been found that biochar and ash produced at 500°C have a higher nutrient content when compared to other temperature conditions. This highlights the potential use of King Coconut Husk Waste-derived biochar and ash as nutrient-enriched soil conditioners, with enrichment in nitrogen, phosphorus, potassium, and magnesium.

Keywords: King Coconut Husk, Pyrolysis temperature, Waste disposal, Sustainability, Ecofriendly solutions

Abstract No: MP-03

Investigation of antioxidant and antityrosinase activities of *Premna serratifolia*

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In recent times, cancer and hyperpigmentation have been the most problematic issues faced by the people. As cancer is caused mostly by the free radicals in the body, antioxidants, which are radical scavengers, may reduce the mutations in the body. Hyperpigmentation is reduced by the compounds inhibiting the tyrosinase enzyme's activity. So, the compounds responsible for antioxidant and antityrosinase activities are analysed. Many harmless bioactive compounds responsible for many bioactivities are present naturally in plants. For this research work, the Sri Lankan species *Premna serratifolia* was chosen as the focal subject with specific attention to its leaves, traditionally employed for alleviating ingestion related issues. Considering the absence of prior research on this plant in previous studies, the leaves and twigs were chosen to determine the antioxidant and antityrosinase activities. The leaves were extracted by maceration process (cold extraction) through a sequential extraction using hexane, ethyl acetate and methanol. The twigs were extracted using the Soxhlet apparatus (hot extraction) through a sequential extraction using ethyl acetate and methanol. The antityrosinase activity was determined by the tyrosinase enzyme's catalytic reactions. The methanol extracts of leaves and twigs show higher antityrosinase activity (the IC_{50} value of leaves is 6.83 ± 1.31 mg/mL and the IC_{50} value of twigs is 8.20 ± 5.54 mg/mL) than their respective ethyl acetate extracts (IC_{50} value of leaves is 87.06 ± 54.90 mg/mL and IC_{50} value of twigs is 168.82 ± 2.60 mg/mL). The methanol extracts of leaves and twigs show similar antityrosinase activity within the concentration range of 0.200 – 1.600 mg/mL. At a concentration of 0.025 mg/mL, the methanol extracts of leaves and the twigs show higher antityrosinase activity than the standard Kojic acid yet, the twigs show more than the leaves. In ethyl acetate extracts, at a concentration of 0.025 mg/mL, twigs show higher antityrosinase activity than the standard Kojic acid and the leaves. The DPPH-radical scavenging method was employed to determine the antioxidant activity. The EC_{50} values of ethyl acetate extracts of leaves and twigs are higher (2.63 ± 1.61 mg/mL and 3.89 ± 1.57 mg/mL, respectively) than their respective methanol extracts (1.21 ± 0.64 mg/mL and 1.10 ± 0.65 mg/mL). Despite the methanol extracts having lower EC_{50} values, indicating high potent antioxidant activity, the ethyl acetate extracts of leaves and twigs exhibit higher antioxidant activity within the concentration range of 0.025 – 0.800 mg/mL. In ethyl acetate extracts of leaves and twigs, at a concentration of 0.025 mg/mL, the leaves show highest antioxidant activity than the twigs, but the twigs show higher antioxidant activity than the leaves within the concentration range of 0.100 - 0.200 mg/mL.

Keywords: Antioxidant, Antityrosinase, DPPH-radical scavenging, Kojic acid, *Premna serratifolia*

Abstract No: MP-04

Facebook Network Analysis Based on Graph Theory

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In the present world social media has become an essential part of humans' life. Most people use social networks to do their day today life activities. Analyzing real world social networks is also a very important and emerging research area. This research work mainly focused on Facebook social network and analyzed its properties using graph theory concepts. The network is assumed as a graph, that is, a set of vertices (or nodes) representing a person and a set of lines (or edges) representing one or more social relations among them. Graph theory techniques and properties help to analyze and visualize the behavior of networks. To construct our Facebook network, we collected real world data set by doing survey from group of university students. According to our data set we construct a network with 221 nodes and 698 edges to represent our Facebook model. To construct the Facebook model, we used Gephi, which is an open-source software for analyzing and visualizing networks. Real world networks are very complex and massive, and it is not easy to analyze. To analyze our Facebook network model, we basically used content analysis under the following categories such as metric, network structure, temporal, random walks, and visualization. Network metrics identify the most important or central character of the network. Under metric analysis we discussed homophily, density, centrality, and transitivity those are measure principal nodes in a network tends to have links to other nodes, how close the network is to complete, the most influential character of the network and tendency of the nodes to cluster together, respectively. In our model graph density is very low compared with complete. Closeness centrality is very low in the network and it is represented the connections among the people who are in the network is very distant. In the network structure basically discussed how we explore network from its structure, based on two areas such as network features and community detection. The page rank, Hyperlink – Induced Topic Search (HITS) and Stochastic Approach for Link Structure Analysis (SALSA) discussed under random walk. Random Walks is a path across a network created by taking repeated random steps. By temporal we analyze the explicit time dependent properties of the network. Probabilistic ties, time aggregated, media matrix, multi agent and discretization discussed under temporal. Visualization of the network is important, but it is impractical with the very large dataset. This work mainly focusses on analyzing our constructed Facebook model using graph theory properties. The method we used can be applied to find many interesting information in social networks.

Keywords: Facebook network model, Gephi, Graph theory, Social network analysis, Social media

Conference Paper No: PF-01

Optimization of growth parameters of electrodeposited tin oxide thin films for PV applications

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Abstract

Tin oxide (SnO_2) is a promising photoactive semiconducting material due to its optoelectronics properties. Even though, growth of SnO_2 using the method of electrodeposition is advantageous, it has paved low attention among semiconductor researchers. In this study, well-adhered photoactive SnO_2 thin film was successfully electrodeposited on Cu substrates. The growth parameters, such as film deposition potential, bath temperature, and duration of deposition were optimized. Electrodeposition of SnO_2 layers was performed on copper substrates in a three-electrode electrochemical cell using a solution containing 30 mM $SnCl_2$ and 150 mM HNO_3 at a deposition potential of -0.85 V vs. Ag/AgCl. The fabricated best thin film resulted J_{SC} value of 410 μA cm^{-2} and V_{OC} value of 113 mV in 0.1 M $NaNO_3$ electrolyte. The best thin film obtained at a bath temperature of 85°C for a deposition time of 120 seconds. The Mott-Schottky analysis revealed that the fabricated SnO_2 thin film exhibits n-type conductivity, and it has a flat band potential of -0.51 V vs. Ag/AgCl.

Keywords

Electrodeposition, Photovoltaics, SnO_2, Thin film, Tin oxide

Introduction

Tin oxide (SnO_2) is considered to be a defect type photoactive semiconducting material. It has wide direct band gap of approximately 3.8 eV (Li et al., 2009). SnO_2 exhibits properties such as high mobility, excellent conductivity, great thermal stability and transparency in the visible region (Riahi et al., 2021). These properties are highly favorable for semiconductor applications. SnO_2 is already being using in solar cells (Xiong et al., 2018) as window layer as well as anode material for Li-ion batteries (J. S. Chen & Lou, 2013) and gas sensors (Das & Jayaraman, 2014).

Like all other metal oxide semiconductors (Kafi et al., 2020), SnO_2 thin films can be grown using techniques including chemical bath deposition (Khallaf et al., 2012), spray pyrolysis (Gordillo et al., 1994), sol-gel process (Chatelon et al., 1994), metal-organic deposition (Park et al., 2006), liquid flow deposition (Supothina, 2003) and electrodeposition (X. Chen et al., 2010). Among the range of techniques available for depositing SnO_2, fabrication of SnO_2 using the method of electrodeposition is less reported in literature. Additionally, the fabrication of SnO_2 using the method of electrodeposition owes advantages like cost effectiveness, easiness, and uniformity in growth of thin film layer.

Electrodeposition of SnO_2 thin films requires the presence of hydroxyl ions (OH^-) or O^- radicals on or near the working electrode (Therese & Kamath, 2000). Various types of oxygen precursors can be utilized for this purpose, including hydrogen peroxide

(Pauporté & Lincot, 2001), nitrate ions (Izaki & Omi, 1997), and blown oxygen (Peulon & Lincot, 1998). Generally, application of a potential to the working electrode causes a reduction of the oxygen precursor resulting creation of OH^- groups. Then, these anions create tin hydroxide ($Sn(OH)_4$) using the Sn^{4+} ions in the solution of SnO_2 film deposition bath. However, this $Sn(OH)_4$ is unstable. Thus, it quickly dehydrates and precipitates to form SnO_2, as presented in the following reaction:

$$Sn^{4+} + 4OH^- \rightarrow Sn(OH)_4 \rightarrow SnO_2 + 2H_2O$$

Many researchers have developed various film deposition baths for the fabrication of SnO_2 thin film employing electrodeposition technique is listed in the Table 1.

Table 1. *Reported film deposition baths for fabrication of SnO_2 thin films*

Working Electrode	Film deposition bath	Mode	References
Cu	20 mM $SnCl_2.2H_2O$ 100 mM $NaNO_3$ 75 mM HNO_3	Galvanostatically	(Chang et al., 2002)
Cu	25 mM $SnCl_2.2H_2O$ 150 mM HNO_3	Galvanostatically	(Chang et al., 2004)
Au	25 mM $SnCl_2.2H_2O$ 100 mM $NaNO_3$ 75 mM HNO_3	Potentiostatically	(Lai et al., 2006)
Pt	100 mM $SnCl_2.2H_2O$ 400 mM $NaNO_3$ 500 mM HNO_3 0.2 wt.% SDS	Potentiostatically	(Spray & Choi, 2007)
ITO	20 mM $SnCl_2.2H_2O$ 100 mM $NaNO_3$ 75 mM HNO_3 5 mM SDS	Potentiostatically	(Ishizaki et al., 2009)
Cu	20 mM $SnCl_4.5H_2O$ 80 mM HNO_3	Potentiostatically	(X. Chen et al., 2010)
ITO	30 mM $SnSO_4$ 1.07M HNO_3	Potentiostatically	(Vequizo et al., 2010)
Cu	100 mM $SnCl_2.2H_2O$ 500 mM $NaNO_3$ 400 mM HNO_3	Potentiostatically	(Kim, S., Lee, H., Park, C. M., & Jung, 2012)

ITO	40 mM $SnCl_2$ 100 mM HNO_3 100 mM $NaNO_3$	Potentiostatically	(Daideche, K., Azizi, 2017)

In this study, nitrate ion-based bath was used for the potentiostatically electrodeposition of the SnO_2 thin film followed by a pre-treatment of oxygen bubbling to the film deposition bath. The growth parameters such as potential of film deposition, temperature of the bath and duration of the film deposition were altered in order to find the optimum growth parameters. In literature, details of optimization of growth parameter for the SnO_2 film deposition is rarely reported. Further, the performance of photoactive SnO_2 thin films in sodium nitrate electrolyte is not reported. Thus, this study is significant to understand the electrical properties of electrodeposited SnO_2 thin films.

Methodology

SnO_2 thin films were potentiostatically electrodeposited on well-cleaned copper substrates using a Hokuto Denko Potentiostat / Galvanostat HAB-151 in a setup of three-electrode electrochemical cell. The aqueous film deposition bath consisted of 30 mM stannous chloride ($SnCl_2$ regent grade, 98%) and 150 mM nitric acid (HNO_3 regent grade, 69%). The working electrode was the copper foil and the counter electrode was a platinum foil. The reference electrode was a Ag/AgCl electrode. Initially, a pre-treatment step was carried out in order to oxidize the stannous ions (Sn^{2+}) into stannic ions (Sn^{4+}). Here, the oxygen gas was bubbled into the electrochemical bath for 1 hour at the relevant temperature of the electrodeposition bath. A cyclic voltammetry was taken to determine the deposition potential. Then, the growth parameters such as temperature of the film deposition bath and the duration of the film depositions were altered, in order to identify the optimum growth parameters. The tested temperature values of the film deposition bath were 70, 75, 80, 85, 90, 95 ℃ and the tested duration of the film deposition were 30, 60, 120, 150, 180, 240 seconds. After the SnO_2 thin film deposition, all the samples were washed with deionized water, then immersed in 0.1 M sodium nitrate ($NaNO_3$) and dried under ambient conditions in a desiccator.

