PROCEEDINGS

13th RUHUNA INTERNATIONAL SCIENCE & TECHNOLOGY CONFERENCE

January 21, 2026

Bridging Frontiers in Science and Innovation
Towards Sustainable Solutions!

Abstracts and Plenary Lectures

Faculty of Science
University of Ruhuna

RISTCON 2026

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Editorial Note

Thanks to all the authors, we have received a high number of abstracts in diverse disciplines of Science and Technology for RISTCON-2026. First, all initial submissions were screened for originality and ensuring plagiarism-free. We then used a double-blind review process, with each extended abstract sent to two or three experts in the relevant field. The final decision on the submitted abstracts was made by the editorial board by considering the decisions and comments made by the reviewers. We believe that this unbiased review process has ensured high quality and standards in the publication of proceedings. However, the responsibility for the content in each publication remains with the respective authors. No part of this serial publication may be reproduced in any form. When citing the published abstracts, this serial publication can be referred to as "Proceedings of the 13th Ruhuna International Science and Technology Conference - 2026, Faculty of Science, University of Ruhuna, Matara, Sri Lanka".

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Message from the Vice Chancellor
University of Ruhuna

It is with great pleasure that I extend my warmest greetings to all participants of the 13th Ruhuna International Science and Technology Conference (RISTCON-2026), organized by the University of Ruhuna. Over the years, RISTCON itself has emerged as a reputable international platform, that brings together researchers, academics, and industry professionals to share knowledge and innovative research.

The theme of this year's conference, "Bridging Frontiers in Science and Innovation Towards Sustainable Solutions", reflects the significance and importance of science-driven innovative solutions when addressing today's pressing global challenges. RISTCON-2026, therefore, will provide an ideal platform to explore interdisciplinary collaborations and solutions, contributing both global and regional development. The diverse research shared at this conference will highlight the enthusiasm and commitment of the researchers involved.

I commend the organizing committee for their dedication and meticulous planning in ensuring the success of this conference. I also extend my sincere appreciation to the authors, keynote speakers, reviewers, and participants whose valuable contributions have greatly enhanced the success of this conference.

I extend my best wishes for the success of RISTCON2-026 and wish all participants a productive and enriching experience.

Senior Professor P. A. Jayantha
Vice Chancellor
University of Ruhuna

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Message from the Dean, Faculty of Science, University of Ruhuna

It is with great pleasure that I extend my warmest greetings to all contributors and readers of this Conference Proceedings, published in conjunction with the 13th Ruhuna International Science and Technology Conference (RISTCON 2026), under the theme 'Bridging Frontiers in Science and Innovation Towards Sustainable Solutions.'

The 13th RISTCON provides a vital platform for researchers, academics, and students to share their collective intellectual efforts. By fostering the exchange of ideas and interdisciplinary collaboration, the conference plays a key role in advancing scientific knowledge and promoting innovative solutions to the complex challenges faced by our society and our planet. In today's era of rapid technological progress, climate change, and evolving socio-economic demands, gatherings that integrate science and innovation are more important than ever for driving sustainable development.

I sincerely congratulate the organizing committee, reviewers, and all authors for their dedication and hard work in producing this valuable publication. I am confident that the research presented in this volume will stimulate further dialogue, collaboration, and impactful innovation.

I wish the 13th Ruhuna International Science and Technology Conference (RISTCON 2026) every success and trust that it will make a meaningful contribution to the advancement of science and sustainable solutions.

Prof. D.H.N. Munasinghe
Dean, Faculty of Science
University of Ruhuna

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Message from the Chairperson – RISTCON 2026

On behalf of the organizing committee, I am delighted and honoured to convey this message to the 13th Ruhuna International Science and Technology Conference (RISTCON) 2026, scheduled for January 21, 2026.

The fields of science and technology serve as systematic ventures that shape and establish knowledge through verifiable predictions and explanations, addressing global developments while providing sustainable solutions for dynamic challenges. The theme "Bridging Frontiers in Science and Innovation Towards Sustainable Solutions" is therefore designed to leverage this remarkable gathering of researchers and professionals to identify gaps in science and technology and bridge them in novel and innovative ways. I believe the conference will deliberate on current issues of national and international relevance, particularly in science and technology, allowing participants to seed new ideas and initiate collaborations towards excellence in research. Further, I am confident that the knowledge shared at the conference will lead to technological initiatives and advances.

RISTCON has evolved into a leading platform for scholarly exchange, bringing together researchers and thought leaders to present their findings from various fields.

RISTCON 2026 is enriched by the keynote address of a distinguished scientist, Professor Ajith Karunaratne from the Department of Chemistry, School of Science and Engineering, Saint Louis University, USA, along with plenary lectures by eminent scientists, Professor Ashoka Dangolla from the University of Peradeniya and Professor S.R.D. Rosa from SLTC Research University. This presents a valuable opportunity for all conference attendees to hear the latest findings from their respective fields of research and to learn from their vast experiences.

On behalf of the organizing committee, I greatly appreciate the support and guidance given by the Vice Chancellor of the University Ruhuna, Senior Professor P. A. Jayantha, who demonstrates genuine enthusiasm and a sincere desire to advance research at the University. We express our sincere gratitude to the Dean of the Faculty of Science, Professor D. H. N. Munasinghe, for her support, cooperation and encouragement throughout the planning of RISTCON 2026. I also thank all Heads of Departments, academic and non-academic staff members of the Faculty of Science for their kind cooperation in making this event possible.

I express my heartfelt gratitude to the keynote speaker and the plenary speakers for accepting our invitation with much enthusiasm. The members of the organizing committee, the advisory board and the editorial board are greatly regarded for their hard work, sense of responsibility

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and valuable contributions to organizing the conference. I convey my sincere gratitude to our sponsors for their generous financial assistance, which has been instrumental in the success of RISTCON 2026. A special note of appreciation is extended to the reviewers for their thorough and timely appraisal of the submissions.

Most of all, I am grateful to all the authors for enriching the conference by sharing the contemporary knowledge of their research findings at RISTCON 2026. I convey my best wishes for a successful and productive conference.

Dr. Y. M. A. L. W. Yapa
Chairperson – RISTCON 2026
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Physical and Chemical Sciences

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Mathematics and Statistics

Mathematics/Applied Mathematics, Statistics, Modeling & Simulation, Computational Mathematics, Mathematical Physics, Operations Research, Actuarial Science

Computer Science and Information Technology

Computer Science & ICT, Engineering, Artificial Intelligence & Machine Learning, Data Science, Information Security, Software Engineering

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Harnessing Scientific Discovery to Understand and Sustain Life

Professor Ajith Karunarathne
Department of Chemistry, Saint Louis University, USA

Let's begin with a grand perspective to spark curiosity about our cosmic origins. As you see, the universe is unimaginably vast. In fact, distances are so absurd that even light, traversing at 300,000 kilometers per second, is a minuscule speed at the vast cosmic distances. And yet, out here in this seemingly indifferent expanse of stars and gas clouds, we've somehow found ourselves and been made from stardust, no less, providing the meaning to the universe! It's humbling to think that while the universe might not care much about meaning, it's us, life on Earth, that gets to create it. In the vast cosmos, stars are born and die in spectacular explosions, creating elements such as carbon, hydrogen, oxygen, and nitrogen. These elements spread throughout space and combine to form molecules such as nucleic acids and proteins, which are fundamental to life, including you and me.

In my research laboratory, the Molecular Cell Lab, we build on this foundational understanding and examine the molecular regulation of cellular processes that govern life and are implicated in disease. Delving even deeper, we find that quantum phenomena such as superposition and entanglement govern the interactions and behaviors of molecules at the microscopic scale, influencing macroscopic biological functions and enabling our Newtonian world. It is a significant obligation for us, as humans and especially as scientists, to create and harness this knowledge, expanding our understanding of chemistry, physics, and biology, and their intertwined quantum-level regulation, to combat diseases and make the world a better place for all. Through research, we recognize that knowledge is the most effective remedy for all challenges, while ignorance is the nemesis to living pain- and suffering-free, enjoyable lives. Unfortunately, we do not yet know enough to accomplish this goal, which is why we need your help with this endeavour. Leading the way together with

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many pioneering efforts, my research group is busy deciphering the molecular underpinnings of crucial life processes.

Let us reflect on this further. It is well known that the hormone Oxytocin mediates the feelings of love and affection. Oxytocin receptor (OXTR) is a G protein-coupled receptor (GPCR) that represents the largest group of disease-implicated proteins, along with members such as adrenergic and opioid receptors. When Oxytocin binds to these receptors, it can facilitate neurotransmitter release, improve emotional recognition, and enhance the positive feelings associated with social interactions, creating a sense of safety and sociality, as well as survival and reproduction. Put simply, without Oxytocin and love, mammals may survive but not thrive. And life will be miserable. Understanding the molecular foundation of these processes does not diminish the beauty of love but rather enhances our appreciation of the intricate biological mechanisms at play. Our broader goal, therefore, is to understand the atomic-level details so we can manipulate them to infuse love and affection into loveless lives as a form of neuropsychiatric disorder therapy. Oxytocin is just one of many pathways on which life depends, and our research broadly focuses on many such GPCRs and their signaling partners to identify targets and means to combat a variety of psychological and physiological conditions that undermine the livelihoods of many. You are already familiar with people seeking happiness through chemical means, such as methamphetamine or heroin, which respectively target the Trace Amine-Associated Receptor 1 (TAAR1) and Mu-Opioid Receptor (MOR). Therefore, understanding molecular mechanisms that govern such drug-induced euphoria and pain release enables us to develop molecular solutions to be happy and pain-free with no deleterious consequences. Pathway information also offers insights into conditions like autism, depression, Alzheimer's disease, dementia, and social anxiety, where chemical balance and cellular integrity are disrupted. Therefore, our molecular neuropharmacology research focuses not only on decoding how drugs trigger essential and pathological signaling, but also on advancing the engineering of ligands with overwhelmingly beneficial signaling properties to treat pain and other neurological conditions.

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The sun fuels everything and provides energy for having feelings, including love. Being on the Earth, exposed to the sun, we absorb wavelengths ranging from 100 km to 1 femtometer. One-km-wavelength radio waves are very low-energy and require amplification before use. Femtometer radiation is ionizing gamma radiation, characterized by extremely high energy and destructive power to living beings. Why do we see only 400 to 700 nm radiation, which we call the visible region? To induce electron excitation of a molecule with pi-electrons, we need energies from 36 to 72 kcal/mol, and only visible light possesses this ability. More energy, as in UV, can break bonds and damage molecules; while less energy in the IR radiation, you only get rotation and vibrational changes in the bond electrons, and therefore, it is used in vibrational and rotational spectroscopy. Our research harnesses the power of light-sensitive proteins to perceive light and control cellular processes, such as vision, flower blooming, and photoprophism. We manipulate these proteins through genetic engineering to harness light as a tool to influence cellular functions that are usually controlled by chemicals. These innovative approaches enable us to dissect the intricacies of molecular interactions and pathways with subcellular precision and millisecond temporal control, showcasing the profound connection between the universe's fundamental elements and the sophisticated machinery in cells that drives life.

Opsins are photoreceptors in the eye and are members of the GPCR family. Light travels through retinal neurons to reach opsin-rich rod and cone cells, which generate impulses that create vision. Rod cells contain rhodopsin for low-light detection, while cone cells have cone opsins for color vision. Since opsins and other GPCRs, like oxytocin and opioid receptors, share similar mechanisms, our research uses natural and engineered opsins to control cell, tissue, and organ functions, such as movement and contractions, solely with light, hijacking chemically-controlled pathways. Plant photoreceptors, such as the LOV domain in phototropins, with a Flavin Mononucleotide (FMN) chromophore, drive phototropism, causing plants to grow toward light. Cryptochromes contain Flavin Ddenine Dinucleotide (FAD)

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chromophore, and regulate flowering. These light-sensitive proteins are also key tools in our molecular toolkit, allowing us to engineer proteins to control and probe cellular and *in vivo* signaling with light, advancing our ability to manipulate biological processes.

Despite their extreme complexity, contemporary cellular sciences still examine the regulation of cellular responses, such as growth, invasion, and apoptosis, primarily through global pharmacological or genetic perturbations. However, little is known about how cells respond to temporally varying asymmetric external stimuli that unevenly activate cell-surface or intracellular receptors, how the resultant signals propagate through the 3D cell interior, and how they target specific organelles to control effectors. To address this, as mentioned above, we engineer optogenetic signaling actuators. These are light-sensitive proteins and small molecules that can control the specific signaling activities of multiple or single cells, individual neurons, or nanoscopic organelles within a cell. Our results demonstrate that coordinated molecular communication between cell compartments yields pharmacologically crucial cellular outputs, as we have shown in dissecting front-to-back communication in migrating and polarized cells.

Regarding engineered optogenetic signaling actuators, these light-sensitive proteins can be tailored to respond to specific wavelengths of light, enabling precise manipulation of cellular activities. For example, we engineered an opsin, melanopsin, a photoreceptor that governs day-night sensing and circadian rhythms, which is activated by the entire visible spectrum. We blue-shifted melanopsin to eliminate its red-light sensitivity via computationally guided protein engineering. This opsin now enables targeted interrogation of subcellular signaling, with blue light controlling activity and red light visualizing signaling outcomes. Activating these actuators enables researchers to manipulate cellular signaling pathways in real time, providing a powerful tool for studying cellular responses to various stimuli in a controlled environment. This approach can uncover how different cell types or subcellular compartments communicate under physiological and pathological conditions. A LOV-based optogenetic tool we developed exposes two amino acid

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residues at its carboxy terminus upon blue light, enabling us to decode a crucial mechanism that regulates protein lipidation, which is heavily implicated in cancer. Additionally, a cryptochrome-based optogenetic tool from our group demonstrated, for the first time, the function of the signaling protein Activators of G protein Signaling 3 (AGS3). The potential applications of this technology are extensive, spanning from understanding neurodegenerative diseases to developing new cancer therapies.

By deepening our understanding of cellular mechanisms, we illuminate the complex chemistry of life and equip ourselves to confront societal health challenges. Additionally, beyond the realms of basic biology, photopigments such as opsins, phototropins, and cryptochromes, with their engineered ability to control defined pathways, will provide the perfect interface for computer-controlled life processes. Therefore, our scientific pursuits collectively carry profound responsibilities, from exploring the vastness of the universe to unraveling the intricacies of living cells and, when necessary, controlling them, as in disease. This journey of discovery, driven by imagination and strengthened by scientific rigor, underscores our commitment to improving life through research and innovation, a collaboration-heavy endeavor.

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Transforming Cancer Diagnosis: The Realization of Sri Lanka's First Medical Cyclotron for Radiopharmaceutical Production

Professor S. R. D. Rosa
Sri Laka Institute of Technology, Malabe, Sri Lanka

Cancer represents a profound health burden in Sri Lanka, with 29,604 new cases and 16,691 deaths recorded in 2021, and a projected 23% annual increase through 2030. Historically, the diagnostic landscape has been constrained by a reliance on importing ^{18}F-fluorodeoxyglucose (FDG) from India, a process where 97% of the product's value is lost to radioactive decay during transit. This inefficiency limits treatment to approximately 1,500 patients annually, despite an estimated need for 35,000 PET/CT scans. To address this critical gap, the Sri Lanka Atomic Energy Board (SLAEB) has initiated the establishment of a Cyclotron-based Radiopharmaceutical Production Facility. While the project was originally planned for government funding, economic shifts necessitated a transition to a Public-Private Partnership (PPP). Following a rigorous selection process, the Cabinet approved a "Build, Own, and Operate" (BOO) model. This 6.5 million USD joint venture, comprising Private Sector (80%), SLAEB (10%), and the Ministry of Health (10%) is supported by technical assistance from the IAEA. Significant progress has been achieved since the foundation stone was laid on November 08, 2024. Civil construction is currently 88% complete, and the cyclotron machine and key equipment have been successfully installed. Once operational, the facility will drastically reduce the cost of FDG from the current import price of $320 to $245 per 10 mCi dose. Furthermore, the project ensures long-term sustainability through a 2.2% R&D contribution to SLAEB from private sector sales and the establishment of a dedicated radiopharmaceutical laboratory utilizing IAEA-donated equipment. With the installation of QA/QC laboratory equipment underway, the facility is on track to commercially launch its first radiopharmaceuticals by May 2026, marking a new era of medical self-sufficiency and enhanced life expectancy for cancer patients in Sri Lanka.

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From Conflict to Coexistence: A New Vision for Human-Wildlife Harmony in Sri Lanka

Professor Ashoka Dangolla
Department of Veterinary Clinical Science
University of Peradeniya

Altogether 13 species of wild animals, including elephants, wild boar, monkeys, porcupines, peacocks etc. are known to be in conflict with people to share resources for their existence. Animals such as house squirrels are being added to the growing list. Animals carrying poisons for their feeding and survival such as snakes, scorpions, stingray etc. are excluded. Reduction and fragmentation in jungle coverage with steadily increasing human population and their needs is the route cause for this. It is possible that some species of wild animals also have increased their numbers since the food chain has been seriously disturbed. The numbers of wild or domesticated animals or at least a decent estimate on these are not known in our country. The importance of such demographic data has been highlighted and progress of suggestions in this regard depends on the political will and commitment. It is clear that 30% jungle coverage which is being fragmented, from which only 20% is protected, has reduced over the years and some jungle corridors have been utilized by people for various activities. Global warming, industrialization with carbon emissions and green house gasses make these worse, and are route causes from which Sri Lanka has no escape but compelled to find local solutions. Genetically improved varieties of agricultural crops has solved global human hunger within limited available land but signs of protein, zinc and iron deficiencies in people fed with such food are being increasingly reported. Seriously disturbing health impacts on food chain due to heavy reliance of chemical fertilizer, weedicide and insecticides, have been reported. These are important challenges which must be faced by current scientists, higher education and research institutes to find solutions before they reach disasters levels. Natural derivation and evolving of germs, specially viruses and new zoonotic and occupational hazards make these challenge

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worse. In this context, it is important to study chronology of MERS, SARS, COVID and Birdflu situation.

Animal loving culture in Sri Lanka demands scientists and wildlife managers to solve these conflicts towards coexistence, in which culling of animals is almost impossible. Finding solutions to wild animals already in conflict, with people and will not retrieve back to wilderness such as community monkeys, is difficult. Domesticating wild animals for various reasons, for example culture, is also challenging because one must decide whether wild animals must live in wilderness and die early due to various detrimental human activities or to live in domestication for longer periods, for example elephants. There are many scientific means of increasing numbers of agricultural and wild animals but not that many methods are available to humanely reduce their numbers rapidly. The latter is equally important in scientific management of wild animals. Such wild animal management with a national strategy and dedicated political determination and commitment, would bring the conflict into a tolerable level after which principals of co existence, the scientifically palatable solution, can be implemented. Sri Lanka has some research stations to conduct field experiments required to conduct field trials towards such coexistence. We do have a means and a system of reporting, recording, trying out new innovations in this regard to be demonstrated and perform field trials though they are less active and have not been prioritized as yet. We must immediately decide how to acutely reduce the wild animal populations grown disproportionately, while implementing long terms solutions such as population control to assure its sustenance. Perhaps, we may have to revisit, establishment of human dwellings, agricultural lands and jungles in a different way and a serious restructuring in land use pattern must be brought in with new legislature. Coexistence is a battle between animals and humans for resources which requires a delicate balance in which both parties must suffer at inception, and must be brought in fast anticipating long term results.

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BERT Supervised Fine tuning for More Effective Semantic Classification

Ibrahim M.Z.I.A.A.S. [1*], ***Abishethvarman V.*** [2], ***Kumara B.T.G.S.*** [1,2]

[1] Department of Software Engineering, Sabaragamuwa University of Sri Lanka
[2] Department of Computing and Informations System, Sabaragamuwa University of Sri Lanka

This study investigates the application of BERT for context-aware semantic classification, with a focus on English phrasal verbs whose meanings often vary depending on context, a setting where existing approaches often rely on frozen embeddings or lack systematic task- specific adaptation for fine-grained semantic disambiguation. We employed the BERT- base-uncased architecture and explored two fine-tuning strategies: full supervised fine- tuning and QLoRA, a parameter-efficient method that applies low-rank adaptation under 4-bit quantization to reduce resource usage. The models were trained to predict the intended meaning of phrasal verbs in sentence contexts and evaluated using accuracy and macro F1-score. Results indicate that supervised fine-tuning of BERT provides a clear improvement over a frozen embedding baseline, confirming the benefit of adapting pretrained language models directly to this task. Furthermore, QLoRA demonstrates nearly comparable performance to full fine-tuning while requiring substantially less GPU memory, making it a practical choice for deployment in settings with limited computational resources. These findings highlight two main contributions: first, that task-specific fine- tuning significantly enhances BERT's ability to capture phrasal verb semantics; and second, that parameter-efficient methods like QLoRA offer a promising balance between accuracy and efficiency. Overall, this work demonstrates the effectiveness of supervised fine-tuning for semantic classification of phrasal verbs and underscores the potential of lightweight adaptation methods for efficient large-scale language model deployment. The code implementation can be found at: https://github.com/Abishethvarman/bert-semantic- classification

Keywords: *BERT, Parameter-efficient, QLoRA, Semantic Classification, Supervised Fine-Tuning*

**Corresponding author*: ssujair@gmail.com

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Higher order cognitive skills among IT graduates in Sri Lanaka: A comparison between industry expectation and the reality

De Silva, Amila[1*], Abeygunawardana R.A.B.[2], Hewagamage K.P.[3]

[1]Faculty of Graduate Studies, University of Colombo, Sri Lanka.

[2]Department of Statistics, Faculty of Science, University of Colombo, Sri Lanka.
[3]University of Colombo, School of Computing, Sri Lanka.

Industry experts believed that the producing Information Technology (IT) graduates with strong Technical Skills (TS) and Higher Order Cognitive Skills (HOCS) is essential in Higher Education Institutes (HEI) in Sri Lanka. These skills are vital in enabling graduates to pilot dynamic innovate technological environments and meet industry expectations. Surly, through the strong curriculum, HEI producing IT graduates with strong TS. However, in many forums industry experts highlighted that Sri Lankan IT graduates often face a gap between the expected and actual levels of HOCS. This study focuses to compare the HOCS among IT graduates and Sri Lankan IT industry expectations. Drawing on Bloom's revised taxonomy and constructivist learning theories, the study examines institutional, pedagogical, and individual-level factors influencing HOCS. Key factors such as curriculum structure, teaching methodologies, digital integration, leadership training, soft skills development, and learner dispositions were considered. A structured questionnaire used to collect data from state and private institutes in Sri Lanka. Industry experts were selected from thirty SLASSCOM registered IT organizations. Industry experts believed that analytical reasoning, adaptive problem solving, and critical thinking are dominant HOCS. Quantitative data were analyzed statistically. Average of AR, APS and CT skills of IT graduates are close to 4 (Maximum 5). APS and CT skills are not difference with respect to the gender. Lot of industry experts believed recent IT graduates depends on the supervisor to solve IT problems. Soft skills training and reflective learning activities contribute significantly to critical thinking. The findings reveal that exposure to project-based learning, internships, and e-learning platforms strongly correlates with improved analytical reasoning and problem-solving skills. The study highlights the importance of use of experiential learning strategies, and stronger academia-industry partnerships. Implications extend to education managers, curriculum designers, and policymakers seeking to align graduate attributes with the demands of the industry requirements.

Keywords: *Higher-order cognitive skills, IT graduates, higher education, Sri Lanka, critical thinking, problem-solving*

*Corresponding author: *amadesilva2011@gmail.com*

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Forecast Political Trends in Sri Lanka using Social Media Sentiment Analysis.

Chandrasena A.C., Dayarathne H.R.O.E., Hemalika Abeysundara*

Department of Statistics and Computer Science, University of Peradeniya, Sri Lanka

In the era of digital media, political opinions expressed on social media platforms have become a rich source of insights into public sentiment. This research focuses on classifying political opinions in Sinhala, using classification machine learning for sentiment analysis. The primary objective of this research is to develop a classification AI model to forecast the 2024 presidential election trend in Sri Lanka by analyzing sentiments and opinions on social media. The recent Sri Lankan presidential election was used as a case study to investigate the potential of modeling political sentiment through the mining of social networks. The study compares advanced AI models such as BERT (sinBERT and AshenBERTo) with supervised machine learning techniques including Support Vector Machine (SVM), Naïve Bayes, Random Forest and XGBoost. Furthermore, the research highlights the potential of AI-driven sentiment analysis as a predictive tool for election outcomes. The proposed approach demonstrates high accuracy for BERT based models in classifying political opinions and reveals significant patterns and trends in public sentiment. Furthermore, the proposed method accurately predicted the winning party in the 2024 presidential election with 67.1% positive votes among the group of people considered. Our best classification model SinBERT achieved 95% accuracy with high precision, recall values by confirming that transformer-based models outperform traditional machine learning techniques. This work contributes to the growing field of Sinhala NLP, offering a framework for the intersection of AI and political data analysis.

Keywords: *Natural Language Processing; Sentiment Analysis; BERT; Machine Learning, Social media analysis*

*Corresponding author: ayeshachandrasena9@gmail.com

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GAN-Based Fraud Detection and Cluster Forecasting for Highly Imbalanced Insurance Claim Data

Herath U.K., Nawarathna R.D.*

Department of Statistics and Computer Science, University of Peradeniya, Sri Lanka

The insurance industry in Sri Lanka faces critical challenges in claims processing and fraud detection. Leading insurers report receiving over 400 daily alerts on potentially fraudulent activities, with motor insurance fraud rates globally ranging from 9-10%. Two primary challenges persist: accurate claim amount forecasting complicated by heterogeneous customer segments, and fraud detection severely hindered by extreme class imbalance where fraudulent claims represent less than 1% of total cases. Traditional supervised learning and oversampling techniques like SMOTE fail to capture the true underlying distribution of legitimate claims in such severely imbalanced scenarios. This research addresses these challenges through two novel machine learning approaches. For claim amount forecasting, K-Mode clustering segments data by categorical features, followed by cluster-specific XGBoost regression models on 119,864 insurance records. For fraud detection, a Generative Adversarial Network trained exclusively on legitimate claims learns normal claim distributions, enabling fraud identification through anomaly detection. Evaluated on 15,420 insurance claims from a Sri Lankan insurer with 0.65% fraud rate, results demonstrate substantial improvements. Cluster-based forecasting achieved R^2 equals 0.63, representing 26% improvement over baseline XGBoost. The GAN-based fraud detection achieved 77% accuracy with precision equals 0.73, recall equals 0.77, and F1-score equals 0.75, significantly outperforming One-Class SVM at 51% accuracy and SMOTE-based approaches. These findings provide actionable AI solutions for enhancing operational efficiency and fraud prevention in insurance operations.

Keywords: *Insurance fraud detection; Generative adversarial networks; Class imbalance; Claim forecasting; Machine learning*

*Corresponding author: udaya.herath.ds@gmail.com

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Macaw Species Recognition in Images: Comparative Analysis of CNN, CNN-SVM, and Transfer Learning

Vidanagamachchi C.S.[1,*], Chathuranga W.G.D.[2], Chathuranga L.L.G.[1], Yeshani R.B.[1], Jayathilake K.T.A.S.[1], Vidanagamachchi S.M.[1].

[1] Dept. of Computer Science, University of Ruhuna, Matara, Sri Lanka
[2] Dept. of Zoology, University of Ruhuna, Matara, Sri Lanka

The accurate and automated identification of bird species is essential for advancing biodiversity conservation, ecological research, and sustainable wildlife management. Traditional identification methods based on manual observation and expert knowledge are often subjective, time-consuming, and difficult to scale across large datasets or remote regions. This study explores deep learning, based automatic macaw species identification, concentrating on three prominent Ara genus species Blue-and-yellow, Green-winged, and Scarlet macaws, while including other bird categories as non-target classes for robust and generalized classification. A balanced dataset of 8000 images was curated and divided into training (70%), validation (15%), and testing (15%) subsets. Four models, a custom CNN, CNN-SVM hybrid, and VGG16 and VGG19 transfer learning architectures were implemented to compare baseline, hybrid, and transfer learning strategies, not to comprehensively evaluate all existing architectures. The experimental evaluation revealed that the VGG19 transfer learning model achieved the best performance, attaining a test accuracy of 82.50%, surpassing CNN, CNN-SVM, and VGG16 approaches. Class-wise analysis showed strong F1-scores across macaw species and non-target birds, resulting in a macro-averaged F1-score of 0.82. These results emphasize VGG19's robustness and confirm the effectiveness of transfer learning for accurate species recognition with limited training data. Although external validation and on-device evaluation are not addressed, this work establishes a baseline framework for macaw species recognition and offers insights to support future scalable, real-world image-based biodiversity monitoring research.

Keywords: *macaw species, deep learning, transfer learning, ecological monitoring*

**Corresponding author*: channavidanagamachchi@gmail.com

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A Comparative Analysis of Hybrid Machine Learning and Deep Learning Models for Network Intrusion Detection: Integrating K-means Clustering and Multi-Classifier Frameworks

D.P.M Lakshan[1*], Harinda Fernando[2]

[1]Department of Computer Science, Faculty of Science, University of Ruhuna, Sri Lanka

[2]Faculty of Computing, Computer Systems Engineering, Sri Lanka Institute of Information Technology, Sri Lanka.

The escalating sophistication of cyberattacks, including zero-day exploits, ransomware, and advanced persistent threats (APTs), has necessitated the evolution of intrusion detection systems (IDS) that achieve a delicate balance between accuracy, scalability, and adaptability. Traditional signature-based IDS, while effective against known threats, is fundamentally incapable of detecting zero-day attacks due to its reliance on predefined attack patterns. This paper proposes a hybrid intrusion detection framework that combines K-means clustering with a multi-classifier learning architecture to enhance the detection of both known and previously unseen cyber threats. The framework leverages the widely used KDD Cup 1999 dataset, a benchmark for evaluating IDS due to its comprehensive representation of network attack scenarios. The K-means clustering algorithm is employed to uncover latent attack patterns and group similar instances, thereby enhancing the discriminative power of the subsequent classification stage. To evaluate detection performance, seven machine learning and deep learning classifiers are examined, including Support Vector Machine (SVM) variants, K- Nearest Neighbours (KNN), Linear Discriminant Analysis (LDA), Quadratic Discriminant Analysis (QDA), Multi-Layer Perceptron (MLP), Long Short-Term Memory (LSTM), and Random Forest. Experimental results demonstrate that the Random Forest classifier achieves the highest overall detection accuracy of 99.95%, indicating strong robustness against overfitting and class imbalance. Meanwhile, the LSTM model exhibits superior performance in identifying temporally correlated attacks, such as Distributed Denial-of-Service (DDoS) and APT-related activities, due to its ability to capture sequential dependencies in network traffic. These findings highlight the complementary strengths of ensemble-based machine learning and sequence-aware deep learning models within a unified intrusion detection framework. The proposed framework addresses key limitations of traditional IDS and provides practical insights for designing intelligent and scalable detection architectures. Future work will focus on validating the proposed approach using more recent and realistic intrusion detection datasets to further assess its applicability in contemporary network environments.

Keywords - *Network intrusion detection, K-means clustering, APT, deep learning, temporal analysis.*

**Corresponding author*: pathiranam@dcs.ruh.ac.lk

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Sentiment Analysis of Customer Reviews on Sri Lankan E-commerce Platforms using Machine Learning

D.M.R. Wickramanayaka*

Department of Computer Science, University of Ruhuna, Sri Lanka

The rapid expansion of e-commerce platforms in Sri Lanka has generated a substantial volume of customer reviews containing valuable insights into consumer satisfaction and service quality. This study investigates sentiment classification of customer reviews collected from major Sri Lankan e-commerce platforms using a classical and interpretable machine learning approach. The primary objective is to establish a strong baseline sentiment classification model and evaluate its effectiveness in a domain specific, low- resource setting. Text preprocessing techniques including normalization, stop word removal, and n-gram extraction are applied, followed by feature representation using Term Frequency–Inverse Document Frequency. A Logistic Regression classifier is employed as the baseline model, as it is widely used in sentiment analysis literature due to its robustness, computational efficiency, and interpretability. Customer reviews are classified into positive, negative, and neutral sentiment categories. Experimental results demonstrate that the baseline TF–IDF and Logistic Regression model achieves an overall accuracy of 97%, with high precision, recall, and F1-scores across all sentiment classes. This performance represents within dataset benchmark results rather than a claim of state-of-the-art performance. While advanced deep learning and transformer-based models such as LSTM and BERT have shown strong results in large scale sentiment analysis, they require substantial computational resources and reduce transparency. In contrast, the proposed baseline model provides an efficient, transparent, and easily deployable solution suitable for practical sentiment analysis in Sri Lankan e-commerce environments. The study establishes a reliable benchmark that can support future comparisons with more complex machine learning and deep learning approaches.

Keywords: *Sentiment Analysis; E-commerce; TF–IDF; Logistic Regression; Machine Learning*

**Corresponding author*: methmirasara1997@gmail.com

Relationship of HbA1c with TyG Index and TG/HDL Ratio among Patients with Type 2 Diabetes Mellitus

Amanda K.A.M.[1*] , Bandara W.V.R.T.D.G.[1], Gunawardena S.[2].

[1] *Department of Medical Laboratory Science, Faculty of Allied Health Sciences, University of Ruhuna, Sri Lanka*

[2] *Department of Physiology, Faculty of Medicine, University of Ruhuna, Sri Lanka*

Diabetes mellitus (DM) is a global health problem while type 2 DM is being the most common form due to its high prevalence and long-term complications. A good glycemic control is essential in managing patients with diabetes. The HbA1c test is the gold standard for assessing glycemic control; however, it is relatively costly. This study was conducted to assess the relationship of HbA1c with Triglyceride-glucose (TyG) index and Triglyceride to high-density lipoprotein (TG/HDL) ratio of patients with type 2 DM, in order to evaluate their potentials as alternative and cost-effective markers for glycemic control. A cross-sectional study was conducted in Diabetes and Endocrine Unit at National Hospital, Galle enrolling type 2 DM patients (n=271), aged 30-70 years. Participants were divided into two groups based on HbA1c levels: poor glycemic control (≥7%, n=158) and good glycemic control (<7%, n=113). Anthropometric data and clinical parameters were recorded. TyG index, TG/HDL ratio was calculated. Results showed that HbA1c, FPG, TG, TyG index, TG/HDL ratio, TyG-BMI and TyG-WC were significantly higher in poor glycemic control group (t-test). Spearmen correlation test showed HbA1c correlated moderately with TyG index (r=0.467, p<0.001) and weakly with TG/HDL ratio (r=0.147, p=0.016). Receiver-operating characteristic curve analysis revealed that TyG index had the highest diagnostic value (Area Under Curve=0.749, cutoff=8.4). Findings concluded that, TyG index is having a significant moderate correlation with HbA1c and can be considered a useful, low-cost marker for assessing glycemic control in type 2 DM patients.

Keywords: *Glycemic control, HbA1c, TyG index, TG/HDL ratio, Type 2 DM*

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**Corresponding author:* madhushiamanda123@gmail.com

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Warming-induced shifts in the mean state of the Arabian Sea Oxygen Minimum Zone from 1993 to 2022.

Rathnayake.H.M.C.N.[1,2,*], Gayan Pathiran[1], Iroshanie.R.G.A[1], Kyung-Min Noh [2,] Dongxiao Wang[3].

[1] Department of Oceanography and Marine Geology, Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Matara, Sri Lanka.
[2]Princeton University/Atmospheric and Oceanic Sciences Program, Princeton, New Jersey.

[3]School of Marine Sciences, Sun Yat-sen University: Southern Marine Science and Engineering Guangdong Laboratory, Zhuhai, China.

Oxygen Minimum Zones (OMZs) are a vital part of the ocean's biogeochemical cycles as they strongly influence the nitrogen and carbon cycling and thereby modulate the ocean's role in regulating the climate. OMZs impact marine ecosystems by constraining the growth and survival of organisms while enhancing microbial processes, such as denitrification, that contribute to the release of greenhouse gases, including nitrous oxide and methane. Recent studies have shown that OMZs are expanding in response to climate change, with the Arabian Sea hosting the largest OMZ globally. Despite the significance of this region, long-term assessments of OMZ variability and the mechanisms driving its vertical shifts remain limited. This study focuses on addressing the knowledge gap by analyzing the oxygen minimum depth (OMD) from 1993 to 2022, where OMD was derived from model-based dissolved oxygen fields, evaluated against independent datasets. The results revealed that the mean state of the OMD has deepened markedly since 2006, compared to earlier years, reaching differences of up to approximately 180 m in the Northern Arabian Sea region. Spatially resolved mean state changes in physical and biogeochemical drivers behind OMD indicate that sea surface warming, through its impact on thermal stratification, productivity, and monsoon-driven wind patterns, acts as the primary cause behind this deepening. These findings highlight the growing threat to biogeochemical cycling and marine ecosystems in the Arabian Sea, emphasizing the urgent need for continued monitoring and research.

Keywords: *Oxygen Minimum Zone; Arabian Sea; Climate Change*

**Corresponding author*: rathnayake.chithya@gmail.com

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Influence of aquatic habitat trophic status on gut parasite abundance in *Polypedates cruciger* tadpoles across developmental stages

Welikala D.U.K., Sudarshani K.A.M.*

Department of Zoology, University of Ruhuna, Matara, Sri Lanka

Declining amphibians has become a global conservation concern, driven primarily by habitat degradation, water and land pollution, climate changes, parasitism, and diseases. The common hourglass tree frog, *Polypedates cruciger* (Anura: Rhacophoridae) is a widely distributed, arboreal endemic frog, found predominantly in the wet zone of Sri Lanka. This study investigated the abundance of gut parasites in *P. cruciger* tadpoles across freshwater ecosystems representing different trophic conditions: oligotrophic, mesotrophic, and eutrophic. Tadpoles were sampled at three developmental stages- (10, 30, and 50-days old) from three stagnant water bodies in Wellamadama area, Matara district. Foamy egg masses of *P. cruciger* were collected from the University of Ruhuna premises and reared under controlled laboratory conditions simulating different trophic status. Ten tadpoles per replicate tank were examined for gut parasite abundance. Gut contents from the foregut, midgut, and hindgut were analyzed microscopically. Five protozoan gut parasite genera; *Opalina* sp., *Protoopalina* sp., *Cepedea* sp., *Nyctotherus* sp., and *Balantidium* sp. were recorded across all trophic condition. Parasite abundance differed significantly among trophic status in 10-days-old ($p=0.012$), 30-days-old ($p=0.014$), and 50-days-old ($p=0.026$) tadpoles. The highest parasite abundance occurred under eutrophic conditions, indicating that nutrient enrichment promotes parasite proliferation. The hindgut harbored the highest abundance of parasites, likely due to favorable conditions such as higher nutrient availability, slower food passage, and reduced digestive enzyme activity across all developmental stages. Overall mean gut parasite abundance increased significantly from oligotrophic to eutrophic conditions, highlighting the strong influence of habitat trophic status on gut parasite dynamics in tadpoles.

Key words: *developmental stages, Polypedates cruciger, tadpole gut parasites, trophic status*

**Corresponding author*: *mangalas@zoo.ruh.ac.lk*

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In Silico Discovery of Conserved B&T cell Epitopes in ASFV B175L Protein for Vaccine Design

Kavishka Lakshan*, Sijani Vasanthakumar, Nuwan Pradeep, Jayamal Kulasinghe, Pasindu Malshan, Nethmini Hennayake, Kasuni Karunarathne, Lakmal Ranathunga

[1]*Department of Animal Science, Faculty of Agriculture, University of Peradeniya, Sri Lanka*

Global swine production is severely threatened by African swine fever virus due to the lack of a licensed broadly protective vaccine. The ASFV B175L protein, which interferes with the STING pathway and modulates host immune responses, is highly conserved among strains and represents a rational target for multi-epitope vaccine design. This study aimed to identify and prioritize conserved B and T cell epitopes in the ASFV B175L protein for rational multi-epitope vaccine design. Initially, 46 ASFV B175L protein sequences were retrieved from geographically diverse isolates using ASFVdb, the NCBI Protein Database, and UniProt, and conserved regions were identified through multiple sequence alignment (MUSCLE v5, Clustal Omega, and Jalview). Linear B-cell epitopes were predicted using the Kolaskar–Tongaonkar method, while $CD8^+$ and $CD4^+$ T-cell epitopes were identified using NetMHCpanExp-1.0 and the IEDB MHC II tool. This study identified conserved and immunogenic epitopes within the ASFV B175L protein and developed a rational multi-epitope vaccine construct using a systematic immunoinformatics pipeline. Six CTL, one HTL, and four B-cell epitopes were prioritized and assembled into a computationally validated construct. A multi-epitope construct was assembled in silico using peptide linkers and a CpG-ODN-2007 adjuvant to enhance immune activation. The final construct showed favorable antigenicity, safety, and structural stability, supporting its potential as an ASFV vaccine candidate. This is the first in silico study to target the B175L protein for epitope-based vaccine design. Further experimental studies are needed to confirm the immunogenicity and protective efficacy of the vaccine candidate. This study demonstrates the usefulness of computational methods in accelerating ASFV multi-epitope vaccine development.

Keywords: *African Swine Fever, in-silico, multi-epitope vaccines, immunoinformatic, immune simulation*

Corresponding Author: aberathnakavishka7@gmail.com

Prevalence of Metabolic Syndrome and its association with Urine Parameters among Type 2 Diabetic Patients attending Diabetic Clinic, National Hospital Galle.