A solution containing 0.1 M $NaNO_3$ was used as the photoelectrochemical cell (PEC) for the SnO_2 thin film characterization. The current-voltage (I-V) and capacitance-voltage (C-V) characterizations were implemented through Gamry G series potentiostat/galvanostat/ ZRA instrument. The I-V characterization was conducted under illumination with a mercury lamp.

Result and discussion

The Figure 1 depicts the cyclic voltammetry curve obtained using the Gamry instrument. From the curve of cyclic voltammogram shown in Figure 1, it is clear that well-defined cathodic peaks that can be observed around the potential values of -0.20 V and -0.77 V vs. Ag/AgCl. At the certain deposition potential value of -0.20 V vs. Ag/AgCl, no visible thin film was deposited on the working electrode. At the deposition potential value of -0.77 V vs. Ag/AgCl a thin film of SnO_2 was grown on the working electrode. However, the thin film formed at deposition potential value of -0.77 V vs. Ag/AgCl was not well-adhere to the substrate. Therefore, a set of samples was deposited across a range of potentials, varying from 0.60V to 0.90 V vs. Ag/AgCl. Thus, it is found that the best

adhered SnO_2 thin films were form at the deposition potential value of 0.85 V vs. Ag/AgCl.

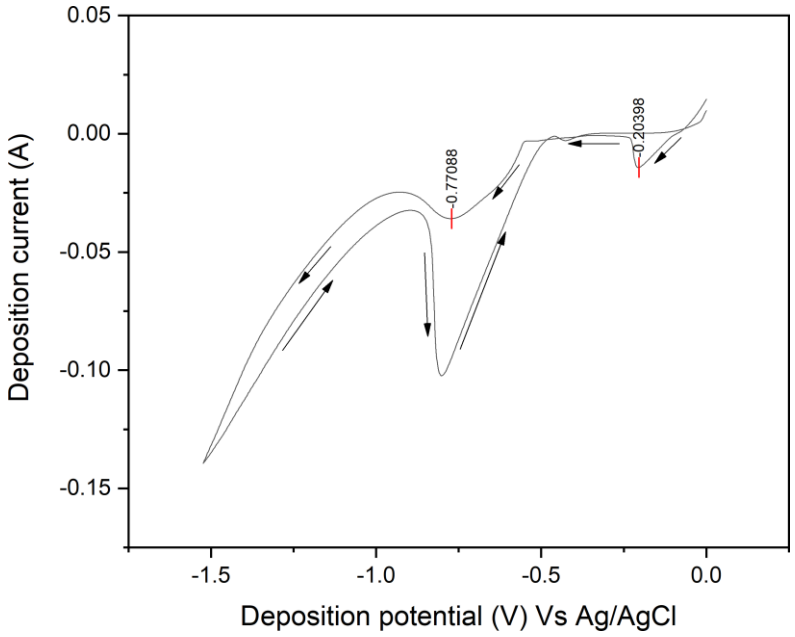

Figure 1. *Cyclic voltammetric curve of SnO_2 thin film deposition*

The Table 2 displays the values of short circuit current densities (J_{SC}) and open circuit voltages (V_{OC}) resulted for the SnO_2 thin films deposited at deposition potential value of -0.85 V vs. Ag/AgCl and at the bath temperature values of 80˚C, 85˚C, and 90˚C. The photoresponses resulted for the other temperature values are insignificant.

Table 2. *J_{SC} and V_{OC} values for the SnO_2 thin films deposited at different temperature values of film deposition for 120 seconds*

Temperature (˚C)	J_{sc} (μAcm^{-2})	V_{oc} (mV)
80	309	69
85	410	113
90	91	50

The Table 3 displays the J_{SC} and V_{OC} values for the SnO_2 thin films deposited at deposition potential value of -0.85 V vs. Ag/AgCl and at the deposition durations of 60, 90, 120 and 150 seconds. The photoresponses resulted for the other deposition durations were insignificant.

The optimal photoactive performance was achieved from the films grown in a bath consisting of 30 mM $SnCl_2$ and 150 mM HNO_3 at a deposition potential of - 0.85 V vs. Ag/AgCl and bath temperature of 85 ℃ for a deposition duration of 120 seconds. Light modulated I-V curve for the optimum sample is shown in Figure 02. Here the area exposed for the I-V characterization was 25 mm^2.

Table 3. *J_{SC} and V_{OC} values for the SnO_2 thin films deposited at different film deposition durations at the bath temperature value of 85* ℃.

Time (s)	J_{sc} (μAcm^{-2})	V_{oc} (mV)
60	59	9
90	254	51
120	410	113
150	227	42

Figure 3 represents the Mott-Schottky plot which was obtain for the optimum sample. According to the Figure 3 it is clear that SnO_2 film exhibits n-type conductivity and has a flat band potential of -0.51 V vs. Ag/AgCl.

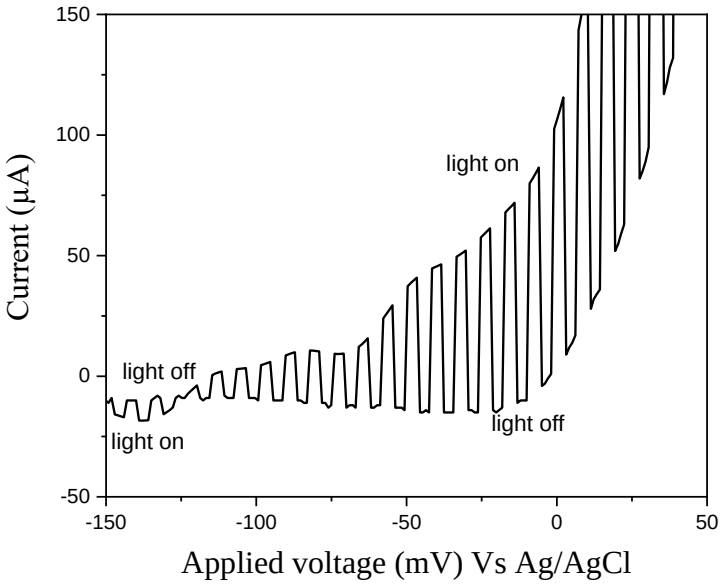

Figure 2. *Dark and light current-voltage characteristics for the film deposited at optimum growth condition*

Conclusion

In this study, it is found that successfully photoactive n-type SnO_2 thin films can be electrodeposited on Cu substrate. The best sample resulted the J_{sc} value of 410 μAcm^{-2} and V_{oc} value of 113 mV. The quality photoactive samples can be deposited in a three electrochemical cell consisting of 30 mM $SnCl_2$ and 150 mM HNO_3 at -0.85 V vs. Ag/AgCl for 120 seconds and bath temperature of 85°C. Moreover, the flat band potential resulted for the best SnO_2 thin films was -0.51 V vs. Ag/AgCl.

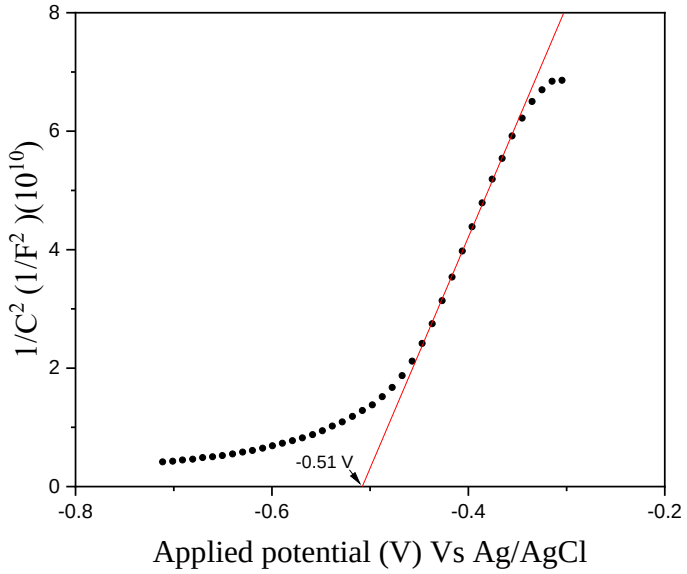

Figure 3. *Mott–Schottky plot obtained in a PEC containing 0.1 M sodium nitrate aqueous solution for SnO_2 thin film electrodeposited under optimum growth conditions.*

Acknowledgment

This work was supported by Internal Research Grant, University of Kelaniya under the research grant no: RP/03/02/05/01/2022

References

Chang, S. T., Leu, I. C., & Hon, M. H. (2002). *Electrochemical and Solid-State Letters*, *5*(8), C71. https://doi.org/10.1149/1.1485808

Chang, S. T., Leu, I. C., Liao, C. L., Yen, J. H., & Hon, M. H. (2004). *Journal of Materials Chemistry*, *14*(12), 1821–1826. https://doi.org/10.1039/B316459D

Chatelon, J. P., Terrier, C., Bernstein, E., Berjoan, R., & Roger, J. A. (1994). *Thin Solid Films*, *247*(2), 162–168. https://doi.org/https://doi.org/10.1016/0040-6090(94)90794-3

Chen, J. S., & Lou, X. W. (David). (2013). *Small*, *9*(11), 1877–1893. https://doi.org/https://doi.org/10.1002/smll.201202601

Chen, X., Liang, J., Zhou, Z., Duan, H., Li, B., & Yang, Q. (2010). *Materials Research Bulletin*, *45*(12), 2006–2011. https://doi.org/https://doi.org/10.1016/j.materresbull.2010.07.029

Daideche, K., Azizi, A. (2017). *J Mater Sci: Mater Electron*, *28*, 8051–8060. https://doi.org/https://doi.org/10.1007/s10854-017-6511-8

Das, S., & Jayaraman, V. (2014). *Progress in Materials Science*, *66*, 112–255. https://doi.org/https://doi.org/10.1016/j.pmatsci.2014.06.003

Gordillo, G., Moreno, L. C., de la Cruz, W., & Teheran, P. (1994). *Thin Solid Films*,

252(1), 61–66. https://doi.org/https://doi.org/10.1016/0040-6090(94)90826-5

Ishizaki, T., Saito, N., & Takai, O. (2009). *Journal of The Electrochemical Society*, *156*(10), D413. https://doi.org/10.1149/1.3190161

Izaki, M., & Omi, T. (1997). *Journal of The Electrochemical Society*, *144*(6), 1949. https://doi.org/10.1149/1.1837727

Kafi, F. S. B., Wijesundera, R. P., & Siripala, W. (2020). *Physica Status Solidi (A)*, 2000330. https://doi.org/10.1002/pssa.202000330

Khallaf, H., Chen, C.-T., Chang, L.-B., Lupan, O., Dutta, A., Heinrich, H., Haque, F., del Barco, E., & Chow, L. (2012). *Applied Surface Science*, *258*(16), 6069–6074. https://doi.org/https://doi.org/10.1016/j.apsusc.2012.03.004

Kim, S., Lee, H., Park, C. M., & Jung, Y. (2012). *Journal of Nanoscience and Nanotechnology*, *12*(2), 1616–1619. https://doi.org/https://doi.org/10.1166/jnn.2012.4646

Lai, M., Gonzalez Martinez, J. A., Grätzel, M., & Riley, D. J. (2006). *Journal of Materials Chemistry*, *16*(27), 2843–2845. https://doi.org/10.1039/B606433G

Li, L., Liu, J., Su, Y., Li, G., Chen, X., Qiu, X., & Yan, T. (2009). *Nanotechnology*, *20*(15), 155706. https://doi.org/10.1088/0957-4484/20/15/155706

Park, H.-H., Park, H.-H., & Hill, R. H. (2006). *Sensors and Actuators A: Physical*, *132*(2), 429–433. https://doi.org/https://doi.org/10.1016/j.sna.2006.02.030

Pauporté, T., & Lincot, D. (2001). *Journal of Electroanalytical Chemistry*, *517*(1), 54–62. https://doi.org/https://doi.org/10.1016/S0022-0728(01)00674-X