Farwin M.H.A.[1*], Bandara W.V.R.T.D.G.[1], Gunawardena S.[2]

[1]*Department of Medical Laboratory Science, Faculty of Allied Health Sciences, University of Ruhuna, Sri Lanka*

[2]*Department of Physiology, Faculty of Medicine, University of Ruhuna, Sri Lanka*

Type 2 diabetes mellitus (T2DM) is frequently associated with metabolic syndrome (MetS), a cluster of cardiometabolic risk factors that increase the likelihood of cardiovascular and renal complications. This study aimed to determine the prevalence of MetS among patients with T2DM attending the diabetic clinic at the National Hospital Galle (NHG) and to assess associated urinary abnormalities using dipstick urine parameters. A cross-sectional study was conducted among 317 T2DM patients aged 30–69 years. MetS was diagnosed using the NCEP-ATP III criteria. Clinical and biochemical data, including waist circumference, blood pressure, lipid profile, and fasting blood glucose, were collected. Midstream urine samples were analyzed using dipstick tests for glucose, protein, pH, leukocytes, nitrites, and blood. Data were analyzed using SPSS version 25.0. The prevalence of MetS was 21.1%, with a significantly higher prevalence among females (24.5%) compared to males (13.4%) ($p = 0.025$). MetS showed significant associations with high waist circumference, elevated triglycerides, low HDL cholesterol, and high blood pressure (all $p < 0.001$). Fasting blood glucose demonstrated a borderline association with MetS ($p = 0.053$). Among the 145 participants who provided urine samples, leukocyturia was significantly more frequent in those with MetS ($p = 0.046$), which may suggest underlying urinary tract inflammation. No significant associations were observed between MetS and other urinary parameters, including proteinuria, nitrites, hematuria, or glycosuria. In conclusion, **approximately one-fifth of patients with T2DM had MetS**, particularly females. **Central obesity, dyslipidemia, and hypertension** were the key associated factors. **Leukocyturia was the only urinary abnormality associated with MetS**, while other urine parameters showed no significant relationship.

Keywords: ***Type 2 Diabetes Mellitus, Metabolic Syndrome, Leukocyturia, Urinary Tract Infections, Dipstick Urine Analysis***

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**Corresponding author:* Asmafarvin180@gmail.com

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Effects of urbanization and habitat features on the abundance and body size of ghost crabs in southern Sri Lanka

Sankalpana T.G.[1], Gunawickrama K.B.S. [1*], Bandara S.N.[2]

[1] *Department of Zoology, University of Ruhuna, Sri Lanka*
[2] *Department of Zoology, Open University of Sri Lanka, Sri Lanka*

Ghost crabs (Subfamily: Ocypodinae) are common inhabitants of sandy beaches and play vital roles as scavengers and burrowers while serving as indicators of beach ecosystem health. This study assessed the impact of urbanization and habitat characteristics on the abundance and burrow morphology of six ghost crab populations across selected Southern Sri Lankan beaches (i.e. Matara, Hikkaduwa, Kamburugamuwa, Midigama, Eliyakanda, and Dondra). Six specimens were collected from each beach for morphological identification, and three morphologically close species (*Ocypode cordimana, Ocypode brevicornis, Ocypode sinensis*) were recorded. However, only genus level identification was done due to practical difficulties of close observation of characters in live crabs. The number of burrows (burrow density as a proxy for population size) applying the Burrow Resetting Method to reduce counting bias, and burrow diameters (as a proxy for body size) were estimated along three line transects on the shore (with 1 m gap) parallel to the waterline denoted as levels 1, 2, and 3 starting from the supralittoral end. Quadrats (2×2 feet) were placed using a systematic sampling method, between 5.00 and 7.00 pm each visit. Sediment moisture, bulk density and grain size were estimated in replicate samples. Urbanization was quantified based on three factors as Urbanization Index with each variable scored from 0 (undisturbed) to 5 (highly disturbed) and standardized according to literature. Burrow counts were relatively uniform across the beaches but varied significantly among the three levels. Burrow diameters showed uniformity across three beach levels but significantly differ across beach sites. Sediment physical parameters such as bulk density, mean grain size, and beach width showed significant differences across six beaches, while moisture content remained relatively uniform among sites. None of the soil physical factors varied significantly across levels, indicating broadly similar substrate characteristics despite tidal influence. Urbanization emerged as the key factor, showing a strong decline in burrow abundance as urbanization increased. Assessing the relationship between habitat characteristics, urbanization, and ghost crab abundance is critical for guiding successful ecosystem conservation and management.

Keywords: *Ghost crabs; Ocypode; Sediment profile, Urbanization index*

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**Corresponding author*: suneetha@zoo.ruh.ac.lk

Evaluation of *in-vitro* Antiurolithiatic Potential of *Biophytum reinwardtii*

Upekshani W.U[1*], Sandamali J.A.N[1], Pathiraja V.M[2]

[1]Department of Medical Laboratory Science, Faculty of Allied Health Sciences,University of Ruhuna, Sri Lanka

[2]Department of Pharmacy, Faculty of Allied Health Sciences, University of Ruhuna, Sri Lanka

Biophytum reinwardtii (Heen Nidikumba) is commonly used by the Ayurvedic medical practitioners in the treatment of urolithiasis. Urolithiasis has been a major health concern due to limited treatment options available and due to its high recurrence rate. This study evaluated ***in-vitro*** effects of aqueous, ethanol, and hexane extracts of *B. reinwardtii* on calcium oxalate (CaOx) crystallization, focusing on nucleation, aggregation, and crystal growth, the key events in urolithiasis. Extracts were assessed using standard crystallization assays, with Cystone as the reference drug. Optical density of reaction mixtures was measured spectrophotometrically, percentage inhibition of crystal nucleation, growth and aggregation were calculated, and all assays were performed in triplicate. Crystal morphology was examined under light microscopy.All three extracts exhibited inhibitions against nucleation, aggregation, and growth of CaOx crystals in varying degrees. Microscopic analysis revealed a shift towards CaOx dihydrate crystal formation compared to CaOx monohydrate crystals. A noticeable reduction in the number of crystals in the tubes treated with plant extracts was observed compared to Cystone treated groups.Ethanol and hexane extracts demonstrated significantly higher inhibitory effects than Cystone ($p \leq 0.05$).The ethanolic extracts showed the most potent inhibition in the nucleation assay at 1000 µg/ml (82.04±0.58%). In the aggregation assay, ethanolic extract had the highest inhibition at 500 µg/ml (53.30±0.55%). However, significant inhibition in growth assay was only seen with the hexane extracts at 1000 µg/ml (35.13±0.50%). These findings highlight the *in-vitro* antiurolithiatic potential of *B. reinwardtii*, particularly its ethanolic extract which demonstrated the strongest activity against crystal nucleation and aggregation.

Key words*;Aggregation, Biophytum reinwardtii, Calcium oxalate, Nucleation, Urolithiasis*

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Corresponding Author: udariwijesuriya@gmail.com

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A Refined Perspective on Indian Ocean Dipole–Driven Surface Salinity Changes and the Salinity Dipole Index

Kokulathasan Thilaksanth[1], Gayan Pathirana[1*], Kyung-Min Noh[2], Aoyun Xue[3], and Dongxiao Wang[4]

[1]Department of Oceanography and Marine Geology, Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Matara, Sri Lanka.

[2]Princeton University/Atmospheric and Oceanic Sciences Program, Princeton, New Jersey.

[3] Bren School of Environmental Science and Management, University of California, Santa Barbara.

[4]School of Marine Sciences, Sun Yat-sen University: Southern Marine Science and Engineering Guangdong Laboratory, Zhuhai, China.

The Indian Ocean Dipole (IOD) is a dominant coupled ocean–atmosphere mode in the tropical Indian Ocean, characterized by opposing sea surface temperature anomalies (SSTAs) between the western and southeastern regions. In addition to its well-established climatic and biological impacts, the IOD strongly modulates sea surface salinity (SSS), a key variable governing ocean circulation and air–sea interactions. However, the nature of IOD-induced salinity changes and the appropriate formulation of a salinity dipole index (SDI) remain debated, particularly across different IOD phases. Previous studies have proposed contrasting definitions of salinity dipole regions: one, based on high-resolution eddy-resolving model simulations, identifies the dipole between the Central Equatorial Indian Ocean (CEIO: 70°E–90°E, 5°S–5°N) and the Sumatra–Java Coast (SJC: 100°E–110°E, 13°S–3°S); while another, derived from satellite-based SSS observations, aligns with the conventional IOD regions. Here, we revisit the IOD–SSS relationship and reassess the SDI using multi-decadal observational SSS products and historical simulations from Coupled Model Intercomparison Project Phase 6 (CMIP6). The SDI is recalculated consistently across datasets by differencing area-averaged SSS anomalies between candidate dipole regions. Our results show the IOD-induced salinity dipole emerges most clearly during boreal autumn, exhibits pronounced interannual variability, and is not co-located with canonical IOD regions. It consistently develops between the CEIO and SJC during strong positive IOD events, with low salinity in the CEIO and high salinity along the SJC. This structure is primarily associated with IOD-driven surface advection and freshwater flux anomalies, while acknowledging potential modulation by other climate modes, such as ENSO. Based on these findings, we propose a refined definition of the salinity dipole regions and SDI, which demonstrates greater consistency across datasets and events.

Keywords: *Air–Sea Interaction; CMIP6; Indian Ocean Dipole; Salinity Dipole Index; Sea Surface Salinity*

*Corresponding author. Email: upgpathirana@fish.ruh.ac.lk

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Isolation of Biofilm Forming Bacteria from Mangrove Sediments in Rekawa Lagoon

Navanjali H.W.M.[1], Kumara M.P.[2], Muthumuni N.T.[1], Wanasinghe W.M.L.A.[1*]

[1] Department of Animal Science, Faculty of Animal Science and Export Agriculture, Uva Wellassa University, Badulla, Sri Lanka

[2] Department of Fisheries and Marine Sciences, Faculty of Fisheries and Marine Sciences, Ocean University, Tangalle, Sri Lanka

The microbiome associated with mangroves is crucial for the ecosystem, as it supports nutrient cycling and the degradation of organic matter. Although the importance of microorganisms is well recognized, gaps remain in understanding their distribution and composition. This study aimed to isolate bacterial strains from mangrove sediment collected at Rekawa Lagoon and assess their biofilm formation ability. Sediment samples were collected from nine locations at a depth of 2 cm, with four replicates from each site, and cultured on Reasoner's 2A agar at 37°C to obtain pure cultures. Colony counts were observed at 24 and 48 hours and analyzed using one-way ANOVA. Gram staining, catalase, urease, and sulfur indole motility tests were performed for biochemical characterization. Biofilm production was assessed using a microtiter dish assay with crystal violet staining, measuring absorbance at 570 nm. Based on the optical density (OD) measurements, strains were grouped according to their ability to produce biofilms. The study successfully isolated 12 distinct bacterial strains from the mangrove sediments. The findings revealed the presence of *Bacillus*, *Streptococcus,* and *Microbacterium* genera, with a predominance of the *Bacillus* genus. Statistical analysis revealed that there is no significant difference in CFU counts among the sampling sites. All tested isolates were capable of forming biofilms, with *Bacillus* demonstrating a particularly pronounced ability. The observed biofilm formation ability of the bacteria highlights their potential ecological significance within mangrove sediments. where biofilm-associated microorganisms are known to influence sediment processes.

Keywords: *Bacillus; Biofilm forming bacteria; Mangrove sediment; Rekawa lagoon*

**Corresponding author*: lakshaniwanasinghe@uwu.ac.lk

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Evaluation of potential toxicity of 2-methyl-4-chlorophenoxy acetic acid (MCPA) based herbicide formulation on non-target aquatic macrophytes: A comparative study

***Ramanayaka R.M.H.T.*[1], *Masakorala K.*[1*]**

[1] Department of Botany, University of Ruhuna, Matara, Sri Lanka

MCPA-based formulations are widely used as post-emergent herbicides in paddy cultivation in Sri Lanka. However, their intensive use raises concerns about potential adverse impacts on non-target aquatic macrophytes inhabiting rice field ecosystems. The present study evaluated the phytotoxic effects of MCPA on two representative aquatic macrophytes, *Lemna minor* and *Azolla pinnata*, selected for their cosmopolitan nature, short life cycle, and low height, and collected from the Department of Botany, University of Ruhuna, Sri Lanka. Plants were individually exposed to a series of MCPA concentrations 0 (C), 10 (T1), 100 (T2), 500 (T3), and 1000 (T4) (µg/L) for seven days under controlled laboratory conditions (2000 lux white fluorescent light, 12 h light/dark cycle, 28_30 °C, pH 7.0). A completely randomized design (CRD) with four replicates (r = 4) was employed. Compared with the control, MCPA exposure induced concentration-dependent and statistically significant ($p<0.05$) changes in dry weight (DW), total chlorophyll (TC), and H_2O_2 contents in both species, as revealed by one-way ANOVA. Except for T1, all treatments showed increases in H_2O_2 content greater than 50% and decreases in DW and TC. Reductions of DW in T2, T3, and T4 were 62.53%, 81.35%, and 96.71% for *L. minor*, and 57.38%, 76.75%, and 90.37% for *A. pinnata*, respectively. The same trend was observed in both species for TC. In *L. minor*, H_2O_2 increased by 67.28%, 66.37%, and 120.55% in T2, T3, and T4, respectively, while in *A. pinnata*, the increases were 103.02%, 181.39%, and 272.09%. These results indicate that MCPA causes a significant reduction in photosynthetic pigment content, biomass, and enhances oxidative stress, even at concentrations lower than the recommended MCPA field dose for rice (3×10^6 µg/L), posing a high potential risk to non-target aquatic macrophytes.

Keywords: *Azolla pinnata, H_2O_2, Lemna minor, MCPA, Photosynthetic pigment*

**Corresponding author*: *mas@bot.ruh.ac.lk*

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Effects of 2-methyl-4-chloro phenoxy acetic acid (MCPA) on paddy rice

Wathsala A.W.D.[1], Masakorala K.[1*]

[1] Department of Botany, University of Ruhuna, Matara, Sri Lanka

MCPA- based formulas are widely used in rice cultivation as selective herbicides. Since their non-target effects on rice have not been systematically studied, this study aimed to evaluate impact of MCPA on photosynthesis and oxidative stress in paddy rice. A series of pot experiments was conducted according to the randomized complete block (RCB) design, using four replicates (n=4) per treatment and control for the selected rice varieties; At 362, At 378, and Bg 360. At the age of 21 days of transplanted rice plants, a concentration series of MCPA in ppm: 0 (Control), 600 (T_1), 1800 (T_2), 3000 / Recommended dose (T_3), 4200 (T_4) and 6000 (T_5) was applied. Following 1,7 and 14 days of exposure, chlorophyll stability index (CSI) and oxidative stress (OS) were determined from the measured total chlorophyll (TC) and H_2O_2 contents. The results showed, MCPA concentration-dependent significant ($p<0.05$) negative impacts on all parameters measured from the tested varieties. Two-way ANOVA revealed a significant ($p< 0.001$) interactive effect of time and concentration. After 14 days of exposure, plants in T_1 and T_2 showed a reversible effect on CSI and the percentage increase of H_2O_2 content while $T_3 - T_5$ showed a non-reversible damages including the complete death of plants in T_5 .The CSI in $T_3 - T_5$ was recorded as 36.5%, 21.2%, and 12.2% for At 362; 22.5%, 10.5%, and 8.3% for At 378 and 24.5%, 10.8%, and 8.9% for Bg 360, respectively. Correspondingly, the percentage increase in H_2O_2 content of T_3 and T_5 was 78.9% and 120.63% in At 362; 85.7% and 150.55% in At 378; and 69.9% and 106.5% in Bg 360. MCPA tolerance based on CSI differs as: At 362 > Bg 360 > At 378.These results indicate that even at the recommended dose (T_3), MCPA negatively affect on total chlorophyll content and oxidative stress. The impact is exacerbated at higher doses (T_4 and T_5), highlighting the potential risk associated with excessive use of MCPA to non-target paddy rice.

Keywords: *herbicide, MCPA, oxidative stress , paddy rice, photosynthesis*

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Warming-induced shifts in Arabian Sea surface chlorophyll a: Implications for regional productivity

Hewage S.S.T.[1*],Pathirana Gayan[1],Thilakarathne R.M.G.N [1],Noh Kyung-Min [2],Wang D.[3]

[1] Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Sri Lanka

[2]Princeton University/Atmospheric and Oceanic Sciences Program, Princeton, New Jersey

[3]School of Marine Sciences, Sun Yat-sen University, China

The Arabian Sea (AS) sustains high marine productivity during the southwest monsoon, supporting regional fisheries and contributing to global carbon cycling, yet this productivity is increasingly threatened by warming-induced stratification that disrupts ecosystem functioning and feeds back to the climate system. Although basin-wide declines in chlorophyll have been documented, the regional processes linking mean-state ocean changes to productivity shifts remain poorly understood. This study investigates summer monsoon chlorophyll a distributions in the AS over 1998–2024 using satellite remote-sensing observations and ocean reanalysis datasets, focusing on how changes in the ocean mean state regulate productivity. Results reveal a statistically significant ($p < 0.05$) shift toward negative chlorophyll a anomalies across the basin after 2006, based on a comparison between two periods, 1998–2006 and 2007–2024. In the northern AS, Chlorophyll a variability is suggestive of phosphate-related limitations, whereas in the western AS, nitrate-related changes appear to play a more important role in influencing chlorophyll-a mean state. These changes are strongly associated with rising sea surface temperature (SST), weakening of monsoon winds, and enhanced stratification, which collectively reduce upwelling and vertical nutrient supply. Analysis from Coupled Model Intercomparison Project (CMIP) simulations also support the observed changes, indicating continued declines in surface chlorophyll a under a warming climate. The findings suggest that warming-related changes in the ocean mean state are altering chlorophyll a variability in the AS, with unequal regional responses that highlight the vulnerability of this globally significant basin to ongoing climate change.

Keywords: *Arabian Sea, Chlorophyll a, Climate Change*

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Morphometric Analysis of Loggal Oya Sub-basin of Mahaweli River Basin, Sri Lanka Using GIS and Remote Sensing

H.A.M.P. Ranasinghe[1*], N.S. Withanage[2], R.A.G.C.N.M. Nawarathna [3], M.D.N.O.W. Madapatha[4], L.P.A. Isurangi[5]

[1]Department of Export Agriculture, Faculty of Animal Science and Export Agriculture, Uva Wellassa University, Badulla, Sri Lanka

Morphometric analysis of watersheds is essential for identifying hydrological and geomorphological characteristics within a watershed and for effective watershed management. GIS and Remote sensing applications play a key role in accurately analyzing these characteristics of watersheds for better planning and development. This study focuses on determining morphometric parameters of Loggal Oya, an identical tributary of the Mahaweli River, Sri Lanka under GIS platform. ASTER DEM was used to derive the drainage network of the study area. Following the established methods available in the literature, linear, aerial and relief aspects of morphometric parameters were then determined. Results show that the stream network of Loggal Oya follows a dendritic drainage pattern, moderate drainage density, with a low bifurcation ratio, indicating the geological control over drainage development. The form factor, elongation ratio, and circulatory ratio indicate a well elongated basin shape, which leads to a lower risk for flash flood generation and soil erosion. The relief parameters reveal moderate values confirming a lower susceptibility for soil erosion. However, though the Loggal Oya Sub-basin is morphometrically stable even with intensive paddy cultivation, proper planning strategies are needed for sustainable land use management during development activities that lead to frequent soil disturbances. The derived morphometric information can be applied to soil and water conservation planning, flood mitigation strategies, and prioritization of micro- watersheds for sustainable watershed management.

Keywords: *ASTER DEM, GIS tools, Morphometric Analysis, Soil conservation, Watershed Management*

**Corresponding author*: malsharanasinghe0@gmail.com

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Effect of Road Traffic on Epiphytic Lichen Communities in Kottawa Rain Forest, Southern Sri Lanka

Manawadu H.S. [1,*] ***, Masakorala K.*** [1] ***, Jayalal R.G.U.*** [2] ***, Gunasekara R.D.A.*** [1]

[1] Department of Botany, Faculty of Science, University of Ruhuna, Sri Lanka

[2] Department of Natural Resources, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, Sri Lanka

Epiphytic lichens are important indicators of air quality because they are sensitive to air pollutants. This study aims to investigate the impact of road traffic emissions on epiphytic lichen diversity and bark characteristics in the Kottawa Rainforest in Southern Sri Lanka, along the B129 road. Three different experimental plots were selected: near the road, in the middle (20 m), and a control plot (50 m). Lichen diversity, bark pH, and electric conductivity (EC) to connect pollution levels with changes in the lichen community were assessed on three native forest species: *Dipterocarpus* spp., *Semecarpus walkeri*, and *Diospyros premadasae Jayas*. Lichen diversity indices (Shannon-Wiener and Simpson), and the Index of Atmospheric Purity (IAP) were calculated. Impact of the pH and Electric Conductivity (EC) on lichens was statistically analyzed using a one-way ANOVA in Minitab version 17 *($P > 0.05$)*. Results showed a pattern of lichen diversity that increased from the near-road plot to the deeper forest plots. The highest diversity and IAP values were found in the control plot. The near-road plot had the lowest lichen diversity and abundance, indicating a strong sensitivity to vehicle emissions. EC significantly differed among the plots, with higher values near the road, due to higher dust deposition. The study highlights the negative effects of vehicle emissions on lichen communities. It emphasizes the role of epiphytic lichens as valuable bio-indicators in tropical forest ecosystems. These findings underscore the need for more effective transportation strategies to mitigate the impact of pollution on biodiversity.