Peulon, S., & Lincot, D. (1998). *Journal of The Electrochemical Society*, *145*(3), 864. https://doi.org/10.1149/1.1838359

Riahi, I., Khalfallah, B., & Chaabouni, F. (2021). *Solid State Communications*, *340*, 114487. https://doi.org/https://doi.org/10.1016/j.ssc.2021.114487

Spray, R. L., & Choi, K.-S. (2007). *Chemical Communications*, *35*, 3655–3657. https://doi.org/10.1039/B704428C

Supothina, S. (2003). *Sensors and Actuators B: Chemical*, *93*(1), 526–530. https://doi.org/https://doi.org/10.1016/S0925-4005(03)00178-3

Therese, G. H. A., & Kamath, P. V. (2000). *Chemistry of Materials*, *12*(5), 1195–1204. https://doi.org/10.1021/cm990447a

Vequizo, J. J. M., Wang, J., & Ichimura, M. (2010). *Japanese Journal of Applied Physics*, *49*(12R), 125502. https://doi.org/10.1143/JJAP.49.125502

Xiong, L., Guo, Y., Wen, J., Liu, H., Yang, G., Qin, P., & Fang, G. (2018). *Advanced Functional Materials*, *28*(35), 1802757. https://doi.org/https://doi.org/10.1002/adfm.201802757

Conference Paper No: PF-02

Sound absorption properties of structures developed using waste materials

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Abstract

This study investigates the sound absorption coefficients (SAC) of structures developed using coconut shell powder, charcoal powder, and hair. Large amounts of coconut shells and human hair are readily available in Sri Lanka. The study used those to build sound absorption structures (SAS) using natural liquid rubber as a binder. Sample sheets were prepared by varying the volume ratio of the binder and fillers. Samples were tested for their SAC by using the impedance tube for different frequencies within the range of 1000-3500 Hz. Finally, the samples were further improved by changing physical properties such as lowering density, increasing thickness, and increasing porosity with surface roughness and combining layers. A coconut shell powder sample with a 50% volume ratio shows the SAC in the range of 0.80-0.83 for 2500 Hz and 0.85-0.93 for 3000 Hz. Improved charcoal samples, with 1.5 cm in thickness and a volume ratio of 66%, exhibited sound absorption over 60% beyond 2000 Hz, which indicates efficient absorption of incident sound energy without reflections or transmissions. A Hair sample also showed some magnificent SAC of 0.93 at 2500 Hz. A 2 cm thick layering type sample, which combines hair sample layers and charcoal powder sample layers, also shows a SAC of 0.80–0.80 for higher frequencies more fabulous than 3000 Hz. Acoustic materials in the market (thickness > 2 cm) have SAC of 0.20-0.99 for 125-4000 Hz. So, these versatile, cost-effective, eco-friendly SAS are suitable for architectural acoustics, studios, theatres, and the automotive industry due to flexibility, easy preparation, and thin profile.

Keywords

Acoustic foam, Sound Absorption, Sound absorption material, Sound absorption coefficient, Waste materials

Introduction

Sound pollution is a significant environmental issue that impacts human health and well-being. Unlike other types such as water, air, or soil pollution, it is an invisible form of pollution. Excessive noise exposure can lead to health problems like high blood pressure, heart disease, sleep disturbances, hearing loss, and stress. Children are particularly vulnerable. Sound pollution also contributes to social conflicts and family issues. Major sources include vehicle and traffic noise, factory operations, uncontrolled musical shows, and urbanization. The trend of constructing low-cost buildings with thin short walls exacerbates the problem. Smooth walls contribute to increased sound reflection and reverberation within rooms. Addressing sound pollution is crucial for maintaining a calm and healthy environment. This study's main target was to investigate the possibility of discovering confident natural, low-cost, and user-friendly SAS that are made from waste materials such as coconut shells, and human hair.

Global waste production has surged due to economic growth and improved living standards. To address this, researchers are developing sound absorption materials using

waste resources like recycled rubber tires, textile waste, wood dust, and green tea residues, offering a value-added solution(Yan et al., 2014; Borlea et al., 2012; Chanlert & Ruamcharoen, 2021; Tiuc et al., 2018; Storodubtseva et al., 2018). We can mitigate environmental harm by repurposing these materials and contribute to sustainable waste management practices. Fiberglass board, glass wool, mineral wool, foam plastic, and wood wool boards are some of the mainly used SAS available in the market. Those have shown SAC between 0.20 – 0.98 for 125-4000 Hz (Materials, 2011; *Sound Absorption Coefficient Chart | JCW Acoustic Supplies*, n.d.).The market price of those materials in one square foot was more than 3-10 $. However, the production cost of these improved sound absorption materials are between 0.5- 1.5 $. So throughout this research, the physical properties of those samples changed by lowering density, increasing thickness, and increasing porosity with surface roughness and combining layers until the SAC increased. All SAC were taken by Impedance tube (Russell, n.d.).

Methodology/materials and methods

In Sri Lanka, there were lots of coconut shells available throughout the country. The selected coconut shells were slightly thicker than usual. The coconut shells were cleaned, ground, dried, and sifted to obtain the powder (Figure 1). It was then mixed with natural liquid rubber in a 1:1 volume ratio, compressed, solidified, milled, and dried to create a uniform sheet. The sheet was cut into samples' size, and their thickness, mass, and diameter were recorded to calculate density. The SAC was measured for high frequencies (1000 Hz, 1500 Hz, 2000 Hz, 2500 Hz, 3000 Hz, and 3500 Hz) for a thickness of 1.5 cm. Samples with a thickness of 1.5 cm were drilled with hole spaces of 1.5 cm for different depths (0.7 cm and 1.1 cm), and the SAC was measured for these combinations. Additionally, the SAC was tested by increasing the number of holes (with a hole space of 1 cm) for a depth of 1.1 cm.

Then 40 coconut shells were dried in sunlight for 2 days, cleaned, burned to convert into charcoal, and hammered into charcoal powder. The charcoal powder was sifted through a sieve and mixed with natural liquid rubber in a 2:1 volume ratio. After compression and a day of solidification, the mixture was milled into a uniform sheet, dried under sunlight for 2 days, and cut to sample holder size. The thickness, mass, and diameter were noted, and the SAC was measured at the same high frequency range, for thicknesses of 0.7 cm, 1.1 cm, and 1.5 cm. Similarly, samples with a thickness of 1.5 cm were drilled with hole spaces of 1 cm for different depths (0.7 cm and 1.1 cm), and the SAC was measured for these combinations. Rubber wood dust samples, made by mixing with natural liquid 1:1 ratio, are also used as a reference to check the thickness effect on SAC of samples.

(a) (b)

Figure 1. *(a) coconut shells powder (b) charcoal powder*

Human hair was washed, dried, soaked in rubber liquid, and compressed in a molder. The resulting hair sheet was milled to remove water, dried under sunlight, and cut to sample holder size. Thickness, mass, and diameter were recorded for density calculation. SAC was tested for the same high frequency range at 0.7 cm and 1.5 cm thicknesses. This research investigates the SAC of hair-based samples as sound absorption materials. Then

a layer type, 2 cm thick sample (sample C) was made by combining charcoal powder layer and hair layer (Tiuc et al., 2018).This sample C tested for both sides, the one sets of reading set were taken when incident beam fell on hair layer and other set of reading ware taken when incident beam fell on charcoal layer.

Results and Discussion

Coconut shell powder samples

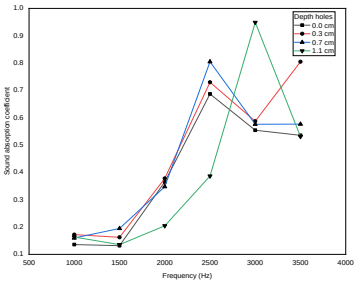

Figure 2. *The graph of the SAC vs frequency for different depths of holes of a 1.5 cm thick coconut powder sample with a 1.5 cm hole space*

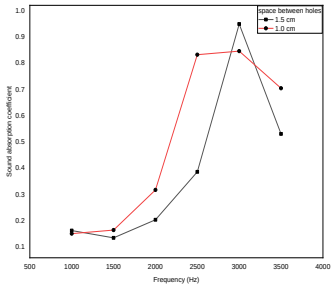

Figure 3. *Variation of SAC for 1.1 cm depth of holes in a 1.5 cm thick coconut powder sample with different hole spaces*

(a) **(b)**

Figure 4. *coconut powder sample (a) without holes, and (b) with holes and space between two holes was 1.5 cm*

Figure 2. illustrates the impact of holes depth on the sample. The sample with holes exhibited a higher SAC than those without holes. This can be attributed to increased surface roughness and reduced total reflection due to the presence of holes. Additionally, the density of the sample decreases with the holes, while the direct sound interaction area of the sample surface increases, resulting in enhanced sound absorption. However, the SAC varied with holes depth, indicating that specific depths of holes corresponded to the highest absorption for different frequencies. Increasing the number of holes or decreasing the hole spacing resulted in higher roughness and density, increasing sound absorption, as shown in Figure 3. There is a direct correlation between the number of holes and sound absorption. However, if the number of holes is increased excessively, the sound wave would transmit through the sample without absorption, indicating a limitation to the increment of holes. Similarly, when the depth of the hole is increased further, SAC is decreased due to the full transmission through holes.

Charcoal powder samples

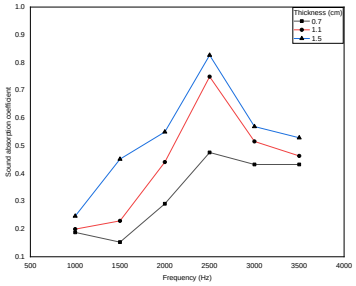

Figure 5*. The graph of SAC vs frequency for different thickness of charcoal powder sample*

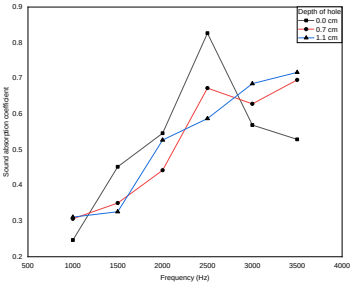

Figure 6. *The graph of SAC vs frequency for different depths of holes of a 1.5 cm thick charcoal powder sample with a 1 cm hole space*

(a) **(b)**

Figure 7. *Charcoal powder sample (a) without holes, and (b) with holes of hole space 1 cm*

Figure 5. illustrates the increased sound absorption coefficient with thicker materials. The 1.5 cm thick charcoal (blue line) demonstrated better sound absorption than to the coconut shell powder sample. Charcoal exhibited the highest absorption coefficient within the 2000 -3000 Hz frequency range. Each sample of 1 cm thick showed a peak in sound absorption coefficient, specifically at 2500 Hz. However, it is essential to note that the readings were not taken continuously because there were no readings within the frequency gap of 500 Hz. *Figure 6.* demonstrates the impact of holes and their depths on sound absorption. The black line represents sound absorption without holes, which showed no significant improvement. However, the sample with holes displayed effective sound absorption within the frequency range of 3000 Hz to 3500 Hz, serving as an example of successful absorption in that specific range. *Figure 8.* Interprit the SAC increased with decreased material density. The densities of the coconut shell powder sample (Red line) and charcoal powder sample (Black line) are 297.24 kg m^{-3} and 203.82 kg m^{-3} respectively. When density decreased, the speed of sound increased. So, the vibration increased, and the thermal energy loss also increased. Therefore, sound absorption should be increased accordingly.