Keywords: *Air pollution, Bark pH, Bio-indicators, Electric Conductivity, Epiphytic lichens*

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Effect of Rice Husk Biochar and Urea on Nutritional Properties of Rice under Low Country Dry Zone Conditions in Sri Lanka

K.H.C.H. Kumara[1], H.K.M.S. Kumarasinghe[2], K.M.C. Fernando[2], D.M. Withanawasam[3], D.L. Wathugala[2]*

[1] Rice Research Station, Department of Agriculture, Ambalantota, Sri Lanka

[2] Department of Crop Science, Faculty of Agriculture, University of Ruhuna, Sri Lanka

[3] Regional Rice Research and Development Center, Department of Agriculture, Bombuwala, Sri Lanka

Rice husk biochar is a promising soil amendment, but its interaction with nitrogen fertilization across seasons on rice grain nutritional properties in dry zone rice systems is not well understood. A four-season field experiment was conducted for variety AT362 from the 2023 *Yala* season to the 2024/25 *Maha* season in the low country dry zone of Sri Lanka to examine the effects of one-time rice husk biochar (BC) (pH: 7.27, EC: 388.5 µS/cm, C: 41.92%) and seasonal urea applications on nutritional traits of rice (*Oryza sativa*). Grain amylose (AMY), iron content (Fe) and ash content (ASH) and antioxidant activity (AO) were measured. Four biochar rates (0, 1, 2, and 3 t ha^{-1}) and the Department of Agriculture, Sri Lanka recommended rate of partially burnt paddy husk (PBPH; 625 kg ha^{-1}), along with four urea levels (0, 67.5, 157.5 and 225 kg ha^{-1}) were arranged in a split-plot design with three replicates. Analysis of variance showed that BC had a significant effect on all measured parameters ($P \leq 0.05$). Higher biochar rates, particularly 3 t ha^{-1} combined with the recommended urea level, produced the highest AO (9.68 × 10^{-2} µM mL^{-1}) in 2024 *Yala*, AMY (29.88%) in 2023/24 *Maha*, Fe (21.84 µg g^{-1}) and ASH 73.33% in 2023 *Yala* seasons. Overall, higher rates of BC combined with the recommended urea level performed better than recommended level of PBPH in enhancing and maintaining grain nutritional traits over four seasons under low country dry zone conditions in Sri Lanka.

Keywords: *Biochar; Grain nutritional traits; partially burnt paddy husk; Urea; Season*

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**Corresponding author*: wgdlakmini@crop.ruh.ac.lk

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Comparative Study of Physical, Chemical, Functional and Nutritional Properties of Selected Guava (*Psidium guajava* L.) Varieties In Sri Lanka

***Wickramarathna P.A.B.B.* [1], *Fernando G.S.N.* [1]*, *Kumarathunge D.*[2] *and Perera U.I.P.* [3]**

[1]Department of Food Science and Technology, Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitiya, Sri Lanka

[2]Department of Agricultural Biology, Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitya, Sri Lanka

[3]Fruit Research and Development Institute, Kananwila, Horana, Sri Lanka

Guava (*Psidium guajava* L.) is a nutritionally rich fruit widely consumed in Sri Lanka, yet systematic comparisons of physical, chemical, and functional attributes among local varieties remain scarce. This study aimed to highlight the nutritional diversity and potential for value addition of selected guava varieties by evaluating their physical, chemical, proximate, functional, and mineral properties. Six varieties; *Horana* white (HW), *Horana* red (HR), *Kanthi* (KN), *Pubudu* (PB), *Horana rosi* (HRo), and Apple guava (AG) were collected at commercial maturity, pooled to form composite samples for each variety, and analyzed for physicochemical, nutritional, and antioxidant properties using standard methods, with data subjected to Tukey's post-hoc multiple comparison test ($P<0.05$). Significant varietal differences ($P<0.05$) were observed across the tested properties of the fruits. PB had the highest fruit weight (384.11±18.71 g). AG showed the highest L* (lightness) (52.67±3.65), whiteness index (52.19±3.68), total sugar (9.43 ± 0.50 g/100 g), moisture (85.09±2.35%), ascorbic acid (179.53±5.36 mg/100 g), and mineral contents of K (431.08 ± 30.79 ppm) and Na (4.05±0.00 ppm). HR recorded the highest a* (red–green chromatic axis) (15.16±2.84), b* (yellow–blue chromatic axis) (10.75±0.49), pH (4.33±0.04), Total soluble solids (10.90±0.17 °Bx), titratable acidity (0.37±0.02 g/100 g), fat (0.94±0.05%), and carbohydrate (11.83±0.55%). KN contained the highest protein (1.20±0.01%), while HW exhibited the highest ash content (1.00±0.20%), antioxidant activity (568.92±2.52 mg TE/100 g), and total phenols (246.62±4.42 mg GAE/100 g). PB recorded the highest flavonoids (158.33±0.00 mg QE/100 g). These findings reveal wide nutritional and functional diversity among Sri Lankan guava varieties, highlighting their potential for targeted value-added applications such as fresh consumption, juice and beverage formulations, functional foods and nutraceutical products.

Keywords: *Functional properties; Mineral composition; Physicochemical properties; Proximate composition; Varietal characterization*

**Corresponding author:* gsnfernando@fst.ruh.ac.lk

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Assessment of Morphological Diversity Among Major Brinjal (*Solanum melongena*) Cultivars Cultivated in Jaffna District

***Ossika B.*[1*], *Sivachandiran S.*[1]**

[1] Department of Agronomy, Faculty of Agriculture, University of Jaffna, Sri Lanka.

Brinjal (*Solanum melongena*) is one of the demanded vegetables throughout the year in Sri Lanka, especially in Jaffna district, where farmers cultivate various cultivars to meet the market needs. However, Hybrid 704 is an Indian-origin cultivar which is not recommended in Sri Lanka for cultivation. Thus, a study was planned to evaluate and classify different cultivars based on their growth and yield performance. Eight brinjal cultivars which are commonly grown by Jaffna farmers: Jaffna special, Madduvil muddi, Eirkku vellai, Neela vellai, Thinnavely purple, EGH 10, Plastic, and Hybrid 704 were selected and evaluated for 15 qualitative and 13 quantitative traits. The experiment was conducted using the randomized complete block design, during *yala* season 2024 at the District Agriculture Training Centre, Thirunelvely, and Jaffna. A highly significant ($p<0.05$) differences was observed in traits such as plant height, number of leaves and branches, flower and fruit count, fruit size and weight and total yield. Cluster analysis identified three distinct clusters based on the dendrogram. Cluster 1 comprised high performing cultivars namely Hy 704 and Jaffna special. Cluster 2 (EGH 10, Madduvil muddi, Eirkku vellai, Neela vellai, and Thinnavely purple) which are medium performers and Cluster 3(Plastic), represented a poor performing cultivar. Based on growth and yield traits, Jaffna special and Hybrid 704 could be recommended as the better cultivars for cultivation, although Hybrid 704's legal status remained unresolved. This genotypic diversity supports breeding through hybridization and assists farmers´ selection of high-performing brinjal cultivars for improved yield and marketability in the northern region.

Keywords: *brinjal, cluster analysis, growth and yield traits, traditional cultivars*

**Corresponding author*: baskaranossika@gmail.com

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Sublethal effects on erythrocyte nuclear morphology and liver somatic index in *Oreochromis niloticus* inhabiting selected reservoirs with reported toxic algal blooms in Southern Sri Lanka

Kumari K.G.A.P.[1*], Masakorala K.[2], Gunawickrama K.B.S.[1]

[1] *Department of Zoology, University of Ruhuna, Matara, Sri Lanka*
[2] *Department of Botany, University of Ruhuna, Matara, Sri Lanka*

Harmful algal blooms (HABs) have become serious environmental and public health concerns globally. In this study, selected biological endpoints were assessed in adult *Oreochromis niloticus* collected from two reservoirs in southern Sri Lanka namely Ridiyagama (N=20) and Lunugamvehera (N=20) where HABs have been reported (in 2024 or recent past). In addition, *O. niloticus* from Muruthawela tank (N=20, National Aquaculture Development Authority) with no known episodes of blooming (in 2024 or recent past) were analyzed as a reference. The liver somatic index (LSI), Fulton's condition factor (K) and erythrocyte nuclear abnormalities (ENA) were assessed in individual fish and cell densities of *Microcystis* and two other cyanobacteria were estimated in the water samples. A significant induction of total ENA, including micronuclei, lobed nuclei (LN), blebbed nuclei (BN), bilobed nuclei (BL), notched nuclei (NN), kidney-shaped nuclei (KN) and fragmented apoptotic nuclei (AP) was found compared to the reference site, while there was no significant difference in LSI ($P>0.05$). One of the major cyanotoxin-producing genera, *Microcystis* was present both in Ridiyagama (average cell density 12.2×10^6 cell/mL) and Lunugamvehera (3.73×10^6 cell/mL). *Dolichospermum* spp. was observed only in Ridiyagama in much higher density (2.21×10^7 cell/mL). *Microcystis* cells were not detected in water samples collected from the reference site. *Cylindrospermopsis* spp. was observed in both reservoirs but apparently in very low density (not enumerated). Accordingly, total cyanobacterial count was significantly higher in Ridiyagama than in Lunugamvehera ($p<0.05$), whereas the same trend was observed in the total ENA as well. Principal Component Analysis (PCA) for samples from Ridiyagama indicated a positively associated cyanobacterial density loaded alongside BN, AP, and KN, but not with the total ENA. Samples from Lunugamvehera showed positive loadings of total cyanobacterial density alongside total ENA, LN, NN and KN. Accordingly, causal relationship of the cyanobacterial density on ENA was not confirmatory and requires further data collection. Fulton's K (mean ± SD) was different significantly among sites where the reference site (0.0022 ± 0.0002) was followed by Lunugamvehera (0.0020±0.0001), and Ridiyagama reservoir (0.0016±0.0001) ($p<0.05$). These results indicate that there may be an association of ENA and environmental stress of cyanotoxins, emphasizing the necessity of monitoring to mitigate the possible impacts of harmful algal blooms

Keywords: *Cyanotoxins, ENAs, Harmful algal blooms, Microcystis*

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*Corresponding author: anushikum77@gmail.com

Captive Wildlife Architecture as a Cognitive-Experiential Medium for Ex-Situ Conservation

Ranawaka R.A.T.S. [*].

Department of Architecture, Faculty of Built Environment and Spatial Sciences, General Sir John Kotelawala Defence University- Southern Campus, Sri Lanka

Captive wildlife facilities are purpose-built environments that promote ex-situ conservation by advancing primary aims of ecological awareness, education, and conservation ideologies. Yet, many continue to prioritise containment and operational efficiency over experiential design, limiting opportunities for deeper human engagement, thus resulting in the underutilisation of achieving those primary aims, especially in the Sri Lankan context. To address this gap, the study proposes a strategic framework that positions captive wildlife architecture as an active agent in ex-situ conservation. A three-phase methodology was applied where Phase I synthesised global literature on captive wildlife architecture and neuroarchitecture, deriving five core parameters: naturalism and enclosure quality, spatial narrative, learning and engagement, sustainability and resilience, and community participation. Phase II operationalised these parameters across three selected Sri Lankan sites: National Zoological Gardens of Dehiwala, Pinnawala Open Zoo, and Ridiyagama Safari Park, using spatial observations and guided interviews with four selected stakeholder groups comprising visitors, operational staff, architects, and zoo educators, with 12 participants each. Phase III triangulated the findings, revealing that naturalism and enclosure quality, along with spatial narrative, were the strongest, while sustainability and resilience ranked lowest. Learning and engagement, as well as community participation, showed moderate presence but weak implementation, particularly at Ridiyagama. Based on these insights, a five-strategy framework is proposed: layered visibility, spatial programming, integration of interactive elements, context-sensitive sustainability, and conservation as architectural narrative. This framework redefines captive wildlife environments as a cognitive-experiential medium that achieves those primary aims and strengthens long-term public commitment to biodiversity protection.

Keywords: *Captive Wildlife Architecture; Ecological Awareness; Ex-situ Conservation; Neuroarchitecture; Sustainability*

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*Corresponding author: <tashiiisranawaka983@gmail.com

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Diversity and Abundance of Potential Insect Vectors of Dog Haemoparasites in Selected Localities of Matara

Wijesinghe H.M.N.P.[1,2,*], Sudarshani K.A.M.[2], Wegiriya H.C.E.[3].

Department of Zoology, University of Ruhuna, Sri Lanka

Domestic dogs are important reservoirs of haemoparasites and play a role in sustaining insect vector populations, creating potential risks for both canine and human health. This study examined the diversity and abundance of potential insect vectors in ten sites of Matara District, Sri Lanka, where canine haemoparasites had been reported. Insects were collected monthly over eight months using CDC light traps with castor oil–coated sticky papers placed near a dog dwelling in each site. Captured specimens were identified morphologically, and diversity was assessed using Shannon–Wiener and Simpson indices. Five vector groups were recorded: mosquitoes, sand flies, moth flies, Ceratopogonidae, and midges. Species richness varied between 2 and 5 across sites, with Shannon index values ranging from 0.68 to 1.47. Sand flies included *Phlebotomus argentipes* (63.3%) the principal vector of visceral leishmaniasis and cutaneous leishmaniasis in Sri Lanka and *Sergentomyia* species (36.7%) of limited epidemiological significance. Mosquito collections revealed *Anopheles culicifacies* (30%) and *Culex quinquefasciatus* (27%) as dominant species, both implicated in filarial transmission. *Ceratopogonidae* (181) were more abundant than midges (73) at most sites, with marked peaks (e.g., 68 individuals at Beach Site), reflecting their potential role in pathogen transmission, while midges mainly served as ecological indicators. The presence of diverse vector species in dog habitats highlights the risk of sustained transmission of *Leishmania* and *Dirofilaria* in the region. These findings emphasize the need for integrated vector surveillance and management strategies, including dog-targeted interventions, to reduce the burden of canine and zoonotic vector-borne diseases.

Keywords: *Insect vectors, Sand flies, Mosquito, Ceratopogonidae, Midges*

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* Corresponding Author:*pimi8621@gmail.com*

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Hematological Alterations and Serum Resistin Associations in Dengue

Wanigarathna G.U.S.[1*], Weerasinghe P.S.D.[2], Welikala G.A.[2], Weeratunga P.N.[2], Rockwood N.[2], Pathirana S.L.[1], Handunnetti S.M.[1], Nitsche A.[3], Rajapakse S.[4], Fernando N.[1]

[1] Institute of Biochemistry Molecular Biology and Biotechnology, University of Colombo, Sri Lanka
[2] Faculty of Medicine, University of Colombo, Sri Lanka
[3] Robert Koch Institute, Germany
[4] Postgraduate Institute of Medicine, University of Colombo, Sri Lanka

The key hematological features of dengue include leukopenia and thrombocytopenia, with progression to severe disease often linked to elevated hematocrit (HCT) and plasma leakage. Resistin, a pro-inflammatory molecule, is implicated in various inflammatory and metabolic diseases, though its correlation with key hematological parameters of dengue remains poorly defined. In this prospective study, dengue fever (DF) and Dengue Hemorrhagic Fever (DHF) patients were recruited from National Hospital, Sri Lanka and Kaluthara Teaching Hospital after obtaining written informed consent (Ethical approval- EC/24/038). qPCR was performed for laboratory confirmation of dengue. Resistin levels were quantified using the ELISA technique. Platelet (PLT), white blood cell (WBC), HCT, and resistin levels were analyzed between the groups using SPSS version 22. Twenty DF and twenty DHF patients with mean illness durations of 4.7±1.17 and 5.95±1.19 days at recruitment were studied. This included 28 males and 12 females, with mean age of 30.6 years. PLT was significantly lower in DHF (36.5×10³/µL; IQR 44.3), than in DF (120.5×10³/µL; IQR 72.5, $p<0.001$), while HCT and resistin did not differ significantly. WBCs were higher in DHF; 5.63±2.67 (×10³/µL) than in DF; 3.38±1.14 (×10³/µL) ($p<0.05$). Resistin showed no associations with hematological parameters in DF, whereas showed a borderline negative correlation with PLT in DHF ($r=–0.440$, $p=0.05$). Although resistin and HCT were not significantly elevated in DHF, findings suggest a potential contribution to thrombocytopenia in DHF. WBC levels were also significantly lower in DF. Larger studies with broader biomarker profiling may clarify exact role of resistin in dengue pathogenesis and its importance as a prognostic marker.

Key words: *Dengue; Hematocrit; Platelet; Resistin; WBC*

**Corresponding author*: upekshawanigarathna@gmail.com

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Evaluation of coral and non-coral community structure and water quality of the southern coast of Kayankerni Marine Protected Area, Batticaloa, Sri Lanka

S.Priyanchanaa[1]*, T. Keerthanaram[1], K. Arjunan[1].

[1] Department of Bio-science, Faculty of Applied Science, University of Vavuniya, Sri Lanka

Kayankerni Marine Protected Area (MPA), located on the south-eastern coast of Sri Lanka, supports ecologically important coastal habitats, including coral reefs and associated benthic communities. This study aimed to quantify coral and non-coral benthic cover and document selected physio-chemical water quality parameters at designated sampling stations within the MPA. Benthic composition along a 1.5 km shoreline was assessed using systematic transects and underwater photographic sampling, and analyzed using Coral Point Count with Excel extensions *(CPCe, version 4.1)*. Five major transects for every 300m shoreline (each 50m perpendicular to the seaward) were established. Among these, major transects 3 and 4 were divided further into six systematic sub-transects (each 200m perpendicular to the seaward). A total of 30 point-count stations were evaluated within the six sub-transects. Both the Small Polyp Stony (SPS), *Acropora* and *Montipora* of Scleractinian corals were observed in the study area but, *Montipora* only found outside the transects. Mean coral cover of Genus *Acropora* was estimated at 36.34%, while non-coral components such as coral rubble and algal categories especially *Padina sp.*, comprising a substantial proportion of the non-coral cover for remaining. Water quality parameters, including pH, electrical conductivity, salinity, and turbidity *(7.95 ± 0.11, 50.34 ± 0.24 mS, 4.3 ± 0.03 Brix %, and 0.62 ± 0.045 NTU, respectively)*, were within ranges generally reported for coastal reef environments. Also, the observed *Acropora*, was in highly bleached state which may due to environmental stressors, primarily elevated sea temperatures which needs to be further studied. The findings provide a quantitative baseline of coral cover, benthic composition, and water quality conditions in the Kayankerni MPA, which may support future monitoring and management initiatives aimed at sustaining reef-associated biodiversity.

Keywords: *benthic composition; coral cover; coastal resource management; shallow coast; Kayankerni MPA*

**Corresponding author*: spchanaa28@gmail.com

Evaluating stool PCR as a non-invasive diagnostic tool for *H. pylori* in Dyspeptic patients: A Comparison with gastric biopsy PCR

V Vithushan[1], K Kolinsan[1], S Sinthuja[1], P Kaarunya[1], G P Amaya[1], S Kisnujan[1], S Saseevan[1*], TJ Ganakarunyan[1], FJ Mark Mithulan[2], R Ramachandran[2], A Kajendran[3]

[1]Department of Medical Laboratory Sciences, Faculty of Allied Health Sciences, University of Jaffna
[2]Department of Clinical Virology and Molecular Biology, Teaching Hospital, Jaffna
[3]Gastroenterology Unit, Teaching Hospital, Jaffna

Helicobacter pylori colonize in gastric mucosa and is a major cause for gastric carcinoma. Molecular detection of *H. pylori* DNA from gastric biopsies using PCR technique offers highly sensitive and specific diagnosis. However, due to its invasive nature, non-invasive methods are needed. This study aimed to compare the molecular detection of *H. pylori* infection using stool samples with gastric biopsies among dyspeptic patients attending to Gastroenterology clinic, Teaching Hospital Jaffna. This is a laboratory-based study included thirty-four dyspeptic patients with mean age of 57.79 ±14.4 years. Gastric biopsies and stool samples were collected after obtaining informed written consent. Genomic DNA was extracted using a silica-based spin column technique. The extracted DNA was subjected to real-time PCR targeting the *H. pylori* specific *UreA* gene. A known *H.pylori* DNA was used as a positive control. *H. pylori* DNA was detected in 29.4% (*n*=10) gastric biopsies of patients using PCR, while only 8.8% (*n*=3) were positive by stool PCR. All stool-positive patients were shown biopsy-positive. Biopsy PCR was considered as gold standard method and the sensitivity, specificity, positive (PPV) and negative predictive values (NPP) for stool PCR were 30%, 100%, 100% and 77.4% respectively. Concordance analysis shows a fair agreement between stool PCR and biopsy PCR (k=0.38). Stool PCR showed high specificity and PPV indicating that positive results are highly reliable. Low stool PCR sensitivity may reflect limited *H.pylori* survival in the lower gastrointestinal tract due to an unfavorable environment and commensal competition. Thus, stool PCR has limitations as non-invasive confirmatory test for diagnosis. Negative cases require biopsy-based confirmation, especially in symptomatic patients.

Key words - *Gastric Biopsy, Helicobacter pylori, Polymerase chain reaction, UreA, Stool*

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Growth Performance of Sea Cucumber (*Holothuria scabra*) Juveniles Fed with Seaweed Based Feeds In Indoor Nursery Culture

Keerthana S[1*], Patrick A E S[1], Thulasitha W S[2] , Thamiliny H A[3], Nirooparaj B [4]

[1]Department of Bio-Science, Faculty of Applied Science, University of Vavuniya,
[2]Department of Zoology, Faculty of Science, University of Jaffna,

[3]Suganth Sea Food (Pvt) Ltd, Jaffna,

[4]National Aquaculture Development Authority of Sri Lanka

The global demand and high commercial value of sea cucumber (*Holothuria scabra*) have exerted heavy pressure on wild populations, resulting in overharvesting. To reduce these impacts, cultivating *H. scabra* has become an important approach for both conservation and production. A key requirement for successful indoor nursery culture is the use of practical, cost-effective, and locally available feed for producing healthy juveniles. This study evaluated the growth performance of *H. scabra* juveniles under three seaweed-based feed treatments (T_1, T_2, T_3) and a control in an indoor. Experimental feeds were prepared with varying proportions of three seaweeds and sea mud: T_1 (*Sargassum* sp.: *Gracilaria* sp.: *Kappaphycus* sp.: Sea mud = 4:3:2:1), T_2 (2:4:3:1), T_3 (3:2:4:1), and the control with sea mud alone (100%). A total of 240 juveniles of similar age and genetic background were distributed among 12 tanks. Juveniles (initial weight: 2.46 ± 0.09 g) were reared for eight weeks in three replicates (20 individuals per 120L tank), with uniform water quality maintained throughout the experiment. Juveniles were fed daily at a rate of 8% of their body weight, with feed quantity adjusted. Among the treatments, T_3 (containing 40% *Kappaphycus* sp.) yielded the highest growth performance, with a mean final weight of 26.33 ± 0.49 g ($p<0.05$), a growth rate of 0.39 ± 0.01 g day^{-1} ($p<0.05$), and the lowest food conversion ratio (2.62 ± 2.13, $p<0.05$). These findings suggest that seaweed-based feeds, particularly those incorporating *Kappaphycus* sp., enhance juvenile growth, whereas sea mud alone (control) is nutritionally inadequate.

Key Words: Juveniles, Nursery culture, Sea cucumber, Seaweed-based feeds.

Utricularia Gibba as a Natural Mosquito Control Agent: Larval Handling Time and its Effects on Mosquito Oviposition Preferences

Dhananjaya, D.G.S.[1], Munasinghe, D.H.N.[1], De Silva, W.A.P.P.[2], and Chathuranga, W.G.D.[1*]

[1]*Department of Zoology, Faculty of Science, University of Ruhuna, Matara, Sri Lanka*

[2]*Department of Zoology, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka*

The carnivorous plant genus *Utricularia* possesses the ability to capture a wide range of prey, resulting in their death primarily through anoxia. This study evaluated the larval handling potential of *Utricularia gibba* (Humped bladderwort) against all four instars and the pupal stage of *Aedes albopictus* (Skuse, 1894); a secondary dengue vector in Sri Lanka. *Aedes* eggs were collected using ovitraps, and were reared under controlled laboratory conditions (12:12 h light–dark photoperiod). Larvae were fed daily with finely ground fish food (TetraMin Tropical Flakes, Tetra, Melle, Germany) on per-capita basis. Samples of *U. gibba* were collected from muddy paddy fields in Ginnaliya, Sri Lanka, and identified using a standard field guide. To assess larval handling time, *U. gibba* shoots with five bladderworts were placed in cups containing 50 ml of dechlorinated water, each with 20 mosquito larvae or pupae in ten identical replicates. Time between successive prey captures was recorded. For oviposition preferences, ten pairs of ovitraps (with and without *U. gibba*) were placed in natural settings. A significant difference in prey handling time was observed (Kruskal-Wallis Test) across the larval stages of *Ae. albopictus* ($p = 0.000, df = 3$): 11.4 ± 2.37 h (1st instars), 14.1 ± 4.01 h (2nd), 19.8 ± 2.10 (3rd), and 20.1 ± 10.96 h (4th), where *U. gibba* was more efficient against early larval stages. The results of the Two-sample t-test revealed that, Oviposition did not differ significantly ($p = 0.625$, T value = 0.50, $df = 14$) between cups with *U. gibba* (70.2 ± 13.0 eggs) and controls (62.7 ± 7.8). These results indicate that *U. gibba* possesses promising potential as a natural, biocontrol agent for sustainable dengue mosquito vector management, without influencing mosquito oviposition preference.

Keywords: *Aedes albopictus, Bladderworts, Dengue vectors, Prey handling time, Utricularia gibba*

**Corresponding author*: *chathurangawgd@zoo.ruh.ac.lk*

Determination of the effectiveness of bio transformed shellfish waste as an enriched Artemia feed on the growth performance and color enhancement of Platy fish (*Xiphophorus maculatus)*

Kularathne R.H.M.N.[1]*, Senaarachchi W.A.R.K.[2], De Silva M.P.K.S.K.[1]

[1] *Department of Zoology, Faculty of Science, University of Ruhuna, Matara, Sri Lanka.*

[2] *Agri Farm Elevators (Pvt)Ltd, 302, D/1, Alubadda, Awkana, Sri Lanka.*

The shellfish waste generated during processing is a rich source of carotenoproteins. The present study evaluated the effectiveness of bio transformed *Penaeus monodon* waste as an enriched Artemia feed on the growth performance and color enhancement of Platy fish. Shellfish waste was ground, autolyzed for 20 minutes at 55^0 C and the filtrate obtained was dried. Optimized enrichment concentration of the dried filtrate was 0.5g/L. Total length and the gut fullness of Artemia was recorded for six consecutive hours during enrichment. One month old platy fish having initial average weight (0.2606 ± 0.008 g) and length (19.5861 ± 0.0326 mm), were randomly assigned to six glass tanks in triplicate, with fourteen fish per tank. Fish in treatment 1 (T1) were fed with unenriched Artemia larvae and fish in treatment 2 (T2) were fed with carotenoprotein enriched Artemia larvae twice per day for 35 days. Weight and length measurements of platy fish were taken weekly and every two weeks respectively. Images of randomly selected fish were taken by a phone camera (2.02.072, Galaxy A03) kept at a constant height, with the same light intensity and exposure time. The skin color intensity of the fish was analyzed with "ImageJ" software. A significantly higher ($P < 0.05$) gut fullness to total length ratio was observed in enriched Artemia compared to those of unenriched. However, no significant difference was observed in any of the growth parameters between fish in T1 and T2. Higher values for red, green, and blue colors were observed in T1 with no significant difference during the short study period.

Keywords: *Artemia enrichment, Bio transformation of shellfish waste, Carotenoprotein*

**Corresponding author*: madushikularathne6@gmail.com

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An Approximate Riemann Solver for the Isentropic Euler Equations in the Low Mach Number Regime

Nisansala K.A.S.[1,*], Abeyratne M.K.[2], Fernando M.C.S.[1]

[1] Department of Mathematics, Faculty of Science, University of Kelaniya, Sri Lanka.

[2] Department of Mathematics, Faculty of Science, University of Ruhuna, Sri Lanka.

The accurate numerical simulation of compressible flows at low Mach numbers remains a challenging task due to stiffness arising from disparate wave speeds and the limitations of conventional explicit schemes. Capturing the correct asymptotic behavior as the Mach number approaches zero is essential for achieving both stability and physical fidelity in computational fluid dynamics. In this study, we investigate the numerical behavior of the isentropic Euler equations in the low Mach number (ε) regime using an approximate Riemann solver. The asymptotic properties of the system are examined under periodic boundary conditions. We develop a semi-implicit time discretization within the Roe solver framework to efficiently handle the system. The method approximates the original nonlinear system by a linear system with constant coefficients, while exactly preserving the initial conditions. For the discretization of the system, a partially implicit flux function is employed. The pressure term is decomposed into implicit and explicit components using an ad-hoc parameter α to suppress non-physical oscillations. Einfeldt speeds are applied to the Roe scheme to enforce the entropy condition. Classical explicit schemes remain stable only for very small-time steps, following the CFL condition $\Delta t = O(\varepsilon \Delta x)$, whereas the semi-implicit scheme enhances both efficiency and stability. The semi-implicit Roe scheme is validated by comparison with the classical explicit Roe scheme using fine spatial and temporal resolutions. The comparison shows that the semi-implicit scheme produces stable and accurate solutions across a range of Mach numbers, including very low Mach number regimes (e.g., $\varepsilon = 0.05$). Furthermore, preconditioning techniques can be applied to stabilize the Roe scheme in extremely low Mach number regimes.

Keywords: *Approximate Riemann Solver; CFL condition; Mach number;*

**Corresponding author*: nisansalak@kln.ac.lk

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A Novel Hybrid Cryptosystem Combining RSA, Elliptic Curve Cryptography, and the Chinese Remainder Theorem

Madhuwanthi K.H.K.*, Ranasinghe P.G.R.S.

Department of Mathematics, Faculty of Science, University of Peradeniya,
Peradeniya, Sri Lanka

Cryptography is essential for secure communication in modern digital systems, protecting sensitive information from unauthorized access. Among the public-key cryptographic schemes, RSA and Elliptic Curve Cryptography (ECC) are widely used due to their strong mathematical foundations; however, RSA suffers from high computational cost during decryption, while ECC relies on a single hardness assumption. The present study aims to overcome these limitations by proposing a hybrid cryptosystem that integrates RSA, ECC, and the Chinese Remainder Theorem (CRT) into a unified framework to enhance both security and efficiency. First, the plaintext is masked using an ECC-derived shared secret key before being encrypted with RSA, while CRT is applied during decryption to accelerate modular exponentiation. The security of the system is based on two independent cryptographic assumptions: the difficulty of integer factorization underlying RSA and the elliptic curve discrete logarithm problem underlying ECC, ensuring that compromising a single component does not reveal the plaintext. Compared to conventional RSA, the use of CRT improves the decryption performance, mitigating RSA's primary drawback. In contrast to standalone ECC, the hybrid approach provides an additional layer of protection through RSA-based encryption, strengthening resistance against cryptanalytic attacks and enhancing private key confidentiality. Furthermore, the scheme is flexible, allowing different elliptic curves and parameter selections to be adopted according to application requirements. By achieving a balanced combination of improved security and practical efficiency, the proposed hybrid cryptosystem is well suited for real-world applications such as secure messaging and electronic transactions.

Keywords: *Chinese Reminder Theorem (CRT); Elliptic Curve Cryptography (ECC); Hybrid Cryptography; RSA Cryptography*

**Corresponding author*: s19434@sci.pdn.ac.lk

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A study on fuzzy pre β-continuous functions in fuzzy topological spaces

Umadevi S.[1], Arunmaran M.[2*], Kannan K.[3]

[1,2,3] Department of Mathematics and Statistics, University of Jaffna, Sri Lanka

Based on the fuzzy set theory introduced by L. A. Zadeh in 1965, C. L. Chang proposed the concept of fuzzy topological spaces. For a non-empty set X, a fuzzy topology is defined as a family τ of fuzzy subsets that includes the empty set 0_X and the whole set 1_X, and permits an arbitrary union and a finite intersection of its elements. Then, the pair (X, τ) is called a fuzzy topological space. A. E. Monseb, S. N. El-Deeb, and R. A. Mahmould introduced fuzzy β-open sets and β-continuous mappings. This work aims to introduce and study fuzzy pre β-continuous mappings in fuzzy topological spaces. For two fuzzy topologies τ and σ defined on the non-empty sets X and Y, the map f: $(X, \tau) \rightarrow (Y,\sigma)$ is said to be fuzzy pre β-continuous, if $f^{-1}(V)$ is fuzzy pre β-open set in X for each fuzzy open set V in Y. Also, we show some equivalent conditions for fuzzy pre β-continuous mappings, and establish some relationships between fuzzy continuous mappings, fuzzy α-continuous mappings, and fuzzy β-continuous mappings. We prove that every fuzzy continuous function is fuzzy pre β-continuous; every fuzzy pre β-continuous function is fuzzy β-continuous; every fuzzy α-continuous map is fuzzy pre β-continuous. Moreover, we investigate some new properties regarding the composition of fuzzy pre β-continuous mappings, and provide counterexamples to show the noncoincidence of these mappings. In future work, we aim to study fuzzy λ-open sets and fuzzy λ-continuous functions.

Keywords: *Fuzzy topology; Fuzzy pre β-open sets; Fuzzy pre β-continuous; Fuzzy β-continuous; Fuzzy α-continuous.*

**Corresponding author*: marunmaran03@gmail.com

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Application of Weighted Goal Programming for Optimizing School Meal Plans in Sri Lanka

Hettiarachchi L.H.D.C.M. *, ***Samarathunga D.M.***
Department of Mathematics, University of Ruhuna, Sri Lanka

This study develops a Weighted Goal Programming (WGP) model to optimize meal plans recommended by Ministry of Education, Sri Lanka for primary school children, ensuring nutritional balance while minimizing deviations from recommended nutrient level and food quantities. The Ministry of Education, Sri Lanka published the *Manual on School Nutrition Programme* in 2020. This manual proposed school meal plans on a daily basis among school children targeting to improve attendance, learning, and physical and mental development for needy students. Our aim in this study is to address the nutritional analysis for the proposed meal plans using goal programming techniques. The model addresses the challenge of providing nutrient rich meals using locally available food in Sri Lanka, such as kekulu rice, kathurumurunga leaves, dry fish, cowpeas, coconut, oil, papaya and milk packets. The aim of the constructed model is to find the daily amount of foods needed to be served for each meal plan suggested by the nutritional program setting the suggested amount as the goals. Constraints include nutrient requirements based on 1/3(since one meal per day) of daily allowances for children, food quantity targets, hard bounds on portion size, and upper limits on certain nutrients to prevent excesses. The objective function prioritizes key nutrients like energy, protein, vitamins, and minerals, with higher weights assigned to goals such as energy and protein intake. The proposed model considered daily and weekly meal plans, accounting for variations in meal composition over these periods. Result demonstrates meal plans providing the required amount of food item in each meal plans, daily that closely achieve main nutrient targets, with minimal deviations, highlighting the model's potential to support school meal programs by improving health outcomes and resource efficiency.

Keywords: *Meal Optimization; Primary; School Nutrition; Sri Lankan Foods; Weighted Goal Programming*

**Corresponding author*: hettiarachchi11453@usci.ruh.ac.lk

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Cayley Graph - Shortest Path Masking for Elliptic Curve ElGamal Encryption

Ranasinghe P.G.R.S., Aryarathna S.C.
Department of Mathematics, Faculty of Science, University of Peradeniya, Sri Lanka

Building on Taher El Gamal's 1985 discrete logarithm-based cryptosystem, we present a variant that combines Elliptic Curve Cryptography (ECC) with Cayley Graph (CG) structures, and Shortest Path Masking (SPM). Messages are first encoded as unique points on an elliptic curve over a finite field via deterministic encoding. Encryption then computes, using the CG of the curve, the shortest path from the group's identity element to the encoded message point. This path is used in the SPM mechanism, which masks the message by adding intermediate node values along the path. This layered design enhances security beyond standard ECC ElGamal. We confirm feasibility through numerical calculations on a standard elliptic curve in a finite field. Although path finding increases computational cost, the scheme leverages the dual difficulty of the discrete logarithm and shortest path problems for significantly improved security. Moreover, encryption and decryption preserve the message and produce an authentication tag point for integrity. The resulting balance between efficiency and heightened security makes the method particularly suitable for secure messaging and Internet of Things applications, where lightweight yet robust encryption is essential.

Key words: *Cayley Graph, ElGamal encryption, Elliptic Curve Cryptography, Shortest Path Masking*

**S.C. Aryarathna*: s19314@sci.pdn.ac.lk

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A Computational Study of Product and Pentagonal Sum Forms of Dedekind Eta Function Transformation Formula

Pabasara T.M.Y.L.[1*], Ranasinghe P.G.R.S.[1].

[1] Department of Mathematics, Faculty of Science, University of Peradeniya, Peradeniya.

The Dedekind eta function $\eta(z)$, introduced by Richard Dedekind in 1877, is a modular form of weight $1/2$ defined on the upper half-plane. Originally expressed as an infinite product, $\eta(z)$ is also written as a summation using Euler's Pentagonal Number Theorem, reflecting the interplay between combinatorial number theory and modular analysis. A key feature of the eta function is how it changes under the modular group $PSL(2,Z)$ especially the inversion $z \mapsto -\frac{1}{z}$ leads to the Dedekind functional equation, which involves a scaling factor and a root of unity, both of which are determined by Dedekind sums. In literature, this equation has been established using several methods, emphasizing its importance in the theory of modular forms. In this study, we revisit the Dedekind functional equation through a computational approach. Both the product and the pentagonal formulae definitions of $\eta(z)$ are implemented in Python, and their behavior under inversion is tested numerically. Our results confirm that the two forms yield consistent values and satisfy the functional equation. The accuracy of the inversion formula is quantified by computing the relative error between the two sides of the equation, and it confirms that the inversion formula is satisfied to a high degree of precision, with the relative error typically of order 10^{-30} to 10^{-40}. The 2D graphical visualizations further illustrate this agreement and show that deviations near the real axis arise from computational limitations. This study highlights how modern computation reaffirms classical identities and provides new insights into their numerical behavior, bridging historical theory with contemporary methods.

Keywords: *Dedekind Eta Function; Dedekind Functional Equation; Modular Forms; Pentagonal Number Theorem; Transformation formula*

**Corresponding author*: yashodhyalp@gmail.com

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On the Partial Automorphisms of Edge-Colored Directed Multigraphs

Irshad M.I.*[1,2,*]*, Chathuranga K.M.N.M.*[3]*, Athapattu A.M.C.U.M.*[3]*.

[1] Department of Mathematics, The Open University of Sri Lanka, Nawala, Nugegoda, Sri Lanka

[2] Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka

[3] Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka

The study of symmetries of graphs has traditionally centered on automorphisms, which capture global adjacency-preserving permutations of the vertex set. While graph automorphisms describe global symmetries, in many contexts it is too restrictive to require that a symmetry act on the entire graph. Especially for complex graphs, the automorphism group often tends to be trivial. This motivates the study of local symmetries, partial automorphisms, which generalize global automorphisms by allowing local symmetries between induced subgraphs. Their flexibility makes them a powerful tool for uncovering local structural properties, such as characterizing the local symmetries of aperiodic tiling or the approach to the graph reconstruction conjecture as a problem of partial symmetries, which may not be visible at the global level. Partial automorphisms are defined as isomorphisms between induced subgraphs, and they naturally form an inverse semigroup under composition. In the literature, several notions of partial automorphisms of graphs have been introduced by different authors. Building on this foundation, this study proposes two new types of partial automorphisms that further extend the framework for analyzing local symmetries in graphs. Specifically, we introduce the Color-Restricted Partial Automorphism of edge-colored digraphs and the Color-Permuting Partial Automorphism of edge-colored digraphs. Moreover, we prove that every inverse semigroup embeds naturally into the inverse semigroup of color-preserving partial automorphisms of its Cayley Color Graph.

Keywords: *Cayley graphs; Edge-colored diagraphs; Inverse semigroups; Partial automorphisms*

**Corresponding author*: miirs@ou.ac.lk

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AN ODE MODEL TO STUDY SINGLE BANK DEPOSITS AND LOAN DYNAMICS

Senanayake N.A.H.C., Senagiri R.G.P.S., Keshalini T., Hemachandra J.M.U.M., Hansani K.G.P. *

Department of Mathematics, Faculty of Science, University of Ruhuna, Sri Lanka

Understanding the dynamic relationship between deposits and loans is vital for individuals managing personal finances, particularly in the presence of external cash inflows. Accordingly, this study was focused on an Ordinary Differential Equation (ODE) model to represent how deposits and loans evolve from an individual perspective. The model incorporated key financial parameters such as interest rates on deposits and loans, withdrawal rates, loan repayment rates, and external cash inflows. Using the eigenvalue and eigenvector method, the model was initially solved, and the stability of the system was determined. The zero steady state represented an equilibrium in which there were no net changes in deposits and loans. The negative eigenvalues of the system matrix indicated that any deviation from this state decays over time, leading to stable loans and deposits level. Accordingly, numerical simulations were performed using the classical fourth order Runge Kutta (RK4) method due to its high accuracy and stability for small step sizes. The results demonstrated that deposit balances increase steadily due to continuous cash inflows, while loan balances decrease exponentially as repayments occur over time. The sensitivity analysis showed that the deposit interest rate and the loan interest rate strongly influence the system's dynamics. Higher deposit interest rates and external cash inflows increase savings, while higher loan interest rates accelerated the decline of outstanding loans. Overall, the study shows that the proposed ODE model can clearly represent how an individual's finances change over time. It can also serve as a base for tools that help people understand how their savings and loans may change under different economic conditions.