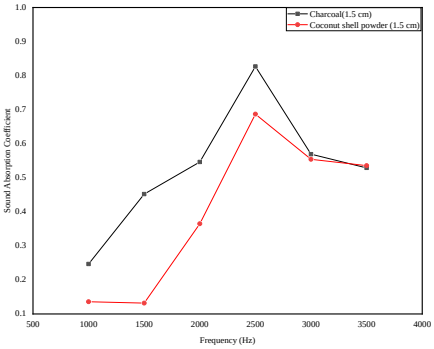

Figure 8. *The graph of SAC vs frequency for different densities of charcoal powder and coconut shell powder sample*

Hair samples

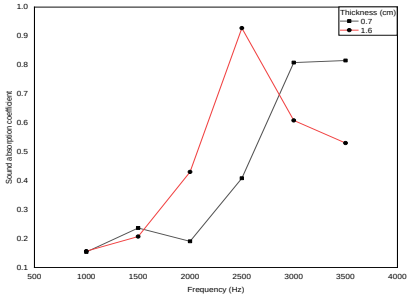

Figure 9. *The graph of SAC vs frequency for different thickness of hair sample*

Figure 9. was a somewhat different set of readings. Here the red line shows the 1.6 cm thick sample and it implies the highest absorption frequency of 2500 Hz. But the black line, which has a 0.7 cm thick sample, suddenly decreased the absorption at 2500 Hz, showings the highest absorption in the range of 3000 Hz to 3500 Hz. This was an unusual incident to the other samples because all other samples imply the highest peak for significant frequency at all thicknesses. Both samples show low absorption for the range 1000 Hz to 2000 Hz. But hair is a fibre-type material and the roughness of the hair sample was high. So, the materials show good performance when absorbing high frequencies between 2500 Hz to 3500 Hz.

Charcoal powder +Hair layer (Sample C)

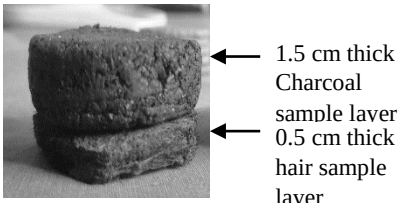

Figure 10.*Two layer Samlple* ***C***

Both materials charcoal and hair had shown good SAC for higher frequencies. The multilayer sample was made by combining a hair sample and a charcoal sample, as shown in *Figure 10*, after considering previous results. So *Figure 11*. implies something essential about sample C, which was the multilayer type sample. Here the sound absorption was checked for both sides of sample C. The black

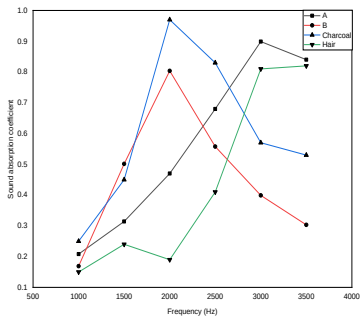

Figure 11. *The graph of sound absorption coefficient vs frequency for both surface of sample* ***C*** *, charcoal sample and hair sample*

line of *Figure 11*, which was labelled as A, was the sample whose interacting surface with sound was hair and other side was charcoal. But this has good absorption for the 2500 Hz to 3500 Hz frequency range. This curve was very similar to the hair sample (green line), and has a higher sound absorption coefficient than the hair sample 0.7 cm thick. Similarly, the SAC shown in the red line (B) is the other side of sample C, which means the sound interacting surface was the charcoal. This one show similar behaviour to the charcoal sample (blue line) with a 1.5 cm thickness. But this has lower effective sound absorption than charcoal. This multilayer sample C shows various sound absorptions for various surfaces. At 2000 Hz, the hair sample (0.7 cm thick) shows a drop of sound absorption coefficient less than 0.2, but when combining this hair sample with charcoal, that drop is overcome. *Figure 11*. shows the importance of surface roughness and the value of the hair layer as a surface layer of multilayering sound absorption material.

Conclusion

Various parameters can affect the sound absorption coefficient. The primary characteristics, taken into account in this study were porosity, thickness, surface roughness, and density. It is clearly observed that the sound absorption directly increased with the increment of sample thickness. Though the tested samples have shown somewhat low sound absorption for the frequency range of 1000 Hz to 2000 Hz, more than 0.7 sound absorption coefficient has been shown in the range from 2000 Hz up to 3500 Hz. The number and depth of holes also showed some increment of sound absorption. But it depends from frequency to frequency. The sound absorption direct impacted on the side of the sample with which sound interacts first. After optimizing porosity, thickness, density, hole depth, and hole diameter, sound absorption of materials can be maximized (Amares et al., 2017). Charcoal powder samples interpret effective performance about sound absorption. The thickness of the tested samples was either less than or equal to 1.5 cm, which means that if the thickness increases better sound absorption would be expected from those samples. The hair sample has a good rough surface. So, a hair sample is a better surface for multilayering sound absorption materials. When considering the density of the hair sample (212.31 kg m^{-3}), it has a low density. So that may also be a good reason for the increment in its sound absorption. Multilayering sample C has some good sound absorption coefficients. However, the sound absorption directly impacted on the side with which sound interacts. Due to their adaptability, simplicity of preparation, and thin profile, charcoal powder, hair, and sample C are flexible, affordable, and environmentally friendly sound absorption materials for architectural acoustics, recording studios, home theatres, and the automotive sector (Yan et al., 2014).

References

Amares, S., Sujatmika, E., Hong, T. W., Durairaj, R., & Hamid, H. S. H. B. (2017). A Review: Characteristics of Noise Absorption Material. *Journal of Physics:*

Conference Series, *908*(1). https://doi.org/10.1088/1742-6596/908/1/012005

Borlea, A., Rusu, T., & Vasile, O. (2012). Using particles of recycled rubber when making some soundproofing materials. *Materiale Plastice*, *49*(4), 275–278.

Chanlert, P., & Ruamcharoen, P. (2021). Sound absorption properties of rigid polyurethane foam composites with rubber-wood sawdust as a natural filler. *Journal of Physics: Conference Series*, *1719*(1). https://doi.org/10.1088/1742-6596/1719/1/012062

Materials, A. (2011). Acoustic and Thermal Insulating Materials. *Building Decorative Materials*, 359–374. https://doi.org/10.1533/9780857092588.359

Russell, D. A. (n.d.). *Absorption Coefficients and Impedance*. 1–6.

Sound Absorption Coefficient Chart | JCW Acoustic Supplies. (n.d.). Retrieved July 17, 2023, from https://www.acoustic-supplies.com/absorption-coefficient-chart/

Storodubtseva, T. N., Aksomitny, A., & Saldaev, V. A. (2018). The study of soundproofing properties of wood polymer-sand composite. *Solid State Phenomena*, *284 SSP*, 993–998. https://doi.org/10.4028/www.scientific.net/SSP.284.993

Tiuc, A. E., Vasile, O., Vermeşan, H., Nemeş, O., & Borlea Mureşan, S. I. (2018). New multilayered composite for sound absorbing applications. *Romanian Journal of Acoustics and Vibration*, *15*(2), 115–121.

Yan, J., Kim, M. S., Kang, K. M., Joo, K. H., Kang, Y. J., & Ahn, S. H. (2014). Evaluation of PP/Clay composites as soundproofing material. *Polymers and Polymer Composites*, *22*(1), 65–72. https://doi.org/10.1177/096739111402200110

Conference Paper No: PF-03

Fuzzy linear regression approach for modelling dengue disease transmission in Colombo

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Abstract

Dengue fever is caused by the dengue virus and is primarily transmitted through the bites of Aedes mosquitoes. Dengue fever is a significant public health concern in Colombo, Sri Lanka, with recurring outbreaks affecting a large number of individuals. Understanding the factors influencing dengue transmission is crucial for effective disease control and prevention. This study aims to explore a fuzzy regression approach for modelling dengue disease transmission in Colombo. As fuzzy linear regression incorporates uncertainty and imprecision into the modelling process, it has an advantage over conventional regression techniques. A fuzzy linear regression model was developed using various climate predictors, such as rainfall, relative humidity, wind speed, and temperature. Among these Climate variables, relative humidity and rainfall, are found to play a crucial role in mosquito breeding and the subsequent spread of the dengue virus. The fuzzy linear regression model is used to assess the relationships between these predictors and dengue transmission rates in Colombo. The suggested fuzzy linear regression model's evaluation criteria were done using R^2, Root Mean Squared Error, and Mean Absolute Error values. This study provides insights into the relationship between climatic factors and dengue transmission in Colombo by utilizing the above regression model. Climate variables, such as relative humidity and rainfall, are found to play a crucial role in mosquito breeding and the subsequent spread of the dengue virus. The findings highlight the importance of considering climatic predictors when developing dengue prevention strategies, particularly in urban environments like Colombo.

Keywords

Dengue fever, Fuzzy linear regression, Mean Absolute Error, R^2, Root Mean Squared Error.

Introduction

In recent years, dengue, a viral illness caused by mosquitoes, has expanded quickly throughout the entire world. It has been suggested that the dengue virus originated in Africa and that the slave trade played a role in its global spread (Sirisena & Noordeen, 2014). According to Withanage et al. (2018), dengue is primarily found in tropical and subtropical parts of the world, home to about 3.9 billion people. This is spread mostly by the Aedes aegypti and Aedes albopictus vectors. They are both highly domesticated urban mosquitoes that like to coexist with people in and around their homes, feed on them, and lay their eggs in small containers. In most tropical nations worldwide, dengue significantly burdens human populations, health, and economic systems compared to other diseases and their impacts. Over the past 50 years, dengue cases have dramatically increased. According to the American Centers for Disease Control and Prevention (CDC), up to 400 million people throughout the world contract an infection every year

(Amerasinghe et al., 1995). Over the past six years, dengue cases in the Colombo district have made up around 25% of all cases nationwide. Using climate data from the Colombo district, Leslie Chandrakantha (Chandrakantha, 2019) built a risk prediction model for dengue transmission. When building the model, a logistic regression technique was applied. Overall, the findings indicated that the only significant factor influencing the chance of experiencing increased dengue occurrences was rainfall. Using Bayesian Poisson spatial regression Thipruethai Phanitchat, et al. (Phanitchat et al., 2019) analysed Spatial and temporal patterns of dengue incidence in northeastern Thailand from 2006–2016. Over the course of this study, there was an increase in the number of dengue cases recorded in older age groups. The maximum ambient temperature was positively correlated with dengue incidence and was extremely seasonal. Climate-related factors, however, did not fully account for the regional variation of dengue in the province. Numerous types of research, like the ones described above, have demonstrated a connection between climatic variables and dengue incidences. Therefore, a risk prediction model based on climatic variables would help lower illnesses by eliminating mosquitoes that carry the virus. The current study is novel because there are limited applications of fuzzy linear regression in dengue transmission. In Sri Lanka, the spread of dengue is a significant public health issue. Dengue cases have been steadily rising in Sri Lanka over time. Moreover, no commercially available vaccination may be used to prevent dengue. Preventive interventions can work more effectively if there is a reliable early warning system. Determining the environmental and climatic elements that may be responsible for the rise in dengue cases and the resulting threat to human health is therefore vital. This study aims to model and forecast dengue disease in Colombo using fuzzy linear regression approach to forecast dengue cases. Generally, the majority of dengue cases are reported in the Colombo district and hence, the study focuses on Colombo. As fuzzy linear regression incorporates uncertainty and imprecision into the modelling process, it has an advantage over conventional regression techniques. Further, it can be given directions to the relevant authority for more attention to control the areas which have more dengue patients.

Methodology/materials and methods

Data Description

The monthly dengue disease incidence data is collected from the Epidemiology Unit, Ministry of Health, Sri Lanka and monthly meteorological data were obtained from the Department of the Census and Statistics in the Colombo district from 2010 to 2022. The data is further split into training and testing data sets, with training data being used to train the regression model.