Keywords: *Deposit–Loan Dynamics, Financial Modelling, Ordinary Differential Equations (ODE), Personal Loans, Runge Kutta Method*

**Corresponding author*: prasadi@maths.ruh.ac.lk

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Assessment of the Incidence Rate and Causative Factors for Hospital Readmissions at National Hospital Galle

Abeyrathne S.L.D.W.[1*], Payas. A.L.M.[1], Fernando G.H.S.[2], Sabapathige R[3], Bandara W.V.R.T.D.G[1]

[1]Faculty of Allied Health Sciences, University of Ruhuna, Sri Lanka

[2]District General Hospital, Matale, Sri Lanka

[3] National Hospital, Galle, Sri Lanka

Hospital readmission refers to any unplanned admission within 30 days of discharge for the same condition. Readmission rates and its causative factors are useful to measure the quality of health care and accountability. This cross-sectional study was conducted among the patients who readmitted to National Hospital Galle (NHG), within 30 days of discharge, regarding same disease condition. Patients of dialysis ward and Oncology unit were excluded. A pre-tested self-administered questionnaire was used for data collection. Hospital management system was used for patient identification. Data were analyzed using SPSS version 25.0, applying descriptive statistics, Pearson correlation, and Chi-square tests. Over the seven days of study period a total of 4492 patients were admitted to the NHG. Among them 946 patients were readmitted**,** resulting in a readmission rate of 21.06%**.** Notably, 19.08% (n=847) of these readmissions were planned**,** including scheduled follow-up treatments or procedures. And 1.98% (n=89) were unplanned readmissions which indicates potential gaps in patient care and management. Elderly population (age ≥65 years) accounted for the majority of readmissions. Patients with multiple chronic conditions such as diabetes, hypertension, and heart failure exhibited a significantly higher rates of readmission. Patients discharged within five days had an increased risk of returning to the hospital, possibly indicating premature discharge or inadequate post-discharge care. Patient satisfaction assessments showed lower scores among readmitted patients, especially regarding communication with healthcare staff and clarity of discharge instructions. Findings concluded that, general readmission rate of NHG is 21.06% with unplanned readmission rate of 1.98%. Readmissions were significantly associated with patients' dissatisfaction with post-discharge support and discharge communication, underscoring the timely need for improving patient education and follow-up.

Keywords: *Incident rate, Causes, Hospital readmission*

**Corresponding author: dinithiwimansa3@gmail.com*

Short-Run and Long-Run Dynamics between Exchange Rates and Share Prices in India: Evidence from Daily Data (2010–2024)

***N.W.P.C GUNARATHNA*[1*]**

[1]Department of Mathematics, Faculty of Science, University of Ruhuna, Sri Lanka.

This study investigates the short-run and long-run relationships between exchange rate movements and share prices in India, with particular emphasis on the direction of causality between the USD/INR exchange rate and the NSE Nifty 50 stock index. Daily data from 2010 to 2024 are analysed using time-series econometric techniques. Stationarity properties of the variables are examined using the Augmented Dickey-Fuller (ADF) test, which reveals that both exchange rates and share prices are non-stationary in levels but become stationary after first differencing. The Johansen cointegration approach, employing both trace and maximum eigenvalue statistics, provides limited evidence of a single long-run cointegrating relationship between the variables. However, the associated loading coefficients are very small, indicating weak adjustment toward the long-run equilibrium. To capture both long-run and short-run dynamics, a Vector Error Correction Model (VECM) is estimated, revealing significant long-run adjustment behaviour, with share prices responding more strongly to deviations from equilibrium than exchange rates, while short-run effects remain lag-specific and limited. Granger causality analysis indicates a bidirectional causal relationship between exchange rates and share prices, with exchange rates exerting a stronger predictive influence on stock market movements. Overall, the findings suggest that although a long-run link exists between exchange rates and share prices in India, the adjustment process is weak, and exchange rate fluctuations play a dominant role in influencing stock market behaviour.

Keywords: *Exchange rate; Share price; Johansen cointegration; Vector Error Correction Model*

**Corresponding author: chathugunarathna96@gmail.com*

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Optimal Radiotherapy Treatment for Cancer through an Impulsive Mathematical Model

Thilakarathne T.M.C.S *, ***Somathilake L.W***
Department of Mathematics, University of Ruhuna, Sri Lanka

Cancer remains a major health issue around the world and radiotherapy continues to play a vital role in its treatment. One of the challenging problems in clinical practice is developing ways to deliver the radiation that kills the cancer cells while not harming healthy tissue. Since the treatment often occurs in individualized sessions, there is a strong need for mathematical models that capture the dynamic management of treatment regimens and offer recommendations for best dose planning. In this study, we address this challenge by applying an existing mathematical model that describes tumor growth, recovery of normal tissue, and the effects of repeated radiotherapy doses. We used this model to evaluate and design effective treatment strategies focusing on optimize radiotherapy dosage schedule. This is achieved by formulating an optimization problem that incorporates dose controlled treatment variables and solving it numerically to determine schedules that maximize cancer cell reduction while preserving healthy tissue. Based on the chosen parameter values, the model results indicate that the optimal radiotherapy strategy achieves an approximately 40% greater reduction of cancer cell population than conventional treatment strategies.

Keywords: *Cancer Treatment Modeling, Impulsive Radiotherapy, Optimal Dose Control.*

**Corresponding author*: chamodisadanika5@gmail.com

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Forecasting Rice Production using SARIMA and Residual Bootstrapping

Darshani G.H.V.C.*, L.A.L.W. Jayasekara
Department of Mathematics, Faculty of Science, University of Ruhuna, Wellamadama, Matara, Sri Lanka

Forecasting agricultural production is a crucial step in ensuring national food security and formulating sustainable agricultural policies. Rice is the staple food in Sri Lanka and is highly sensitive to climatic and economic changes, particularly during the Yala and Maha seasons. While SARIMA models are effective in capturing seasonality and trends in time series data, their performance can be weakened by residual heteroscedasticity and autocorrelation as indicated by Ljung Box test, leading to greater uncertainty. This study addresses these limitations by residual bootstrapping to re-sample residuals, thereby strengthening the model and generating more precise prediction intervals. Using semi-annual rice production data (1952–2024) measured in thousand metric tons, the unit root testing, autocorrelation analysis, and model diagnostics checks identified SARIMA $(0,0,1)$ $(0,1,1)_2$ as the optimal model. The model residuals were then bootstrapped to produce resampled series, enabling improved estimation of uncertainty. The findings reveal that the traditional SARIMA forecast for the 2028 Maha season produced a confidence interval of 2,335,274 to 3,270,809 metric tons, whereas the SARIMA bootstrap hybrid forecast yielded a narrower uncertainty between 2,716,750 and 3,040,050 metric tons for the point estimate of 2,866,920 metric tons, reflecting enhanced interval reliability. These findings suggest that the hybrid approach offers a more robust tool for supporting agricultural and export planning and resource allocation.

Keywords: *Rice Production; SARIMA; Residual Bootstrapping; Uncertainty*

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*Corresponding author: ghvcharithadarshani@gmail.com

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Bartlett's Correction for Enhancing Coverage Accuracy in Interval Estimation for Robust Versions of Lorenz curve

W.A.R. De Mel*[1]*, T.L.S.M. Sathsarani [1,*].

[1] Department of Mathematics, University of Ruhuna, Matara, Sri-Lanka.

The Lorenz curve maps how the distribution of income or wealth differs from perfect equality, with the diagonal line representing perfect equality and any variation from it reflecting varied levels of inequality. Under inference about the Lorenz curve, standard methods lead to biased estimation and poor coverage of confidence intervals in the presence of outliers. To address this, three robust versions of the Lorenz curve utilize quantile measures rather than the mean to ensure stability against extreme data. These versions are enhanced by the influence function-based empirical likelihood (IFEL) method, which provides rigorous interval estimation with non-parametric flexibility. While IFEL effectively manages skewness in large datasets, it faces limitations in small or moderate samples, where its Chi-square calibration often causes statistical undercoverage and diminished performance. The Bartlett's scale correction, which involves multiplying the empirical log likelihood ratio by a correction factor derived using the highest order moment terms, is used to improve finite sample performance. This adjusts a better limiting approximation of the novel test statistics into the Chi-square distribution. The comparison of the existing and Bartlett corrected methods is done using simulated data from the R statistical software. Simulation studies using heavy-tailed (Pareto-II(3,1)) and light-tailed (Weibull(2,1)) data demonstrated that Bartlett's correction enhances the coverage accuracy; implementing higher-order corrections is vital for robust and reliable finite sample analysis. From a policy perspective, results reflect genuine uncertainty, enabling more evidence-based and equitable decision-making in areas such as tax reform, welfare targeting, and poverty alleviation.

Keywords: *Bartlett's correction, Coverage Probabilities, Empirical Likelihood, Influence Function, Lorenz curve.*

**Corresponding author*: sasini.maduranga22@gmail.com

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Nomophobia predicts lower GPA: A robust path analysis of students in the Faculty of Science, University of Ruhuna

Edirisinghe L.*, Jayasekara L.

Department of Mathematics, Faculty of Science, University of Ruhuna, Sri Lanka

In the digital age, how smartphone use affects academic performance is a growing concern. This research investigates the associations between smartphone dependence, sleep disturbance, and study distraction with Grade Point Average (GPA) among students of the Faculty of Science at the University of Ruhuna, Sri Lanka. A cross-sectional survey using a self-administered questionnaire resulted in a final sample size of 166 (Level 2 and 3 undergraduates) selected via convenience sampling, validated by a participant-to-parameter ratio of about 12.8:1. Exploratory factor analysis, with parallel analysis and minimum residual extraction with oblimin rotation, reduced 16 items into 3 meaningful factors: nomophobia, sleep disturbance, and study distraction. To account for multivariate non-normality, path analysis with robust maximum likelihood estimation and bootstrapping with 5,000 resamples was employed to model the direct associations of these factors and demographic variables (gender, year, program) with GPA. Mediation analysis was conducted by extending the path model utilizing 5,000 bootstrap resamples. Model fit was confirmed using absolute and incremental indices. The results indicated that nomophobia had a significant negative direct association with GPA (β=-0.159, p=.039), while sleep disturbance and study distraction did not show significant direct effects. Among demographics, gender was a significant predictor, with female students outperforming males. Mediation analysis revealed that the effect of nomophobia on GPA was direct rather than mediated by sleep or distraction. The study concludes that psychological dependence on smartphones (nomophobia) is a significant negative predictor of academic performance among students in the Faculty of Science at the University of Ruhuna.

Keywords: Nomophobia, Path Analysis, Robust Maximum Likelihood, Exploratory Factor Analysis

**Corresponding author*: edirisinghe11783@usci.ruh.ac.lk

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Principal Component Analysis for Ranking IPL 2022 Players Using Batting and Bowling Parameters

Prasangika K.D.*, Jayawardena J.M.T.N., Abeysinghe A.A.R.P. , Divya Y.D. , Rajapaksha R.M.C.M.
University of Ruhuna, Sri Lanka

Evaluating player performance in cricket, a multivariate and context-dependent sport, poses significant analytical challenges. The main objective of this study is to rank players from the Indian Premier League (IPL) 2022 using Principal Component Analysis (PCA) based on batting and bowling performance statistics. Data from 162 batsmen and 103 bowlers were analyzed using six batting parameters (Runs, Average, Strike Rate, Fours, Sixes, Half-Centuries) and four bowling parameters (Wickets, Bowling Average, Economy Rate, Bowling Strike Rate). Due to strong correlations among these variables, PCA was employed to reduce dimensionality and construct composite performance measures. All variables were standardized using z-scores prior to analysis to ensure equal contribution across different measurement scales. Based on eigenvalues and variance explained, first principal component (PC) explaining 74.7% of the variance was retained to rank batsmen, while first two PCs together explaining 86.3% were combined into a standardized index to rank bowlers. For batting, all variables loaded positively on the first PC, representing a general batting performance dimension. For bowling, the first PC contrasted wickets (negative loading) with bowling average and strike rate (positive loadings), and the second PC was dominated by a negative loading for economy rate. The PCA-based rankings identified Jos Buttler as the top batsman and David Willey as the top bowler in IPL 2022. This study, conducted in Sri Lanka, is among the first to apply PCA to IPL performance data and demonstrates a reproducible, data-driven framework for objective player ranking with applications in player evaluation and team strategy in T20 leagues.

Keywords: *Sports Analytics, Principal Component Analysis, IPL 2022, Player Ranking, Multivariate Statistics*

**Corresponding author: kdprasangika79@gmail.com*

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Comparative Analysis of ARIMA, ARIMA–GARCH, and LSTM Models for Stock Price Forecasting: Evidence from Sampath Bank PLC, Sri Lanka

Sewwandi S.W.T.*, Yapage N.

Department of Mathematics, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

Time series plays a key role as a widely used tool for forecasting in numerous areas including business and finance. However, the financial markets are highly volatile and dynamic, driven by both linear trends and nonlinear behaviors, which make predicting the movement of financial time series challenging. We investigate which selected forecasting approach better predicts stock price movements. It is known that ARIMA is widely used to capture the linear patterns in time series data. However, financial time series often display volatility clustering, fat-tailed (leptokurtic) distributions, and time-varying variance. ARIMA itself cannot fully capture these features. ARIMA-GARCH has been developed to overcome these limitations. The aim of the present work is to predict the daily closing stock prices of Sampath Bank PLC, using daily closing stock price data from September 2017 to September 2024. In the data set, the data corresponding to missing trading days, mainly due to holidays, were incorporated using cubic spline interpolation method to ensure the data continuity. Three appropriate forecasting approaches were explored namely, (i) ARIMA for linear trends, (ii) ARIMA (2,1,1)–GARCH (1,2) with a skewed-t distribution to capture volatility and heavy-tailed behavior, and (iii) LSTM networks for nonlinear dynamics and long-range temporal dependencies. The performance of these models was evaluated using *RMSE, MAE, MAPE,* and R^2. The results show that the LSTM demonstrated superior predictive accuracy, whereas ARIMA–GARCH effectively modeled volatility. ARIMA remained useful for interpretability but limited in handling nonlinear dynamics. These findings suggest that LSTM is better for accurate stock price prediction of Sampath Bank PLC.

Keywords: *Time series forecasting; Stock price prediction; ARIMA-GARCH model; LSTM model; Cubic spline interpolation.*

**Corresponding author*: sewwandit646@gmail.com

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A Comparative Analysis of Random Forest and Ordinal Logistic Regression for Rainfall Classification: A Case Study in Colombo, Sri Lanka

Kumari E.R.D.M.[1*], Jayasekara L.A.L.W.[1], Jayetileke H.L.[1] , Mendis M.M.P.[2]

[1]Department of Mathematics, University of Ruhuna, Sri Lanka

[2]Department of Meteorology, Colombo, Sri Lanka

Rainfall variability during Sri Lanka's inter-monsoon seasons poses major challenges for accurate prediction due to unstable atmospheric dynamics. Reliable daily rainfall classification is therefore critical for agricultural planning, flood risk mitigation, and climate-informed decision-making, particularly in highly vulnerable urban regions such as Colombo. Existing rainfall studies in Sri Lanka emphasize seasonal and monthly scales, offering limited comparative evaluation of advanced models for daily inter-monsoon rainfall classification. This study addresses this gap by systematically comparing Random Forest (RF) and Ordinal Logistic Regression (OLR) models for daily rainfall classification in Colombo during the first and second inter-monsoon seasons. Daily meteorological data from 2019–2023 were obtained from the Department of Meteorology, Sri Lanka, comprising 305 observations per season and 13 predictor variables. Rainfall was categorized into four ordinal classes: no rain, light, moderate and heavy. RF models were developed using Out-of-Bag error estimation, Grid Search and Genetic Algorithm (GA) optimization to enhance predictive performance. OLR models were fitted under proportional and partial proportional odds assumptions, with feature selection based on Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and Lasso regularization. Model performance was assessed using confusion matrices and goodness-of-fit measures. Results indicate that RF models consistently outperformed OLR across both seasons. The GA-optimized RF achieved accuracies of 94.23% and 91.07%, with specificities of 98.09% and 95.50% for the first and second inter-monsoon seasons, respectively. In contrast, Lasso-selected OLR models yielded lower accuracies 52.54% and 43% respectively, but offered greater interpretability of meteorological influences on rainfall. Overall, RF demonstrated superior predictive capability, while GA optimization further improved performance. Future work should investigate advanced ensemble methods, including Gradient Boosting and hybrid deep learning models, and extend the framework to multi-station and real-time operational forecasting.

Keywords: *Rainfall Classification, Random Forest, Ordinal Logistic Regression, Genetic algorithm*

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**Corresponding author*: *dmadushikakumari@gmail.com*

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Data-Driven Bayesian Modeling for Type 2 Diabetes Risk Assessment and Personalized Recommendations Using R Shiny

M.U.I. Salgado *, P.S. Haputhanthr, E.D.I. Wimansa, H.C.M. Samantha, A.W.L. P Thilan

Department of Mathematics, Faculty of Science, University of Ruhuna, Sri Lanka

Making early risk predictions for Type 2 Diabetes, a prevalent and growing health issue in Sri Lanka, is essential for timely intervention. Existing machine learning and logistic regression approaches primarily provide point estimates, leaving a critical gap in capturing predictive uncertainty necessary for reliable clinical decision-making. To address this challenge, this study aims to develop a Bayesian logistic regression–based application for diabetes risk assessment using R. To quantify uncertainty and improve long-term patient outcomes, the system provides real-time visualizations and personalized recommendations.The Bayesian model, implemented with the brms package in R, extends standard logistic regression by incorporating multiple health indicators, including age, BMI, number of pregnancies, Diabetes Pedigree Function, glucose, blood pressure, skin thickness, and insulin within a probabilistic framework. Model training was conducted using the Pima Diabetes dataset from Kaggle, which contains no missing values. The system has been deployed as an interactive Shiny web application, allowing patients and clinicians to input health data and receive personalized risk probabilities along with tailored recommendations. When certain variables are missing (e.g., Diabetes Pedigree Function), the application can either calculate them using additional formulas or fit a simpler model with the available predictors. This flexibility enables users to evaluate the model under different input scenarios while obtaining useful predictions.The Bayesian logistic regression model achieved accuracy comparable to the benchmark GLM (0.783) while showing modest improvements in AUC (0.840), Brier score (0.153), and log loss (0.470), indicating superior probability calibration and supporting its suitability for clinical decision support. Overall, this study demonstrates that a probabilistic, uncertainty-aware modeling approach, implemented as an accessible Shiny web application, can enhance diabetes risk assessment and provide actionable, personalized insights for patients and clinicians.

Keywords: *Bayesian Logistic Regression, brms Package, Diabetes Pedigree Function, Predictive Uncertainty* **Corresponding author*: uishanka11@gmail.com

**Corresponding author*: uishanka11@gmail.com

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Magnetic Energy Analysis of Simple Cubic Ferromagnetic Thin Films Using Fourth Order Perturbed Heisenberg Model

***Farhan M.S.M.*[1,*]*, Samarasekara P.*[2].**
[1] Department of Physical Science, Trincomalee Campus, Eastern University, Sri Lanka
[2] Department of Physics, University of Peradeniya, Peradeniya, Sri Lanka

Ferromagnetic thin films are fundamental to the development of magnetic memory and microwave devices, with their performance strongly influenced by easy and hard magnetization directions. This study investigates the magnetic properties of simple cubic (Sc) ferromagnetic thin films, representative of materials such as Fe-based and transition-metal ferromagnets, with three spin layers using a fourth-order perturbed classical Heisenberg Hamiltonian. The model incorporates key magnetic energy components, including spin exchange interaction, spin dipole interaction, second and fourth-order magnetic anisotropies, in plane and out plane applied magnetic fields, stress-induced anisotropy and the demagnetization factor. The magnetic parameters were chosen based on commonly used normalized values reported in earlier theoretical studies of cubic ferromagnetic thin films, allowing systematic analysis of layer-dependent effects. A simplified analytical form of the total energy equation is derived and evaluated for various magnetic parameter sets. MATLAB simulations are used to generate 2D and 3D plots illustrating the dependence of total magnetic energy on spin angle and demagnetization energy. For specific configurations, the energy values range from 10^8 to 10^{10} units. Results reveal that energy maxima occur at several discrete demagnetization values, with major maxima around $\frac{N_d}{\mu_0 \omega} = 47$ and 49. The minimum energy is consistently zero. Energy versus angle plots show maxima and minima at specific angles, with the most prominent maxima near 5.027 radians and minima around 0.5341 radians. Notably, the angular separation between magnetic easy and hard directions deviates from the expected 90°, indicating anisotropic behavior. Overall, the study highlights how variations in fourth-order anisotropy constants among spin layers significantly affect the total magnetic energy. The findings suggest that minimizing the anisotropy constant in the middle layer results in lower energy configurations. These insights are valuable for tailoring the magnetic properties of thin films in advanced technological applications.

Keywords: *Fourth order perturbed Heisenberg Hamiltonian; Magnetic anisotropy constant; Magnetic thin films; Demagnetization energy; Spin layers*

**Corresponding author*: farhanmsm@esn.ac.lk

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Investigation of Interfacial Tension of the Seawater-Kerosene Interface by Laser Light Diffraction

Dilshani R.A.N.[1], Weerasekara W. M. I. T. [1], Perera H.A.D.S.D.[1*].

[1] Department of Physics, University of Ruhuna, Sri Lanka.

This research investigates the surface tension of seawater and kerosene, and the interfacial tension of a thin kerosene film floating on seawater, using light diffracted from surface capillary waves. A pin attached to a speaker was used to generate surface capillary waves, which act as a dynamic grating on the surface of a liquid samples (seawater and kerosene). A laser beam of wavelength 630nm was directed at an angle toward this dynamic grating to obtain a diffraction pattern on a vertical wall. The diffraction pattern was analyzed under various excitation frequencies, to determine the surface tension of both liquids. The same procedure was repeated after introducing a thin film of kerosene onto the surface of seawater. After analyzing the diffraction pattern for various frequencies, the interfacial tension of the seawater-kerosene interface was estimated. The behavior of the interfacial tension was investigated for different thicknesses of kerosene layers. The surface tension of seawater and kerosene at 27 ^{0}C were calculated as (0.0756 ± 0.0035) Nm^{-1}and (0.0223 ± 0.0022) Nm^{-1}, respectively. Interfacial tension for several thicknesses of kerosene film, as 0.025 mm, 0.050 mm, and 0.100 mm, was estimated at 27 ^{0}C as (0.0467 ± 0.0041) Nm^{-1}, (0.0307 ± 0.0060) Nm^{-1}, and (0.0254 ± 0.0023) Nm^{-1}, respectively. Our results confirm that, at small kerosene layer thicknesses, the surface-mode wave propagation is influenced by the properties of both liquids in addition to the interfacial tension. Fitted data suggests an exponential decay function of the type $\sigma' = A_0 + Ae^{-t/b}$ for interfacial tension σ' against film thickness (t).

Keywords: *Surface Tension; Interfacial Tension; Seawater-Kerosene Interface;*

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**Corresponding author*: pererasd@phy.ruh.ac.lk

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Performance Evaluation of an Image-Based Semi-Automated System for Sustainable Recycling of Disposable Pens

Chamindu J.S.D.S[1], Bogamuwa K.M.T.A [1], Weerasinghe H.A.A.R[1], Thilakarathna K.H.P.W[1], De Silva K.T.KM[1]

[1] Department of Mechanical and Manufacturing Engineering, University of Ruhuna, Sri Lanka

Plastic waste from disposable pens poses a major environmental challenge in Sri Lanka, with approximately 100 million units discarded annually and limited recycling infrastructure. This study evaluates the feasibility of a semi-automated system designed to segregate, disassemble, and clean pen components to enhance material recovery and sustainable waste management. The primary research question examines whether such automation can achieve industrially viable recycling performance in the Sri Lankan context. Field surveys confirmed that back-loading pens constitute over 70% of disposed units, informing the design focus. The system integrates image-based recognition, pneumatic grippers, and chemical bath cleaning, with validation including finite element analysis, testing on over 8000 pen images, and experimental trials on 10 batches of 50 randomly selected pens under laboratory operating conditions. The image recognition module achieved a precision-recall AUC of 0.85, demonstrating robust classification performance. The prototype achieved a cycle time of 6 seconds per pen and successfully segregated components by material type, producing clean, sorted plastic streams suitable for downstream recycling. Overall, the results demonstrate the technical feasibility of semi-automated image guided pen recycling and its potential contribution to a circular economy for stationery plastics, with full-scale industrial testing required to confirm long term scalability.

Keywords: *Automated waste segregation; Plastic recycling; Image recognition; Circular economy implementation; Sustainable waste management*

Corresponding author: muthumali@mme.ruh.ac.lk

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Natural Dyes from Flame Violet Leaves as Light-Capturing Pigments for Dye-Sensitized Solar Cells

Kumara G.R.A.[1*], Kodithuwakku A.K.[1] , Kanchana B. L.[1] .

[1]National Institute of Fundamental Studies, Hanthana Road , Kandy, 20000, Sri Lanka

Solar cells offer a timely solution to the ongoing energy crisis. Silicon-based solar cells are the most prominent commercially available sources of solar power, but they are expensive and pose recycling challenges. In third-generation photovoltaics, Dye-sensitized solar cells (DSSCs) based on ruthenium metal complexes which are costly, toxic, and environmentally unfriendly have begun to employ organic dyes derived from plant pigments, providing a cost-effective and easily scalable way to convert sunlight into electricity. This study investigated Flame Violet (Episcia cupreata) leaves as a source of natural pigment for DSSCs. Fluorine-doped Tin oxide (FTO) glass substrates were coated with Titanium dioxide paste (TiO2) by the drop casting method to form thin TiO2 films. Subsequently, TiO2 coated glasses were sensitized with dyes extracted from the leaves for 24 hours at room temperature. The DSSC was assembled using a Platinum (Pt) counter electrode and an iodide/triiodide (I^-/I^{3-}) electrolyte. Flame Violet showed the energy conversion efficiency (ŋ) of 0.372% and maximum photocurrent density of 0.924 mA cm^{-2} when extracted with acidic ultrasonicated water at 39°C. Flame Violet produced the energy conversion efficiency of 0.317% and maximum photocurrent density of 1.392 mA cm^{-2} under non-acidified hot water extraction at 100°C. Results indicate that dyes from Flame Violet leaves have the potential as natural photosensitizers and with further optimizations, this dye could be practically used in DSSCs, as a low-cost alternative to meet increasing energy consumption.

Keywords: *Dye- Sensitized Solar Cells (DSSC); Natural Dye; Titanium Dioxide (TiO2); Drop casting*

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Influence of Photoanode Composition on D719 Dye Efficiency in Dye-Sensitized Solar Cells

D.G.D.M. Weerasinghe[1,2], S.L.M.D.K.V. Samarathunga[1,3], K.D.M.S.P.K. Kumarasinghe[3], G.R.A. Kumara[1*]

[1]National Institute of Fundamental Studies, Kandy, Sri Lanka
[2]Department of Chemistry, University of Ruhuna, Sri Lanka
[3]Department of Chemistry, University of Peradeniya, Sri Lanka

Dye-sensitized solar cells (DSCs) are third-generation photovoltaic devices that convert sunlight to electricity via a photosensitization process. DSCs are known to represent an alternative to classic silicon-based solar cells, as their production cost is inexpensive , and simple fabrication. This research explores the understudied performance of commercially available D719 dye in DSCs. D719 has also been found to be a highly promising alternative dye in search of high-performance dyes in DSCs because of its superior light-harvesting and electron injection characteristics. So, the performance of the D719 dye in DSCs was evaluated using two different photoanodes, TiO_2 and ZnO/SnO_2 composite. The SnO_2/ZnO composite was sprayed and coated on fluorine-doped Tin oxide (FTO) glass and sintered. TiO_2 films, which were also sintered in a similar way. The two kinds of photoanodes were allowed to soak in a 0.3 mM solution of the D719 dye overnight, at room temperature to promote dye loading. The cells were constructed with dye-loaded photoanode, a platinized counter electrode, an I^-/I_3^- electrolyte and a 0.20 cm^2 active area. J–V measurements under simulated solar illumination revealed TiO_2-based DSCs achieved higher photocurrent and efficiency (6.79%) than ZnO/SnO_2-based devices (5.79%), although the latter exhibited a higher fill factor (0.75 and 0.62, for ZnO/SnO_2 and TiO2 respectively). This demonstrates that improvements in charge generation and collection can outweigh a moderate decrease in Fill Factor, leading to superior device performance. UV-Vis spectroscopy confirmed stronger visible-light absorption of D719 on SnO_2/ZnO, while Raman spectra verified successful dye adsorption on both materials. These results illustrate the SnO_2/ZnO composite as a competitive alternative to TiO_2, offering enhanced light harvesting and electron transport in D719-based DSCs.

Keywords: *Dye-sensitized solar cells; TiO_2; SnO_2/ZnO composite; D719 dye; Power conversion efficiency*

**Corresponding author*: grakumara2000@yahoo.com

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Effectiveness of Beehive Fences in Reducing Human–Elephant Conflict: Case Study of Gonnoruwa, Hambantota, Sri Lanka

Perera K.M.K.[1], Jayasinghe J.A.S.[2], Mohotti K.D.[2], Abeywickrama S.S.[3], Mannakkara A.[1], Adikaram K.K.L.B.[1*], Bodhika J.A.P.[3]

[1] Faculty of Agriculture, University of Ruhuna, Sri Lanka
[2] Southern Provincial Industrial Development Authority, Sri Lanka
[3] Faculty of Science, University of Ruhuna, Sri Lanka

Beehive Perimeter Fences (BPFs) are established as a sustainable, non-lethal solution to human-elephant conflict (HEC) in African countries. However, this mitigation method has not been widely adopted in Sri Lanka due to limited successful trials. This research aims to check the operational feasibility of BPFs in the high-conflict Hambantota area under controlled field conditions. We selected a 1.2 ha farm in Gonoruwa (6.24º N, 81.10º E), which borders a forest and faces frequent raids by a herd of approximately 40 elephants despite an existing electric fence (EF). We installed four permanent online cameras to monitor elephant movements along the forest-bordering path, which leads to a nearby lake. Pre-intervention monitoring recorded three elephant movements within one week. Subsequently, twenty active Apis cerana hives were installed outside the existing EF at 2 m intervals. Hive monitoring confirmed colony health, with internal temperatures (33 ℃– 35 ℃) remaining stable despite high ambient heat (35 ℃–39 ℃). During the 45-day monitoring period (watermelon crop cycle), only two elephant movements were recorded in front of the bee fence, with no breach attempts. Notably, nearby non-BPF fields experienced multiple attacks. A single attempt to breach the EF occurred via a newly created path 50 m away from the BPF, on the farm's uncovered side. These preliminary results demonstrate the BPF's immediate and significant effectiveness in deterring elephants, offering a sustainable HEC solution that provides the co-benefits of honey production and improved crop yield from pollination. This study confirms the potential of BPFs in Sri Lanka, though extended monitoring is necessary to fully evaluate their impact.

Keywords: *Beehive Fence; Elephant Deterrent; Human–Elephant Conflict; Pollination Benefits.*

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**Corresponding author*: lasantha@agricc.ruh.ac.lk

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Anacardic Acid Incorporated Semi-synthetic Bio-polymer as a Pharmaceutically and Therapeutically Effective Enteric Coating Material for Diclofenac Sodium Tablets

Fernando W.D.T.M.[1*] , Dissanayake. A. S.[1] ., Panamgama. L. A.[2] , Wasana, P. W. D.[1]

[1]Department of Pharmacy, Faculty of Allied Health Sciences, University of Ruhuna.

[2]Department of Chemistry, Faculty of Science, University of Ruhuna.

The enteric-coated tablet form of diclofenac sodium is a widely used non-steroidal anti-inflammatory drug (NSAID) for treating pain and inflammation associated with rheumatic and non-rheumatic conditions. The enteric-coating with synthetic polymers is used to overcome adverse effects, such as peptic ulcers and gastrointestinal perforations. However, the existing polymers have several drawbacks, including physical coating defects and inconsistent drug release, making necessity to search for effective coating materials. This study aims to synthesize a semi-synthetic bio-polymer, which holds pharmaceutical and therapeutic significance incorporating anacardic acid (AA) extracted from *Anacardium occidentale* (cashew) nut shell oil and starch from red rice (*Oryza sativa* Ld, 368). Also to evaluate its antifungal activity against *Candida albicans* clinical isolates. The polymer's stability was evaluated spectrophotometrically over a period of one month by storing it at two different temperatures (25 and 4-8 °C) in two different glass containers (transparent and amber-colored). There was no significant change in AA percentage in the polymer mixture. Diclofenac sodium USP 50 mg core tablets were coated with the AA-based biopolymer. Quality control tests including hardness, disintegration, dissolution, and weight variation, were performed to meet USP specifications, showing comparable results to a commercial product. AA-incorporated dried polymer discs and AA liquid polymer (14.5 mg/mL) impregnated paper discs were tested for antifungal activity against *Candida albicans* clinical isolates, using the Kirby-Bauer disc diffusion method. The polymer and paper discs produced average inhibition zones of 10.16 and 11.79 mm, respectively, while the positive control fluconazole (3 mg/mL) yielded 18.62 mm. In conclusion, AA-incorporated semi-synthetic bio-polymer could be used as an effective enteric coating material for diclofenac sodium tablets.

Keywords: *Anacardic acid, Diclofenac sodium, Enteric-coating, Semi-synthetic bio-polymer*

**Corresponding author*: *thilinadewage22@gmail.com*

Synthesis, Characterization and Gelation of Glycerol-Oxalic Acid Esters

Seetharansi K.B.[1], Fernando I.R.[1,*]

[1] Department of Chemistry, Faculty of Applied Sciences, University of Sri Jayewardenepura, Sri Lanka

Glycerol-based dendritic polyesters have emerged as promising biomaterials, yet branched polyesters of glycerol-oxalic acid remain unexplored. Therefore, this research focused on the synthesis, characterization, and gelation of glycerol-oxalic acid esters towards potential biomaterial applications. The branched esters of glycerol-oxalic acid were synthesized using glycerol and oxalic acid molar ratios of 4:9 and 2:1, under the catalyst and solvent-free conditions at 70 ºC over 6-25 hours. The crude mixtures were purified using dialysis and/or column chromatography. After characterizing the resulting products, the gelation conditions of glycerol-oxalic acid esters were studied in the presence and absence of an encapsulating agent, β-cyclodextrin. FTIR spectra of the resulting products demonstrated –C=O and –C–O– stretching vibrations at 1736 cm^{-1} and 1170-1185 cm^{-1}, respectively, confirming the esterification between glycerol and oxalic acid. TGA and differential scanning calorimetry analyses exhibited the thermal stability of products up to 140 ℃. GC-MS analysis of the products revealed that the esters have molecular weights ranging from 164 to 500 g mol^{-1}. The monoester structure related to m/z 164, was attributed to the molecular formula of glycerol oxalate, $C_5H_8O_6$. Among the various gelation conditions tested, an aqueous solution of glycerol-oxalic acid esters yielded a hydrogel in the presence of 1:300 (v/w) ester:β-cyclodextrin ratio under sonication at 80 ℃ for 4 hours, followed by cooling at 5 ℃ for 4 days. The resulting hydrogel remained physically stable, showing no observable changes after being kept at room temperature for 2 days. In conclusion, branched oligoesters of glycerol and oxalic acid were synthesized via a single-step reaction under solvent- and catalyst-free conditions, and were partially characterized. Further characterization of the resulting esters and hydrogel followed by the drug loading and releasing studies are required to evaluate their potential for biomaterial applications.

Keywords : *Biomaterial, glycerol-oxalic acid esters, inclusion complexes, supramolecular chemistry*

**Corresponding author*: isurika.fernando@sjp.ac.lk

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Counselling on Alendronate in Community Pharmacies of Northern Sri Lanka: A Simulated Patient Study

Kajeeban A.[1*], Kalki P.[1], Sweethika J. [1], Ramyasiri B.G.D.T. [1], Aravinthan M.[2]
[1]Department of pharmacy, Faculty of Allied Health Sciences, University of Jaffna
[2] Teaching Hospital, Jaffna

Alendronate is a drug of choice for osteoporosis. Proper administration is essential for optimal bioavailability and to minimize adverse effects, requiring effective patient counselling. A pharmacist plays a vital role in counselling for optimum use of medication and better adherence. If not, treatment outcomes may be compromised. The current research aims to evaluate adequacy of counselling practices and associations with dispenser and pharmacy characteristics. A cross-sectional observational study was conducted using a simulated patient in 151 pharmacies in Northern Province. Information provided was recorded in a structured checklist immediately after leaving the pharmacy; visits with two or more patients were considered as busy hour and pharmacist identification was based on displayed license. Counselling was classified into two domains: advice to enhance bioavailability and to reduce adverse effects. Counselling was categorized as adequate or inadequate; adequate-counselling was further classified as complete (both domains' instructions) or incomplete (first domain only). Others considered inadequate. Of 151 surveyed pharmacies, alendronate was available in 99 and 05 were permanently closed. Only 14 pharmacies provided adequate counselling, of which 8 were complete and 6 incomplete. Aspects of adequate and complete counselling included taking on an empty stomach (26), with a full glass of water (12), maintaining an upright posture (10), and avoiding food/drink for 30 minutes (15). Other counselling included weekly dosing (96), while advice on missed doses, adverse effects, food and/or medicine interactions was almost absent. Counselling adequacy was significantly higher with pharmacist dispensing ($p<0.001$), and during non-busy hours ($p=0.009$) with gender and location have no effect. Counselling on alendronate sodium was largely inadequate in community pharmacies in the Northern Province, Sri Lanka, with adequacy mainly influenced by dispenser qualification and pharmacy busyness.

Keywords: *Alendronate sodium, community pharmacies, osteoporosis, patient counselling*

**Corresponding author*: a.kajee04@gmail.com

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Evaluation of Toxic Trace Elements in Selected Green Tea Products in Sri Lanka Using ICP-MS

Malshika J.K.P.[1], Edirisinghe E.M.R.K.B.[1,*]

[1] Department of Chemical Sciences, Faculty of Applied Sciences, Rajarata University of Sri Lanka, Mihintale, Sri Lanka.

Tea (*Camellia sinensis*) is one of the world's most widely consumed beverages, valued for its rich phytochemical content and antioxidant properties. However, the presence of toxic trace elements may pose health risks, emphasizing the need for risk assessment. In this study, the concentrations of arsenic (As), cadmium (Cd), chromium (Cr), lead (Pb), and mercury (Hg) were measured in six commercially available green tea varieties (3-LGTC, 26-KRT, 21-BGT, 9-GTGP, 6-PGT, and 7-OGT). Tea samples were digested with HNO_3 and H_2O_2 using a microwave digestion system and analysed by Inductively Coupled Plasma–Mass Spectrometry (ICP-MS). Results showed detectable levels of As, Pb, Cd, and Hg, while Cr was absent in all samples. Lead exhibited the greatest variability, ranging from 0.38 ± 0.14 ppm (7-OGT) to 0.95 ± 0.02 ppm (21-BGT). Mercury was detected in only three varieties at trace levels (0.00001–0.00002 ppm). The highest As concentration (0.20 ± 0.003 ppm) was observed in 3-LGTC, 9-GTGP, and 6-PGT, while the lowest (0.18 ± 0.004 ppm) occurred in 26-KRT. For Cd, the highest level was found in 26-KRT (0.39 ± 0.001 ppm) and the lowest in 3-LGTC (0.22 ± 0.11 ppm). These values were compared against maximum permissible limits in beverages (As 1.0 ppm, Cd 0.30 ppm, Cr 1.0 ppm, Pb 1.0 ppm, Hg 0.50 ppm). While other element levels remained within safe limits, Cd exceeded the threshold in some samples. The findings suggest that green tea is generally safe for consumption, but the variability in toxic element content emphasizes the need for continued monitoring to protect consumer health.

Keywords: *Camellia sinensis; ICP-MS; Antioxidants; Heavy Metals*

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**Corresponding author*: ranjith_e@rjt.ac.lk

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Sulfate Radical-Based Oxidation of an organic pollutant, Reactive Turquoise Blue G

Shriya H.Wadumethrige.[1,*], Perera M. P. R.[1].

[1]Department of Chemistry, University of Ruhuna, Matara, Sri Lanka

Radical-based oxidation is a highly effective chemical process that uses free radical species to degrade complex organic pollutants to safer forms. The treatment of Reactive Turquoise Blue G as the pollutant has been examined in this study by sulfate-based oxidation methods for decolorization. Persulfate (PS) is chemically decomposed by ferrous ions, where sulfate radicals ($SO_4^{\bullet-}$) were formed. A Reactive Turquoise Blue G dye sample of 100mg/L was treated with varying concentrations of persulfate and ferrous sulphate, ranging from 0 to 600 mg/L and 0 to 60 mg/L, respectively, under both acidic and basic pH conditions for 1 hour under sunlight. Every experiment was performed in triplicate. The study has shown that Fe^{2+} and PS concentrations, and pH influenced the degradation efficiency. It was observed that the dye was degraded to the extent of 73.5% at an optimized Fe^{2+} concentration of 30 ppm, persulfate concentration of 500 ppm and pH of 3 within the reaction time of 60 minutes for a Reactive Turquoise Blue G dye solution of 100 ppm. These findings suggest that radical-based advanced oxidation processes are highly effective for degrading stable organic contaminants and highlight the need for further research to elucidate specific reaction mechanisms and identify intermediate degradation products.

Keywords: *Reactive Turquoise Blue G, UV-visible spectroscopy, advanced oxidation*

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*Corresponding author: hemalika@chem.ruh.ac.lk

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Computational Study of Nonlinear Optical Properties of Metal Alkynyl Complexes: Impact of Bridge Modification on First Hyperpolarizability

***Kirindage A.D.*[1], *Kodikara M.S.* [1*].**

[1] Department of Chemistry, University of Ruhuna, Sri Lanka

A detailed computational study employing Density Functional Theory (DFT) was undertaken on a series of metal alkynyl complexes, **M**(C≡C-4,4′-C_6H_4**X**C_6H_4-NO_2)(L), where **M** =Au, L = PH_3; Ni, L= (Cp)(PH_3); Fe, L = (Cp)(dHpe); Ru, L = (Cp)(dHpe) and **X** = (E)-CH=CH-, (Z)-CH=CH- **(1)**, -C≡C- **(2)**, -N=CH- **(3)** -N=N- **(4),** along with their biphenyl analogues **M**(C≡C-4-$C_6H_4C_6H_4NO_2$)(L)**(5)** and one-ring complexes **M**(C≡C-4-$C_6H_4NO_2$)(L)**(6),** to investigate the effect of varying the linker group (**X**) between the two aryl groups on the static total first hyperpolarizability (β_{TOT}). The computed data were compared with the available experimental data (β_{TLM}). The computed β_{TOT} using CAM-B3LYP/6-31+G(d)/SDD(M) was further corroborated by (HOMO–LUMO) energy gaps and TD-CAM-B3LYP studies. The computed data revealed that the reduced energy gaps and intense low-energy charge transfer (CT) excitations in these complexes are closely associated with their β_{TOT} values. The azo-linked complexes (**M4**) showed the highest $\beta_{TOT,}$ while the minimum β_{TOT} was predicted for the complexes without a linker (**M5)** due to the red-shifted CT band with high oscillator strengths in the former. β_{TOT} of the complexes containing the -ene linker (**M1)** is smaller than that of azo analogues, but all the complexes with a linker (**M1-4**) showed better NLO response than **M5**. The decrease in the conjugation from **M1-5** to **M6** resulted in a considerable reduction in β_{TOT} due to less favorable two-level parameters in **M6**. The computed β_{TOT} trends fairly agree with the experimental β_{TLM} data of Au/Ni -yne, -ene, and imine complexes. The azo-linked Ru complex showed the largest β_{TOT} among all the studied complexes due to the red-shifted CT excitation with significant metal character.