Fuzzy Linear Regression

Fuzzy linear regression is a variant of linear regression that incorporates fuzzy logic concepts to handle uncertain or imprecise data. It extends traditional linear regression by allowing for fuzzy membership functions to represent the uncertainty associated with the input and output variables. Let X be a universal set, a fuzzy set $\widetilde{A}$ of X is defined by its membership function $\mu_{\widetilde{A}}: X \rightarrow [0,1]$. The universal set X is generally assumed to be the set of real numbers (Buckley & Jowers, 2008).The fuzzy number $\widetilde{A}$ is called LR –fuzzy number if it has the membership function as follows:

$$\mu_{\widetilde{\mathrm{A}}}(x) = \begin{cases} L(x), & \text{if } x \in [a,b) \\ 1, & \text{if } x \in [b,c] \\ R(x), & \text{if } x \in (c,d] \\ 0, & \text{otherwise} \end{cases} \quad (01)$$

for all $x \in \mathbb{R}$ and $a < b < c < d$ where L, R: $[0,1] \to [0,1]$ are two shape functions such that $R[0] = L[0] = 0$ and $R[1] = L[1] = 1$. The support and the core of LR-fuzzy number $\widetilde{\mathrm{A}}$ are closed intervals, i.e., $[a,b]$ and $[b,c]$, respectively. If $L[x] = \frac{x-b}{b-a}$, $R[x] = \frac{d-x}{d-c}$ and $b = c$, then LR fuzzy number $\widetilde{\mathrm{A}}$ is called triangular fuzzy number (TFN). In general, TFN $\widetilde{\mathrm{A}}$ can be denoted by $\widetilde{\mathrm{A}} = (a,b,d)_{\mathrm{T}}$ with the membership function as:

$$\mu_{\widetilde{\mathrm{A}}}(x) = \begin{cases} \frac{x-b}{b-a}, & \text{if } x \in [a,b) \\ \frac{d-x}{d-c}, & \text{if } x \in [b,d] \\ 0, & \text{otherwise} \end{cases} \quad (02)$$

The goal of fuzzy linear regression is to find the best linear relationship between the fuzzy input variables and the fuzzy output variable. This involves estimating the parameters of the linear regression model, such as the intercept and coefficients, while considering the uncertainty associated with the fuzzy membership functions (Buckley & Jowers, 2008). The fuzzy linear regression model typically follows a similar form to traditional linear regression, but with fuzzy membership functions involved. The model can be represented as:

$$\hat{y}_i = \beta_0 + \beta_1(x_{i1}) + \cdots + \beta_p(x_{ip}) \quad (03)$$

In this equation, $\hat{y}_i$ is the predicted value of the fuzzy output variable for the $i-$th data point. x_{i1}, x_{i2}, ..., x_{ip} represent the fuzzy input variables associated with the $i-$th data point, each with their respective fuzzy membership functions. $\beta_0, \beta_1, \beta_2, \ldots, \beta_p$ are the coefficients or weights of the linear regression model. To formulate the above FLRM in Equation (03) can be presented according to the following steps (Rattanalertnusorn et al., n.d.).

Step 1- Defined LR-fuzzy numbers in the fuzzy model. Let $\tilde{y}_i$ and $\tilde{x}_{ij}$ are TFNs, which are denoted by

$\tilde{y}_i = (y_{il}, y_{im}, y_{iu})_T$ and $\tilde{x}_{ij} = (x_{i1l}, x_{i1m}, x_{i1u})_T;\ j = 1, .., k$ (04)

Also the membership function defined as:

$$\mu_{\tilde{y}_i\,(y)=} \begin{cases} \frac{y-y_{im}}{y_{im}-y_{il}}, & y_{il} < y < y_{im} \\ \frac{y_{iu}-y}{y_{iu}-y_{im}}, & y_{im} < y < y_{iu} \\ 0, & \text{otherwise} \end{cases} \quad (05)$$

And

$$\mu_{\tilde{x}\mathrm{ij}\,(x)=} \begin{cases} \frac{x-x_{ijm}}{x_{ijm}-x_{ijl}}, & x_{ijl} < x < x_{ijm} \\ \frac{x_{iju}-x}{x_{iju}-x_{ijm}}, & x_{ijm} < x < x_{iju} \\ 0, & \text{otherwise} \end{cases} \quad (06)$$

Step 2- Transform the fuzzy components into crisp number by using the centroid formulae (Grzegorzewski, 2010) and obtain the conventional linear regression model.

Step 3- Formulated fuzzy linear regression model in Eq. (03) by using fuzzy output data and fuzzy input data are TFNs. Thus, the Eq. (03) can be rewritten by,

$(y_{il}, y_{im}, y_{iu})_T = \beta_0 + \beta_1(x_{i1l}, x_{i1m}, x_{i1u})_T + \cdots + \beta_k(x_{ikl}, x_{ikm}, x_{iku})_T$ (07)

Step 4- Fuzzy estimators were obtained using fuzzy least squares estimator vector,

$$\hat{\beta}_F = [x_l^t x_l + x_m^t x_m + x_u^t x_u]^{-1}[x_l^t x_l + x_m^t x_m + x_u^t x_u] \quad (08)$$

Results and Discussion

The descriptive statistics of the research variable includes the response variable and the explanatory variables, are given in Table 1.

Table 1. *Descriptive analysis of response variable and explanatory variables*

Variable	Minimum	Maximum	Mean	Standard deviation
Dengue Patients	30	3620	1013.1	744.1
Rainfall	0.1	971.5	211.6	168.7
Relative Humidity	71	86	80.694	3.234
Wind Speed	1.5	8	4.497	1.314
Temperature	26.55	29.9	0.0563	0.683

The study of the exploratory data showed that each climate factor affected dengue incidences differently. The impact of climate was anticipated to become apparent one or two months later because it takes time for an egg to mature into an adult mosquito (Nakhapakorn & Tripathi, 2005). Due to this, the climatic data with lags of two, five, and three months were used to model the Dengue Patient variable. For two lag-month data, the Pearson correlation coefficient between dengue incidences and rainfall was 0.357 ($p < 0.05$), indicating a significant positive association. For five lag-months data, the correlation coefficient between dengue incidences and relative Humidity was -0.409 ($p < 0.05$), indicating a significant negative association. Similarly for three lag-month data, the correlation coefficient between dengue incidences and wind speed was -0.237 ($p < 0.05$), indicating a significant negative association, and for two lag-month data, correlation coefficient between dengue incidences and temperature was 0.313 ($p < 0.05$), indicating a significant positive association.

Model: -Fuzzy Linear Regression

Table 2*. Parameters of classical regression model using crisp data*

Coefficient	Estimate	P-Value
Intercept (β_0)	4144.8238	0.003486
RainFall_Lag2 (β_1)	1.1536	0.000831
Relative Humidity_lag5 (β_2)	-41.9266	0.014495

Only the RainFall_Lag2 and Relative Humidity_lag5 parameters were significant under the 5% level of significance. The FLRM can be formulated as,
$(y_{il}, y_{im}, y_{iu})_T = \beta_0 + \beta_1(x_{i1l}, x_{i1m}, x_{i1u})_T + \beta_2(x_{i2l}, x_{i2m}, x_{i2u})_T$ Fuzzy estimators were obtained using fuzzy least squares estimator vector,

$$\hat{\beta}_F = [x_l^t x_l + x_m^t x_m + x_u^t x_u]^{-1}[x_l^t x_l + x_m^t x_m + x_u^t x_u]$$

Thus, $\hat{\beta}_{F0} = -337.206$ $\hat{\beta}_{F1} = 1.47$ $\hat{\beta}_{F2} = 12.61$

Since $\hat{\tilde{y}}_i$ is a triangular fuzzy number and its membership function is,

$$\mu_{\hat{\tilde{y}}_i} = \begin{cases} \frac{\hat{y}-\hat{y}_{im}}{\hat{y}_{im}-\hat{y}_{il}}, & \hat{y}_{il} < \hat{y} < \hat{y}_{im} \\ \frac{\hat{y}_{iu}-\hat{y}}{\hat{y}_{iu}-\hat{y}_{im}}, & \hat{y}_{im} < \hat{y} < \hat{y}_{iu} \\ 0 \quad , & \text{otherwise} \end{cases}$$

where, $\hat{y}_{il} = -337.206 + 1.47x_{i1l} + 12.61x_{i2l}$

$\hat{y}_{im} = -337.206 + 1.47x_{i1m} + 12.61x_{i2m}$

$\hat{y}_{iu} = -337.206 + 1.47x_{i1u} + 12.61x_{i2u}$

Thus, the fuzzy output obtained as,

$$\hat{\tilde{y}}_i = -33.206 + 1.47(x_{i1l}, x_{i1m}, x_{i1u})_T + 12.61(x_{i2l}, x_{i2m}, x_{i2u})_T$$

This fuzzy model suggests that the predicted value $\hat{\tilde{y}}_i$ is a linear combination of the input variables x_{i1} and x_{i2}, where each input variable is assigned a membership value (l, m, u) indicating its degree of membership in a fuzzy set. The model uses the weights 1.47 and 12.61 to scale the contribution of each fuzzy input variable and adds them together with the intercept term (-33.206) to estimate the output $\hat{\tilde{y}}_i$.

Model Performance

Table 3. *Model performance of fuzzy linear regression*

Measure	Upper value	Middle Value	Lower value
R^2	31.7%	35.6%	39.2%
RMSE	1074	1092	936
MAE	771	785	640

Model performance of the Fuzzy linear Regression displays in Table 3, shows that R^2 values range from 31.7% to 39.2%, RMSE range from 936 to 1092, and MAE range from 640 to 785.

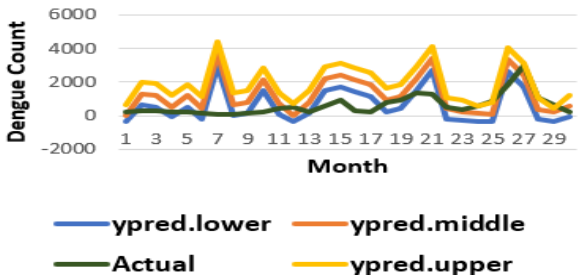

Figure 1. *Actual vs Fitted Values of Fuzzy linear Regression Model*

Actual values of the dengue count are between the upper bound and lower bound, as seen by the actual vs. fitted values for the test set. Fuzzy linear regression has the benefit of allowing lower and upper bounds to be set for the outcomes that are predicted. Fuzzy linear regression can deliver a range of potential outcomes rather than a single point estimate by adding fuzzy sets and membership functions. This lower and upper bound benefit enables a more thorough knowledge of the uncertainty related to the forecasting, improving risk management and decision-making processes. The only significant factor

that increased dengue occurrences, according to previous studies, was rainfall. However, using a fuzzy linear regression model, it was discovered that both rainfall and relative humidity increased dengue cases. The study solely focuses on climate factors and does not take into account non-climatic factors, such as demographics, population immunity, socio-economic structure, availability of affordable public health facilities, and other environmental modification initiatives. Another limitation of this study is that a fixed validation size was used during the model evaluation process. The study is limited only to the Colombo district to analyse monthly climatic data and dengue incidence data. Future studies could expand the scope of analysis to cover more geographically diverse regions of Sri Lanka and use daily or weekly climate data for better accuracy. Additionally, vulnerable groups such as patients' age, gender, health status, and occupation could be taken into account to strengthen the surveillance system and facilitate more effective planning and preparation to prevent future outbreaks. In future studies, it would be valuable to explore alternative techniques for model evaluation, such as cross-validation and random sampling.

Conclusion

Dengue is a significant public health issue not only in Colombo but also in other regions of Sri Lanka. The objective of this study is to model and forecast dengue disease in Colombo using fuzzy regression approach and forecasting dengue cases based on climatic parameters. The study used monthly data from 2010 to 2022. The study found a significant correlation between meteorological parameters (rainfall and relative humidity) and dengue incidences. The study of the Fuzzy Linear Regression model's performance shows R^2 values spanning 31.7% to 39.2%, Root Mean Squared Error values between 936 and 1092, and Mean Absolute Error values range from 640 to 785. The R^2 value's potential range can be increased by including more explanatory factors. The departments of public health, medical researchers, and health geography analysts can make use of these study's outcomes to implement the required precautions based on such forecasts. By accurately predicting the number of dengue patients based on meteorological variables, these stakeholders can take proactive steps to reduce the spread of dengue, such as implementing targeted vector control measures, increasing public awareness campaigns, and improving healthcare infrastructure in areas at high risk of dengue outbreaks. Overall, the insights provided by this research can lead to improved public health outcomes and a reduction in the burden of dengue fever in the Colombo district.

References

Amerasinghe, F. P., Theobald, A., Meigen, A., Meigen, A., Theobald, A., Dyar, C., Linnaeus, C., Theobald, F., Ludlow, H., Theobald, H., Leicester, M., Blanchard, M., Theobald, M., Theobald, O., Leicester, T., Theobald, T., Giles, T., Lynch, U., & Genus Topomyia, A. (1995). *ILLUSTRATED KEYS TO THE GENERA OF MOSQUITOES (DIPTERA: CULICIDAE) IN SRI LANKA* (Vol. 23, Issue 4).

Buckley, J. J., & Jowers, L. J. (2008). Fuzzy sets. In *Studies in Fuzziness and Soft Computing* (Vol. 222, pp. 9–28). https://doi.org/10.1007/978-3-540-76290-4_2

Chandrakantha, L. (2019). *Risk Prediction Model for Dengue Transmission Based on Climate Data : Logistic Regression Approach*. 272–283.

Grzegorzewski, P. (2010). Algorithms for trapezoidal approximations of fuzzy numbers preserving the expected interval. *Studies in Fuzziness and Soft Computing*, *249*, 85–98. https://doi.org/10.1007/978-3-642-10728-3_5

Nakhapakorn, K., & Tripathi, N. K. (2005). An information value based analysis of

physical and climatic factors affecting dengue fever and dengue haemorrhagic fever incidence. *International Journal of Health Geographics*, *4*, 13. https://doi.org/10.1186/1476-072X-4-13

Phanitchat, T., Zhao, B., Haque, U., Pientong, C., Ekalaksananan, T., Aromseree, S., Thaewnongiew, K., Fustec, B., Bangs, M. J., Alexander, N., & Overgaard, H. J. (2019). *Spatial and temporal patterns of dengue incidence in northeastern Thailand 2006 – 2016*. *3*, 1–12.

Rattanalertnusorn, A., Phannarook, S., & Jaroengeratikun, U. (n.d.). *A method for formulating fuzzy linear regression model and estimating the model parameters Parameter estimation in fuzzy linear regression model View project A method for formulating fuzzy linear regression model and estimating the model parameters*. *2015*, 49. https://www.researchgate.net/publication/275275247

Sirisena, P. D. N. N., & Noordeen, F. (2014). Evolution of dengue in Sri Lanka-changes in the virus, vector, and climate. *International Journal of Infectious Diseases: IJID: Official Publication of the International Society for Infectious Diseases*, *19*, 6–12. https://doi.org/10.1016/j.ijid.2013.10.012

Withanage, G. P., Viswakula, S. D., Nilmini Silva Gunawardena, Y. I., & Hapugoda, M. D. (2018). A forecasting model for dengue incidence in the District of Gampaha, Sri Lanka. *Parasites & Vectors*, *11*(1), 262. https://doi.org/10.1186/s13071-018-2828-2.

Conference Paper No: PF-04

Hopf bifurcation in a periodic toxin producing phytoplankton model.

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Abstract

Harmful algal blooms (HABs) caused by toxin-producing phytoplankton (TPP) have become increasingly common worldwide. Understanding the complex interactions between TPP and other organisms in the ecosystem is crucial. This study focuses on the Hopf bifurcation analysis of plankton interactions between TPP and zooplankton, with uptake function and a periodic toxin production. The maximum toxin liberation rate is considered as a bifurcation parameter. The aim is to determine how the toxin liberation rate affects the system. One of the proposed models assumes constant toxin production by TPP, resulting in an autonomous system of ordinary differential equations. To incorporate natural day and night, tidal, or seasonal cycles, the model is extended to a periodic system. The study examines the existence of steady states and trivial periodic solutions and analyses the stability of both models. Moreover, using the concept of uniform persistence, we derive sufficient conditions for the coexistence of the periodic system based on the model parameters. Due to instability of equilibria, we observe Hopf bifurcations in the constant toxin-producing model, providing insights into the system's dynamic behaviour. Numerical simulations are performed to validate the analytical findings of the proposed models and their implications.

Keywords

Harmful algal blooms, Hopf bifurcation, Periodic systems, Toxin-Producing Phytoplankton, Zooplankton.

Introduction

Aquatic ecosystems heavily rely on plankton, specifically phytoplankton and zooplankton, as fundamental components of the food web. Phytoplankton, through photosynthesis, play a vital role in producing oxygen and regulating carbon dioxide levels. Zooplankton, in turn, act as grazers and energy transfer agents, facilitating the flow of energy through the ecosystem. However, the growing prevalence of Harmful Algal Blooms (HABs) caused by TPP poses a significant threat to both aquatic life and human health (Hubbart, 2012), (Phlips, 2004), (Roelke, 2011), (Sopanen, 2011). Mathematical models consist of either autonomous systems of ordinary differential equations or delay differential equations have been developed to explore the mechanisms and impacts of toxin-producing phytoplankton populations (Chattopadhyay J. S., 2002), (Khare, 2010), (Mukhopadhyay, 2006), (Saha, 2009). However, it is plausible that toxin release by phytoplankton is not constant (DeAngelis, 1992), (McGillicuddy Jr, 2003), (Phlips, 2004). The main objective of this study is to discuss the bifurcation analysis of the proposed periodic system that models the interactions between TPP and zooplankton by considering natural cycles. It also aims to analyse the effect of toxin liberation on plankton survival, persistence, and its accumulation in the food chain.

Methodology/materials and methods

Spatial homogenous models

$$\frac{dP}{dt} = r\left(P\left(1-\frac{P}{K}\right) - af(P)Z\right) = rP\left(1-\frac{P}{K}-\frac{aZ}{m+P}\right)$$
$$\frac{dZ}{dt} = bZ(f(P) - d - c\gamma(t)g(P)) = bZ\left(\frac{(1-c\gamma(t))P}{m+P} - d\right) \quad (1)$$

where $P(t)$, $Z(t)$ are TPP, zooplankton populations at time t respectively. K is carrying capacity, r is intrinsic growth rate of phytoplankton, b is intrinsic growth rate of zooplankton, a is maximum uptake rate of zooplankton, $f(P)$ is zooplankton's uptake function, $g(P)$ is phytoplankton's toxin-producing function, d is natural mortality rate of zooplankton $(0 < d < 1)$, c is rate of toxic substances produced by per unit biomass of phytoplankton. m is the half saturation constant for a Holling type II functional response. $\gamma(t) = \gamma\big(1 + Aq(t)\big)$ is the periodic function. Here $q(t)$ is $\tau-$periodic, γ is toxin liberation rate, and A is magnitude of periodicity.

Proposition 1: Solutions of (1) remain non negative and are bounded for $t > 0$.

The Model with constant toxin production

$$\frac{dP}{dt} = r\left(P\left(1-\frac{P}{K}\right) - af(P)Z\right)$$
$$\frac{dZ}{dt} = bZ\big(f(P) - d - c\gamma g(P)\big) \quad (2)$$

$A = 0$ yields a constant toxin production model (2), where the toxin production rate (γ) remains constant.

The Model with periodic toxin production

$$\frac{dP}{dt} = r\left(P\left(1-\frac{P}{K}\right) - af(P)Z\right)$$
$$\frac{dZ}{dt} = bZ\big(f(P) - d - c\gamma(1 + A\sin(Tt))g(P)\big) \quad (3)$$

The positive magnitude of periodicity results in a periodic system, where the toxin production rate varies periodically.

Stability Analysis of the equilibria of constant toxin production

Proposition 2: System (2) has two boundary steady states $E_0 = (0, 0)$ and $E_1 = (k, 0)$, where E_0 is a saddle point, and E_1 is locally asymptotically stable if $f(K) - d - c\gamma g(K) < 0$ and is unstable if $f(K) - d - c\gamma g(K) > 0$. Moreover, (2) has at least one interior steady state if $f(K) - d - c\gamma g(K) > 0$.

When both f and g are of Holling type II with different half saturation constants, we analyze the stability of the unique interior steady state $E^* = (P^*, Z^*)$ by ensuring that the assumptions $f(K) - d - cg(K)\gamma > 0$ and $1 - d - c\gamma > 0$ are satisfied. The functions $f(K)$ and $g(K)$ represent values evaluated at the carrying capacity K. Then bifurcation occurs when the $trace$ of the Jacobian matrix at $E^* = 0$.

Hopf Bifurcation

By considering the maximal toxin liberation rate (γ) as the bifurcation parameter, we can demonstrate a Hopf bifurcation. For that, we employ the following theorem.

Theorem 1: Consider constant toxin production system (2), (i.e., $A = 0$) and assume $f(K) - d - c\gamma g(K) > 0$ and $1 - d - c\gamma > 0$ hold. Then system constant toxin production has a unique interior steady state $E^* = (P^*, Z^*)$. If $g(P) = \frac{P}{k+P}$ and $f(P) = \frac{P}{m+P}$, then there exists a unique $\gamma_0 > 0$ such that a Hopf bifurcation occurs at $\gamma = \gamma_0$ provided $K > m$.

Proof: Hopf bifurcation occurs at $\gamma = \gamma_0$, we verify that the eigenvalues cross the imaginary axis transversally, i.e.,

$$tr'\left(J\left(E^*(\gamma_0)\right)\right) = \left(\frac{dP^*}{d\gamma}\Big|_{\gamma=\gamma_0}\right)\left(\frac{-2r}{K} - arf''\left(P^*(\gamma_0)\right)Z^*(\gamma_0)\right) \neq 0.$$

Stability analysis of periodic toxin production

Proposition 3: Periodic system (3) always has two trivial τ −periodic solutions $(0, 0)$ which is unstable and $(K, 0)$ which is asymptotically stable if $f(K) - d - c\hat{\gamma}g(K) < 0$ and unstable otherwise.

Theorem 2: If $f(K) - d - c\hat{\gamma}g(K) > 0$, then the periodic system (3) is uniformly persistent where $\hat{\gamma} = 1/\tau \int_0^\tau \gamma(t)dt$.

Proof: Notice that the boundary is invariant under (3) and the flow F is dissipative. Let $M_1 = \{E_0\}$ and $M_2 = \{E_1\}$. Then $M = \{M_1, M_2\}$ is composed of disjoint, compact, and isolated invariant sets for ∂F. We prove that the set

$$N_1 = \{(P, Z) \in R_+^2 : d((P, Z), M_1) < \epsilon\}$$

is an isolated neighbourhood, where d is the Euclidean metric. Similarly, by the assumption $f(K) - d - c\hat{\gamma}g(K) > 0$, we can choose $\delta > 0$ sufficiently small. We prove that the set N_2 is an isolated neighborhood of M_2.

$$N_2 = \{(P, Z) \in R_+^2 : d((P, Z), M_2) < \delta\}$$

Therefore M is an isolated covering for ∂F. Moreover, we prove that M is an acyclic covering for ∂F.

Results and Discussion

The model (3) exhibits positive periodic solutions and periodic outbreaks of planktonic blooms. The graphical representations presented in Figure 1 and Figure 2 are derived from the data presented in Table 1 and Table 2, respectively.

Table 1. *Parameter values for model (2).*

Parm -eter	Value	Unit	Source
r	0.7	day^{-1}	Assumed
b	0.6	day^{-1}	Assumed
K	100	μgNI^{-1}	Assumed
m	$(5.7)^2$	$(\mu gNI^{-1})^2$	(Jang, 2014)
a	0.7	day^{-1}	(Jang, 2014)
c	0.8	day^{-1}	Assumed
d	0.4	day^{-1}	Assumed
k	20	day^{-1}	(Jang, 2014)

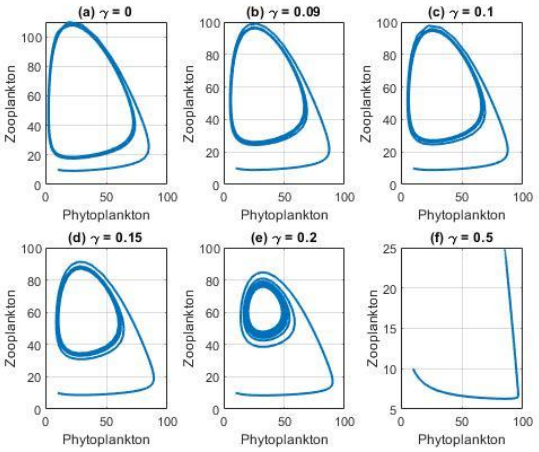

Figure 1. *Effect of Toxin Liberation Rate γ of (2) with $A = 0$.*

Table 2. *Parameter values for model (3).*

Param -eter	Value	Unit	Source
r	0.7	day^{-1}	Assumed
b	0.6	day^{-1}	Assumed
K	80	μgNI^{-1}	Assumed
m	$(5.7)^2$	$(\mu gNI^{-1})^2$	(Jang, 2014)
a	0.7	day^{-1}	(Jang, 2014)
c	0.5	day^{-1}	(Jang, 2014)
d	0.4	day^{-1}	Assumed

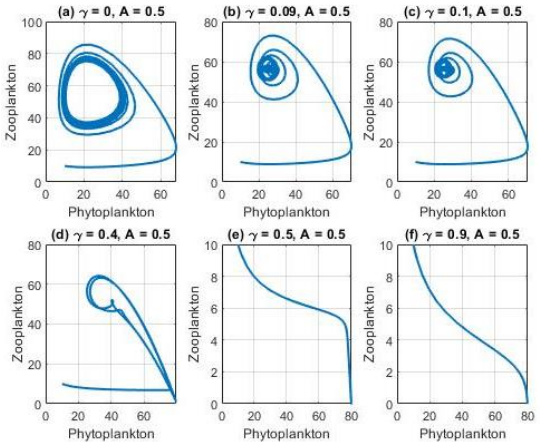

Figure 2. *Effect of Toxin Liberation Rate γ of (3) with Periodicity $A = 0.5$.*

Figure 2 (a) - (d) exhibit unstability, while Figure 2 (e) - (f) display stability.

Conclusion

In this work, we propose a periodic model to investigate the effects of toxin liberation by phytoplankton on planktonic interactions. We incorporate the concept of the periodic

function $\gamma(t)$ and outline the conditions it follows. Since solutions remain nonnegative and are bounded, the proposed model is biologically sound. Additionally, we introduce two variations: constant toxin production and periodic toxin production. We obtain the stability conditions for the model with constant toxin production. Using the concept of uniform persistence and based on the boundary dynamics of the model, we derive sufficient conditions for coexistence under certain parameter conditions. Using toxin liberation rate as a bifurcation parameter, we prove that system can undergo a Hopf bifurcation when interior steady state loses its stability. Specifically, this occurs when the carrying capacity (K) of the phytoplankton is small relative to the half-saturation constant (m) of the zooplankton grazing rate. This finding aligns with biological reasoning, as phytoplankton cannot sustain high population densities when the carrying capacity (K) is small. Consequently, the toxic effects on zooplankton are minimal, allowing both populations to coexist in a unique interior steady state. However, when the carrying capacity (K) is large, the autonomous system exhibits positive periodic solutions. This leads to periodic outbreaks of planktonic blooms, indicating fluctuating population dynamics. Finally, we present the numerical simulations which validate our analytical findings. We demonstrate that altering the toxin liberation rate γ affects the stability of both the constant toxin production system and the periodic toxin production system.

References

Chattopadhayay, J. S. (2002). Toxin-producing plankton may act as a biological control for planktonic blooms field study. *Journal of Theoretical Biology, 215*(3), 333-344.

Chattopadhyay, J. S. (2002). A delay differential equation model on harmful algal blooms in the presence of toxic substances. *Mathematical Medicine and Biology: A Journal of the IMA, 19*(2), 137-161.

DeAngelis, D. L. (1992). *Dynamics of nutrient cycling and food webs Chapman & Hall.* London, UK.

Hubbart, B. P. (2012). Toxigenic phytoplankton and concomitant toxicity in the mussel Choromytilus meridion alis off the west coast of South Africa. *Harmful Algae, 20*, 30-41.

Jang, S. B. (2014). Dynamics of phytoplankton–zooplankton systems with toxin producing phytoplankton. *717*(740), 227.

Khare, S. M. (2010). Role of toxin producing phytoplankton on a plankton ecosystem. *Nonlinear Analysis: Hybrid Systems, 4*(3), 496-502.

McGillicuddy, D. J. (2003). A mechanism for offshore initiation of harmful algal blooms in the coastal Gulf of Maine. *Journal of Plankton Research, 25*(9), 1131-1138.

Mukhopadhyay, B. (2006). Modelling phytoplankton allelopathy in a nutrient-plankton model with spatial heterogeneity. *Ecological modelling, 198*((1-2)), 163-173.

Phlips, E. J. (2004). The occurrence of potentially toxic dinoflagellates and diatoms in a subtropical lagoon, the Indian River Lagoon, Florida, USA. *Harmful Algae, 3*(1), 39-49.

Rao, F. (2014). The complex dynamics of a stochastic toxic-phytoplankton-zooplankton model. *Advances in Difference Equations*, 1-18.

Roelke, D. L. (2011). Effects of inflow on harmful algal blooms: some considerations. *Journal of Plankton Research, 33*(2), 205-209.

Saha, T. (2009). Dynamical analysis of toxin producing phytoplankton–zooplankton interactions. *Nonlinear Analysis: Real World Applications, 10*(1), 314-332.

Sopanen, S. S. (2011). The toxic dinoflagellate Alexandrium ostenfeldii promotes incapacitation of the calanoid copepods Eurytemora affinis and Acartia bifilosa from the northern Baltic Sea. *Journal of Plankton Research, 33*(10), 1564-1573.

Conference Paper No: PF-05

An application of time series techniques to forecast the Open market weekly average retail price of lime in Sri Lanka

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Abstract

Limes are known for their acidic and tangy flavour and are commonly used in cooking, as a garnish, or to add flavour to drinks. The lime market in Sri Lanka is highly volatile, with prices fluctuating significantly on a weekly basis. In this research study, the main objective is to forecast the weekly lime price in Sri Lanka. Even though some research has been conducted on forecasting fruit prices in Sri Lanka, there is currently a lack of research on forecasting lime prices. The weekly price of lime from 1st week of January 2010 to 3rd week of February 2023 was considered for this study (632 observations). The first 600 observations were used as the training set and reserved data were used as the testing set. The time series plot of the weekly lime price of Sri Lanka indicates a slight upward trend and a non-constant variance with a seasonal pattern. The presence of a seasonal pattern motivated the development of a Seasonal Autoregressive Integrated Moving Average (SARIMA) model. When comparing Akaike's Information Criterion (AIC), ARIMA(1,1,2)$(0,1,1)_{[24]}$ generated the minimum AIC value (-1.125469). Assumptions of autocorrelation and heteroscedasticity were not violated and the normality was violated. Although, the performance measures of ARIMA(1,1,2)$(0,1,1)_{[24]}$ were very low, ARIMA(1,1,2)$(0,1,1)_{[24]}$ was identified as the better model with mean absolute error of 40.799, mean absolute percentage error of 7.543, and root mean squared error of 49.793. The results obtained from this analysis would be helpful to mitigate price risks and uncertainties in the lime industry.

Keywords

Forecasting, Lime, Seasonal Autoregressive Integrated Moving Average (SARIMA)

Introduction

The lime industry in Sri Lanka holds historical significance, tracing its roots back to ancient times when Arab traders introduced the fruit to the island. Over the centuries, lime cultivation expanded and became integral to local cuisine, beverages, and traditional Ayurvedic medicine. Beyond culinary and medicinal use, lime's essential oils have gained popularity in cosmetic and fragrance production, contributing to Sri Lanka's exports. Fluctuations in supply and demand impact its price, affecting farmers, traders, and consumers. Forecasting can optimize supply chains, minimize waste, and boost profits. However, despite its significance, no predictive models exist for lime prices in Sri Lanka. This study aims to bridge this gap by identifying a suitable time series model to forecast the weekly average retail price of lime per kilogram.

The importance of forecasting the price of tomatoes due to their high nature in perishability and seasonality has identified by Mathenge Mutwiri, 2019, Adanacioglu & Yercan, 2012 and Reddy, 2019. All three studies have employed the seasonal autoregressive integrated moving average (SARIMA) model. In 2019, Perera et al. have imputed missing values using mean imputation, linear interpolation, log-linear

interpolation, and exponential smoothing in their study on seasonal ARIMA model to forecast monthly potato yield in Sri Lanka. The better technique to explore missing values has been identified as the technique that generates the least root mean squared error (RMSE) and mean absolute percentage error (MAPE) by them. Another study (Mathenge Mutwiri, 2019) has identified a better model using the minimum Akaike Information Criterion (AIC). Performances of the models have been compared using root mean squared error (RMSE), mean absolute error (MAE) and mean absolute percentage error (MAPE). Aryani et al., 2018 modelled ARIMA(1,1,1) with variable exchange rate to predict the effect of the predictor variable on Islamic bank profitability even though the assumption for normality was violated. Their paper claims that the unfulfilled assumption for normality has proved the high volatility in data.

Methodology/materials and methods

Data were collected from the Department of Census and Statistics. It consisted of 632 total observations from 1st week of January 2010 to 3rd week of February 2023 with six missing values. The first 600 observations and the remaining 32 observations were utilized to build the model and evaluate the performance respectively.

Missing value imputation techniques

Missing value imputation techniques involve predicting unknown data points using existing data in a series. Some common methods include linear and log-linear imputation, more advanced techniques like Catmull-Rom and Cardinal Spline, and cubic spline interpolation.

Stationarity series

Stationarity in a time series implies that its mean, variance, and covariance remain constant over time, with the covariance between time periods depending solely on the lag. Tests like the Augmented Dickey-Fuller (ADF), Phillips-Perron (PP), and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) are utilized to assess stationarity.

Transformations

Transformations such as differencing, seasonal differencing, and log transformation are employed to convert non-stationary time series into stationary ones by mitigating trends and seasonality.

Seasonal ARIMA

Seasonal ARIMA, which we denote as ARIMA(p,d,q)(P,D,Q)$_{[S]}$, is the product of the two polynomials generated by the (p,d,q) ARIMA model and the (P,D,Q)$_{[S]}$ ARIMA model (Equation 1).

Equation 1. *SARIMA model and its components*

ARIMA(p, d, q)x(P, D, Q)$_{[s]}$
p - non-seasonal AR order
d - non-seasonal differencing
q - non-seasonal MA order
P - seasonal AR order
D - seasonal differencing
Q - seasonal MA order

S – a time span of repeating seasonal pattern

Model diagnostic

Model diagnostic involves checking for heteroscedasticity, autocorrelation, and normality to assess a statistical model's assumptions and quality.

Model performance

Adequate models are used to generate predicted values for the reserved data (test set). The performance of those adequate models is measured by comparing root mean squared error (RMSE), mean absolute error (MAE), and mean absolute percentage error (MAPE). The model with the least errors is identified as the better-performing model.

Results and Discussion

The dataset was divided into five portions due to containing six missing values. Once imputing the missing values using five imputation techniques the RMSE and were calculated. The below table represents the calculated RMSE values and MAE for each interpolation technique.

Table 2. *Performances of missing value imputation techniques*

	Linear	**Log-Linear**	**Catmull-Room Spline**	**Cardinal Spline**	**Cubic Spline**
RMSE	31.1641	32.5418	32.1810	31.8065	34.6068
MAE	23.9685	24.6768	25.3731	25.0146	29.0654

Considering the minimum RMSE and MAE values, the Linear interpolation technique was identified as the better imputation technique. Therefore, six missing values in the dataset were imputed using the Linear interpolation technique.

The training set consisted of observations from 1st week of January 2010 to 3rd week of June 2022 (600 data points). The remaining observations up to 3rd week of February 2023 were considered as a test set (32 data points).

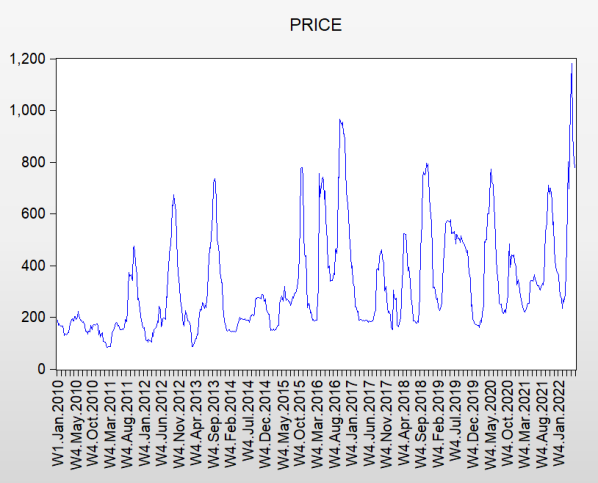


Figure 2. *Time series plot of weekly lime price*

Figure 1 illustrates that, the original lime price series depicts a slight upward trend and seasonal pattern. Three-unit root tests were used to ensure the seasonality of the series.

According to Table 2, ADF and PP tests indicated that the series is stationary while the KPSS test indicated that the series is not stationary at a 5% level of significance. Since the KPSS test is the most robust test for checking stationarity

compared to ADF and PP tests (Afriyie et al., 2020), several transformation techniques were applied to make the series stationary.

Table 3. *Checking for stationarity of the original series*

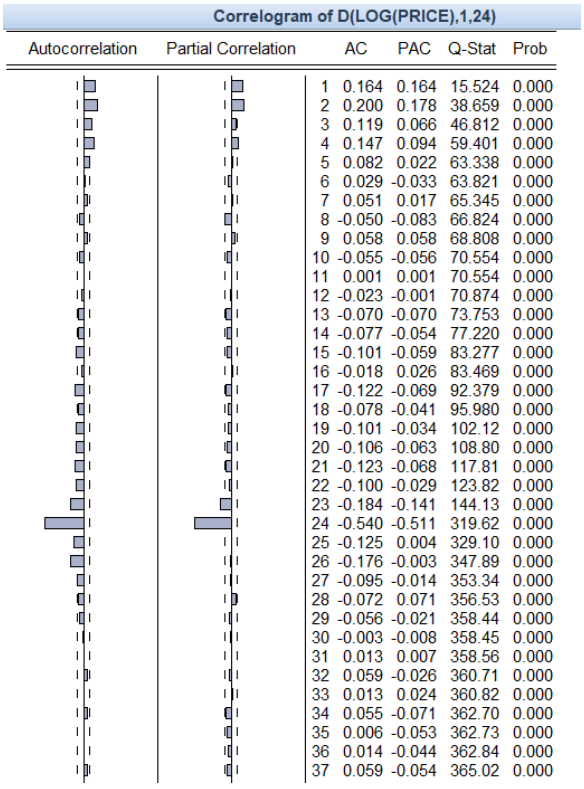
Test	**Criteria**	**Value**
ADF	p-value	0.0000
PP	p-value	0.0002
KPSS	Test statistic	1.2583

Difference transformation was used to eliminate the trend component and log transformation was used to reduce the high variance in the series. Further, the seasonal difference was utilized by identifying the seasonal lag considering the Webel-Ollech (WO) test. According to the WO test, it could be identified that the seasonality of 1st difference log series of lime price is 24. Afterwards, stationarity was investigated again using unit root tests.

Table 4. *Checking for stationarity of d(log(price),1,24)*

Test	**Criteria**	**Value**
ADF	p-value	0.0000
PP	p-value	0.0000
KPSS	Test statistic	0.01252

All three-unit root tests indicated that the series which has applied seasonal difference, first difference and log transformation is stationary at a 5% level of significance.



	AC	PAC	Q-Stat	Prob
1	0.164	0.164	15.524	0.000
2	0.200	0.178	38.659	0.000
3	0.119	0.066	46.812	0.000
4	0.147	0.094	59.401	0.000
5	0.082	0.022	63.338	0.000
6	0.029	-0.033	63.821	0.000
7	0.051	0.017	65.345	0.000
8	-0.050	-0.083	66.824	0.000
9	0.058	0.058	68.808	0.000
10	-0.055	-0.056	70.554	0.000
11	0.001	0.001	70.554	0.000
12	-0.023	-0.001	70.874	0.000
13	-0.070	-0.070	73.753	0.000
14	-0.077	-0.054	77.220	0.000
15	-0.101	-0.059	83.277	0.000
16	-0.018	0.026	83.469	0.000
17	-0.122	-0.069	92.379	0.000
18	-0.078	-0.041	95.980	0.000
19	-0.101	-0.034	102.12	0.000
20	-0.106	-0.063	108.80	0.000
21	-0.123	-0.068	117.81	0.000
22	-0.100	-0.029	123.82	0.000
23	-0.184	-0.141	144.13	0.000
24	-0.540	-0.511	319.62	0.000
25	-0.125	0.004	329.10	0.000
26	-0.176	-0.003	347.89	0.000
27	-0.095	-0.014	353.34	0.000
28	-0.072	0.071	356.53	0.000
29	-0.056	-0.021	358.44	0.000
30	-0.003	-0.008	358.45	0.000
31	0.013	0.007	358.56	0.000
32	0.059	-0.026	360.71	0.000
33	0.013	0.024	360.82	0.000
34	0.055	-0.071	362.70	0.000
35	0.006	-0.053	362.73	0.000
36	0.014	-0.044	362.84	0.000
37	0.059	-0.054	365.02	0.000

Figure 3: Correlogram of d(log(price),1,24)

According to the correlogram (Figure 2), the significant seasonal and non-seasonal lags are identified as below.

Considering ACF cutoff lags, 1 was identified as seasonal lag while 1,2,3 and 4 were identified as non-seasonal lags. Considering PACF cutoff lags, 1,2 and 3 were identified as seasonal lags while 1 and 2 were identified as non-seasonal lags.

Twenty-four seasonal ARIMA models were identified as candidate models. Once fitting those models, the suggested models were reduced to five models due to the non-significance of the coefficients of the parameter terms. Table 4 depicts the reduced seasonal ARIMA models and the AIC values.

Table 5. *AIC values of significant models*

Model	**AIC**
ARIMA(1,1,0)(01,1)$_{[24]}$	-1.098958
ARIMA(1,1,1)(0,1,1)$_{[24]}$	-1.119620
ARIMA(1,1,2)(0,1,1)$_{[24]}$	-1.125469
ARIMA(2,1,1)(0,1,1)$_{[24]}$	-1.125249
ARIMA(0,1,0)(0,1,1)$_{[24]}$	-1.092755

According to Table 4, ARIMA (1,1,2)(0,1,1)$_{[24]}$ was selected as the better model since it represented the minimum AIC value. Afterwards, the three assumptions of autocorrelation, heteroscedasticity and normality were checked, and Table 5 summarizes the results.

Table 6*. Results of the adequacy checking of the fitted model*

Assumption	**Test**	**p-value**	**Decision**
Heteroscedasticity	ARCH test	0.2418	satisfied
Autocorrelation	Ljung-Box Q test	p-values are greater than 0.05	satisfied
Normality	Jarque-Bera	0.0000	Not satisfied

According to the previous literature (Aryani et al., 2018), most of the time series violates the normality assumption. But forecasting can be done considering the fitted model.

Hence, testing set values were forecasted using ARIMA $(1,1,2)(0,1,1)_{[24]}$ to evaluate the performance of the fitted model.

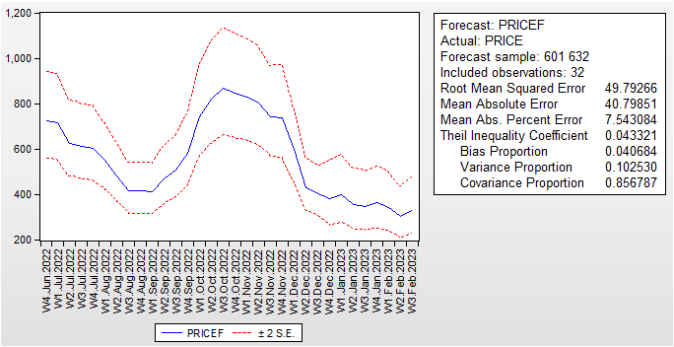


Figure 3. *Performance measures of the fitted model*

According to Figure 3, MAE is 40.799 and MAPE is 7.54. Therefore, ARIMA $(1,1,2)(0,1,1)_{[24]}$ model can be suggested as a better forecasting model to forecast weekly price of lime in Sri Lanka.

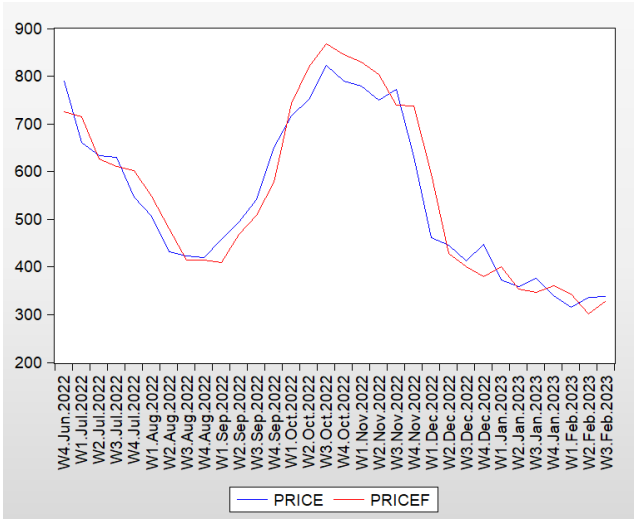


Figure 4*. Actual vs Fitted graph of ARIMA(1,1,2)(0,1,1)$_{[24]}$ model*

Figure 4 depicts the extracted actual value (Blue colour) vs forecasted value (Red colour) graph of the ARIMA $(1,1,2)(0,1,1)_{[24]}$ model for the test set. It can be observed that the fitted model has well captured the pattern of actual data. Moreover, implication of the violated normality assumption and inclusion of other influential factors will be continued in further analysis.

Conclusion

Lime is a very important citrus fruit for Sri Lanka due to its economic and agricultural significance. The lime market in Sri Lanka is highly volatile, with prices fluctuating significantly on a weekly basis. Therefore, this research identified an univariate time series model, ARIMA $(1,1,2)(0,1,1)_{[24]}$ as the better model for forecasting weekly lime prices in Sri Lanka. The performance of this model is based on Mean Absolute Error (40.799), Mean Absolute Percentage Error (7.54), and Root Mean Squared Error (49.7926). The assumptions of heteroscedasticity and autocorrelation among residuals were absent in the suggested model while the assumption for normality in residuals was not fulfilled. The lack of support for the normality assumption demonstrated considerable volatility in data. For further analysis, some factors such as weather conditions, pest outbreaks, and government policies were identified as factors that affect the weekly lime price in Sri Lanka. Moreover, data mining techniques such as Feed Forward Neural Network (FFNN) and Time Delay Neural Network (TDNN) can be employed to deliver a better model. This model can be beneficial in businesses to better manage their supply chains by allowing them to plan their purchases and deliveries more efficiently.

References

Adanacioglu, H., & Yercan, M. (2012). An analysis of tomato prices at wholesale level in Turkey: An application of SARIMA model. *Custos e Agronegocio*, *8*(4), 52–75.

Aryani, S., Aidi, M. N., & Syafitri, U. D. (2018). Analysis of The Profitability of Islamic Banking Using Arimax Model and Regression with Arima Errors Model. *International Journal of Scientific Research in Science, Engineering and Technology*, *4*(8), 49–53.

Limes: A Citrus Fruit with Powerful Benefits. (n.d.). Healthline. Retrieved February 16, 2023, from https://www.healthline.com/nutrition/limes

Mathenge Mutwiri, R. (2019). Forecasting of Tomatoes Wholesale Prices of Nairobi in Kenya: Time Series Analysis Using Sarima Model. *International Journal of Statistical Distributions and Applications*, *5*(3), 46. https://doi.org/10.11648/j.ijsd.20190503.11

OPEN MARKET RETAIL PRICES DASHBOARD. (n.d.). Department of Census and Statistics Sri Lanka. Retrieved February 16, 2023

Afriyie, J. K., Twumasi-Ankrah, S., Gyamfi, K. B., Arthur, D., & Pels, W. A. (2020). Evaluating the performance of unit root tests in single time series processes. *Mathematics and Statistics*, *8*(6), 656–664. https://doi.org/10.13189/ms.2020.080605

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http://conf.kln.ac.lk/icaps
+94(0)112903201

ISSN 2815-0112