Keywords: *DFT; First Hyperpolarizability; Metal Alkynyl Complexes; Nonlinear Optics*

**Corresponding author*: mskodikara@chem.ruh.ac.lk

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Formulation and quality evaluation of functional bael jelly crystals incorporated with citrus peel pectin

Deshan R.G.S.D.* **and Kananke T.C.**
[1]Department of Food Science and Technology, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya.

Modern jelly production relies on artificial additives, criticized due to health concerns and clean-label demand. This study replaced artificial additives in jelly by incorporating bael pulp powder prepared from ripe bael fruits *(Aegle marmelos)* with citrus peel pectin isolated using an acid extraction method and formed sustainable, antioxidant-rich functional jelly crystals. Physicochemical, textural, sensory, and nutritional properties were evaluated by rehydrating bael jelly crystals with hot water and subsequent cooling, Pectin was extracted from *Citrus sinensis, C. aurantifolia,* and *C. aurantium. C. sinensis* pectin exhibited significantly higher yield (36.24 ± 0.81%), methoxyl content (9.05 ± 0.11%) and degree of esterification (68.49 ± 0.49%) with ($P < 0.05$), enabling superior gelation. Sample 751 (*C. sinensis pectin*) was selected as the best formulation, outperforming other samples (509: commercial, 343: *C. aurantium,* 822: *C. aurantifolia*). Hedonic ranking by 30 untrained panelists confirmed its superiority, with higher sensory scores (ANOVA, $p < 0.001$) for overall acceptability (4.27 ± 0.72), firmness (4.65 ± 0.49), and taste (4.65 ± 0.78). Texture Profile analysis approved desirable hardness (452.60 ± 75.10 g), cohesiveness (0.65 ± 0.01), and chewiness (14.05 ± 2.50 mJ), comparable to commercial jelly. Physicochemical evaluation indicated stable rehydrated properties with moisture 71.4 ± 0.4%, soluble solids 32.37 ± 0.40 °Brix, titratable acidity 0.85 ± 0.03%. The jelly showed optimum nutritional attributes, with higher fiber content, strong antioxidant activity (DPPH IC_{50} = 23.03 ppm), and elevated total phenolic content (1.25 mg GAE/g) measured using the Folin–Ciocalteu assay. The production cost is LKR 165 per 100 g pack, supporting commercial feasibility. This study presents a sustainable, natural alternative to synthetic additives, valorizing citrus waste to produce antioxidant-rich, shelf-stable jelly with health benefits.

Keywords: *Antioxidant activity, Bael pulp, Citrus peel pectin, Functional jelly, Waste valorization*

**Corresponding author: Sasikade5@gmail.com*

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Rice and Corn Flour-Based Edible Packaging Materials: as a Sustainable Alternative to Single-Use Polythene Sachets

***Disanayaka D.M.N.S.*[1], *Abeysuriya A.P.H.I.*[1*], *Pasan A.J.R.P.* [2].**

[1] Department of Food Science and Technology, Faculty of Agriculture, University of Ruhuna, Sri Lanka
[2] Division of Applied and Natural Sciences, University College of Matara, University of Vocational Technology, Sri Lanka

This study focused on developing rice flour (RF) and corn flour (CF)-based edible packaging material (PM) as sustainable alternatives to single-use polythene sachets used for spice mixes in instant noodles. Twelve PM formulations were prepared using RF, CF, bee honey (BH), and vinegar in varying ratios, and films were produced by the solution casting method. The twelve formulations were decided based on preliminary trials. Physical and optical barrier [water vapour transmittance rate (WVTR) and water vapour permeability (WVP)], mechanical (tensile strength), and solubility properties were evaluated. Principal component analysis (PCA) identified three formulations (T1: 10g RF, 10g CF, 8mL BH, 12mL vinegar; T2: 10g RF, 10g CF, 6mL BH, 14mL vinegar; T3: 10g RF, 10g CF, 4mL BH, 16mL vinegar in 100 mL water) with superior barrier and mechanical performance. Among them, T3 exhibited the highest tensile strength (4.123±0.440 N/m^2), the lowest WVTR (0.1550±0.0170 mg/m^2s) and WVP (0.4445±0.0770 mg/msPa) values. Based on the surface morphology observed through scanning electron microscopy and transparency measurements, T1 and T3 were selected for storage studies. During 14-day storage of spice mix in the edible sachets, no significant changes were observed in weight gain, moisture content, colour, or acid value. The results demonstrate the potential of RF and CF based edible PMs as viable replacements for polythene sachets in instant noodle applications.

Keywords: *Corn flour-based packaging; Edible packaging; Polythene sachets; Rice flour-based packaging; Sustainable packaging materials*

**Corresponding author*: hashinia@agri.ruh.ac.lk

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In vitro Evaluation of the Antibacterial Activity of *Achyranthes aspera* Root Extract and Formulation of a Mouthwash

***Ahamed G.G.M.A*[1,*], *De Silva K.I.M*[2]**

[1]Department of Medical Laboratory Science, Faculty of Allied Health Sciences, University of Ruhuna, Sri Lanka

[2]Department of Pharmacy, Faculty of Allied Health Sciences, University of Ruhuna, Sri Lanka

The use of plants for medicinal purposes has increased significantly in recent years due to their safety, low cost, and minimal side effects. This has encouraged scientists to explore new plant-based therapeutic agents. *Achyranthes aspera*, in particular, is recognized for its diverse medicinal properties, including anti-inflammatory, analgesic, and antipyretic effects. Thus, this study aimed to evaluate the *in-vitro* antibacterial activity of *A. aspera* root extracts and the development of a herbal mouthwash. Methanolic and aqueous extracts of *A. aspera* roots were prepared using sonication and boiling methods, respectively, followed by filtration and evaporation. The metabolites were identified through standard phytochemical screening tests performed on both methanolic and aqueous extracts. Antibacterial activity of different concentrations of the extracts (150, 50, 25, 12.5, 6.125, and 1.6 mg/mL) was tested against *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Enterococcus faecalis* using agar well diffusion method with Gentamycin (10 µg/ml) as the positive control. Finally, a mouthwash was developed, and its antimicrobial efficacy and stability were evaluated. Alkaloids, phenolic compounds, carbohydrates, saponins and flavonoids were present in both extracts. The highest concentration of methanolic extract (150 mg/mL) exhibited 12.33±0.66, 19.33±0.33, and 19.00±0.57 mm zone of inhibition against *P. aeruginosa, S. aureus,* and *E. faecalis*, respectively, with MIC values ranging from 191 to 382 µg/mL indicating effective inhibition. The gentamicin showed 19.33±0.33, 30.00±0.00, and 19.66 ±0.33 zones of inhibition against *P. aeruginosa, S. aureus,* and *E. faecalis*, respectively. However, the aqueous extract did not show any antimicrobial activity. The formulated mouthwash using the methanol extract demonstrated stability and produced an 8 mm inhibition zone. The study concludes that *A. aspera* methanol root extract possesses notable antibacterial properties, supporting its use in herbal formulations. Formulated mouthwash would be a promising alternative to conventional mouthwashes, offering a safer, plant-based solution.

Keywords: *Achyranthes aspera; Antibacterial activity; Herbal mouthwash; Oral pathogens; Phytochemical screening*

**Corresponding author*: thanishasdf@gmail.com

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Fabrication of functionalized nanoclay-natural clay composite for the removal of dissolved humic acid in drinking water

Samaraweera A.P.K. [1]***, Hewage J.S.*** [1*]

[1] Department of Chemistry, University of Ruhuna, Wellamadama, Matara, Sri Lanka

Levels of Dissolved Organic Matter (DOM) in drinking water are of great concern due to the formation of toxic disinfection by-products and their impact on drinking water quality. Developing an effective and sustainable method for removing DOM is crucial for safer drinking water and this study was focused to develop nanoclay-natural clay composite for the removal of dissolved humic acid in drinking water as the model compound of DOMs. A series of composites was made with various combinations of natural and nano clays, and characterized by Fourier Transform Infrared Spectroscopy (FT-IR), X-Ray Diffraction (XRD) and Scanning Electron Microscopy (SEM). The 5 % halloysite-ball clay composite (5%-HB composite) showed 96.7 % removal efficiency for 20.00 mL of 20 ppm humic acid solution using 2.0 g of adsorbent at pH 5 at room temperature for 3 hours. The point of zero charge (pHzpc) of the 5%-HB composite was found to be 7.3, which indicates a positively charged surface at pH 5, which is favorable for humic acid (HA) adsorption under acidic or neutral conditions. Iron oxide-impregnated composite (5%-HB-Fe_3O_4 composite) achieved 98.7 % removal efficiency as a result of additional active sites and improved porosity due to iron oxide impregnation. Reusability tests of 5%-HB composite provided 96.7 %, 88.6 % and 67.4 % removal efficiencies for 20 ppm HA over three cycles. The results lead to the conclusion that the 5%-HB composite is suitable application as a pretreatment for DOM contaminated ground water in membrane-based treatment plants and the performance can be enhanced by iron oxide impregnation. Further research work is ongoing to evaluate the applicability of this approach.

Keywords: *Dissolved Organic Matter (DOM), Humic acid (HA), Halloysite-ball clay composite, Removal efficiency, Reusability*

**Corresponding author*: jeewantha@chem.ruh.ac.lk

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Machine Learning Framework for Predicting Thermophysical Properties of Polymers from SMILES Representations

Abilash Sundaresan[1], Janith R. R. H. Ramanayake[2], Jaliya Amarathunga[3], Kaveen Tharinda Nagodawithana[4], Anton S. Perera[5]*

[1] *Faculty of Science, University of Colombo, Sri Lanka*
[2] *Department of Statistics, University of Colombo, Sri Lanka*
[3] *Department of Mathematics, University of Colombo, Sri Lanka*
[4] *Department of Chemistry, University of Colombo, Sri Lanka*
[5] *Department of Chemistry, Case Western Reserve University, Cleveland, Ohio 44106, United States*

The accurate prediction of polymer thermophysical properties is a fundamental challenge in computational chemistry, as conventional molecular dynamics simulations, even though widely used, remain computationally demanding and difficult to scale for high-throughput discovery. In this work, we present a hybrid machine learning framework that combines molecular descriptors and graph-based representations to directly predict key polymer properties from SMILES notation. The focus is on five critical metrics: glass transition temperature (Tg), fractional free volume (FFV), thermal conductivity (Tc), density, and radius of gyration (Rg), which collectively govern polymer performance, processability, and sustainability. Our approach integrated molecular descriptors with ensemble gradient boosting models and graph neural networks, while ensuring feature space consistency through a variance-threshold filter. Using five-fold cross-validation, the model demonstrated strong predictive performance across all properties, achieving mean absolute errors of 49.3 ± 4.4 K (Tg), 0.0058 ± 0.0002 (FFV), 0.0261 ± 0.0018 W m^{-1} K^{-1} (Tc), 0.0261 ± 0.0101 g cm^{-3} (density), and 1.55 ± 0.13 Å (Rg). These findings highlight the capacity of descriptor-augmented graph learning to capture complex polymer structure-property relationships beyond the reach of purely physics-based approaches. By substantially reducing computational cost and enabling rapid virtual screening of large polymer libraries, this framework provides a scalable pathway for the accelerated discovery of environmentally responsible, high-performance polymeric materials and underscores the growing role of machine learning in advancing sustainable materials innovation.

Keywords: *Polymer informatics; Machine learning; Graph neural networks; Molecular descriptors; Thermophysical properties*

**Corresponding Author: anton.perera@case.edu*

Improving the Thermal Conductivity of Red Earthenware Clay Using Iron Phosphate as an Additive

***Rusith T.S.S.*[1], *Palliyaguru L.*[1*]**

[1] Department of Chemistry, University of Sri Jayewardenepura, Nugegoda, Sri Lanka

This study aims to increase the thermal conductivity, thermal diffusivity, and volumetric heat capacity of red earthenware clay using iron phosphate, a byproduct from the synthesis of α-$Ti(HPO_4)_2.H_2O$ from ilmenite. Such enhancements will benefit applications such as cookware, nuclear waste containers, and geothermal heat exchangers. Approximately 500 g of red earthenware clay sample from Medawachchiya, Anuradhapura, was refined by dispersing in water, filtering, and drying. TGA/DTA analysis shows a substantial dehydroxylation around 400 °C. Iron phosphate was obtained by neutralizing the phosphoric leachate with 25% Ammonia until the pH reached 7, and was isolated by centrifugation. The XRD of iron phosphate revealed both amorphous and strengite phases. Subsequently, refined clay and clay composites containing 10 wt.% iron phosphate, a ratio selected to maximize thermal enhancement while avoiding vitrification-induced property degradation, were ball-milled and uniaxially pressed at 1 MPa to produce discs of 35 mm diameter and 5 mm thickness. After sintering at 900 °C, thermal analysis was performed using a HotDisk 500S thermal analyzer. The thermal conductivity, thermal diffusivity, and volumetric heat capacity of the pure clay disc were measured to be 0.2860 W/m.K, 0.08475 mm^2/s, and 3.375 $MJ/m^3.K$, respectively. Upon addition of 10% iron phosphate, values shifted to 0.4103 W/m.K, 0.08682 mm^2/s, 4.726 $MJ/m^3.K$, respectively. Based on these data, each parameter increased by 43.5%, 2.4%, and 40.0%, respectively, compared to the untreated clay. These results demonstrate a substantial enhancement of thermal properties through iron phosphate addition, while also improving the mechanical robustness of the material.

Keywords: *Clay composites, Iron phosphate, Thermal conductivity, Sustainable material*

**Corresponding author*: palliyaguru@sjp.ac.lk

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Magnetically Activated Carbon from Palmyra Kernel for Simultaneous Removal of Chromium and Rhodamine B

U.D.D.L Ukwatta[1], C. D. Jayaweera[1]*.

[1] Department of Chemistry, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka

The removal of chromium and Rhodamine B from aqueous solutions has received significant attention due to their carcinogenic nature in industrial wastewater. The separation of activated carbon after its application in the treatment process remains a major problem. Adding magnetic properties to activated carbon makes it possible to separate it using a magnetic field. Magnetically activated carbon was prepared through chemical activation followed by chemical precipitation with magnetite. Rhodamine B removal was optimal at a dosage of 0.08 g, a temperature of 30 °C, and a contact time of 10 minutes, whereas chromium removal required a higher dosage of 0.15 g at pH 2 with a contact time of 13 hours. The adsorption capacity of Rhodamine B was 11.79 mg g^{-1} and in comparison, chromium showed a capacity of 9.41 mg g^{-1} at 30 ºC. The Langmuir model best fits for both pollutants based on correlation values. Thermodynamic studies for Rhodamine B indicated that the adsorption process is feasible, spontaneous, and endothermic. Kinetics revealed that the pseudo-second order kinetic model fit well to the adsorption of both chromium and Rhodamine B by the adsorbent, indicating that the adsorption process followed chemisorption. The magnetic properties of the magnetically activated carbon remain stable after one regeneration cycle. The removal efficiencies were 34 % for Rhodamine B and 48 % for chromium, respectively, while maintaining simultaneous removal of both pollutants. These findings show that palmyra-derived magnetic activated carbon is an efficient and reusable adsorbent for the removal of chromium and Rhodamine B.

Keywords: *Adsorption; Langmuir model; Magnetically Activated Carbon; Regeneration; Thermodynamic*

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**Corresponding author*: dangolle@sjp.ac.lk

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Magnetite doped Graphene Oxide (Fe_3O_4-GO) for Photocatalytic degradation of cephalexin

Paranawaththa H.P.I.L.[1], Dickkumbura A.S.[2], Kalutharage N.K.[1,*].

[1] Department of Chemistry, University of Ruhuna, Sri Lanka

[2] The Open University Sri Lanka

Water pollution caused by pharmaceutical contaminants, particularly antibiotics, poses significant environmental and public health risks. Cephalexin, a widely used first-generation cephalosporin antibiotic, exhibits considerable stability under conventional degradation methods, necessitating innovative approaches for its removal. This study investigates the synthesis, characterization, and application of magnetite (Fe_3O_4)-doped graphene oxide (GO) as a photocatalyst for the degradation of cephalexin under UV light. GO was synthesized via modified Hummer's method, and Fe_3O_4 was doped to enhance photocatalytic efficiency. GO and Magnetite were characterized using FT-IR and UV-Vis spectroscopy, confirming the successful functionalization of GO and its doping with magnetite. Magnetite-doped GO exhibited characteristic Fe–O vibrations at 500–600 cm^{-1}, indicating doping with partial reduction of GO. UV–Vis spectroscopy confirmed the optical characteristics of GO, showing a strong absorption peak at 230 nm and a shoulder peak around 320 nm. The optimal data for the photocatalytic study were the concentration of cephalexin 40 ppm, 0.2000 g of catalyst loading, and pH=5 with 27.63% of degradation efficiency under mercury light. The study shows the potential of Fe_3O_4-doped GO composites as a sustainable solution for mitigating antibiotic pollution in aquatic environments.

Keywords: *Photocatalysis, Cephalexin Degradation, Magnetite-Doped Graphene Oxide, Environmental Remediation, Graphene Oxide Synthesis*

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**Corresponding author*: knishantha@chem.ruh.ac.lk

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Chitosan-Based Microbeads for the Removal of Methyl Violet from Aqueous Solutions

Rathnayake R.A.J.K.[1], Wickramasinghe L.D.C.T.[2], Gunathilake W.S.S.[3*]

[1] Department of Environmental and Industrial Sciences, University of Peradeniya, Sri Lanka
[2] Postgraduate Institute of Science, University of Peradeniya, Sri Lanka
[3]Department of Chemistry, University of Peradeniya, Sri Lanka

Water contamination from industrial dyes is a major issue, as they can harm aquatic life, disrupt plant growth, and accumulate in animals through the food chain. Chitosan, a biodegradable and non-toxic polysaccharide derived from the exoskeletons of crustaceans , is an effective and low-cost material as a dye adsorbent. This study focuses on preparing chitosan-based microbeads to remove methyl violet dye from aqueous systems. Microbeads were synthesized by dropwise addition of 1%(w/v) chitosan in acetic acid into a 2 M NaoH solution using a syringe at an 8 cm syringe to collector solution distance. Synthesized beads were characterized using a light microscope and FTIR analysis. Shaking time, solution pH, dosage, settling time, and initial methyl violet concentration were optimized during batch adsorption experiments. The optical microscopic images confirmed the successful formation of spherical microbeads and FTIR data revealed the presence of hydroxyl, amino, and ether groups on them. The optimal experimental conditions for methyl violet adsorption by synthesized microbeads were determined as 90 min of shaking time, solution pH of 6, 0.02 g of dosage, settling time of 3 min and 10 ppm initial methyl violet concentration. The maximum removal percentage of ~42% was achieved under the optimized conditions. The kinetic data fit the pseudo-second order model, suggesting that the adsorption mechanism is a chemisorption. The equilibrium data best fit the Langmuir model with R2 value of 0.94, suggesting that the adsorption of the dye molecules forms a single layer on the surface of the microbeads. The findings demonstrate that chitosan is an effective precursor for microbead synthesis and has potential as an adsorbent for the removal of methyl violet from aqueous solutions.

Keywords: *Adsorption, Chitosan, Ionotrophic gelation, Methyl violet, Microbeads*

**Corresponding author*: subhashinig@sci.pdn.ac.lk

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Development of Latent Fingerprints Using Modified Zinc Oxide Nanoparticles

Tillekaratne A.*, Piyumali G.D.

Department of Chemistry, Faulty of Science, University of Colombo, Sri Lanka

The development of latent fingerprints plays a crucial role in forensic investigations, yet conventional powders often suffer from low contrast, poor ridge detail, and limited storage stability. This study investigated zinc oxide (ZnO) nanoparticles and their surface modification with 3-aminopropyltriethoxysilane (APTES) as alternative fingerprint powders for use on non-porous surfaces. ZnO nanoparticles were synthesized via precipitation method and subsequently functionalized with APTES to enhance their shelf life. Both modified and non-modified ZnO nanoparticles were applied to develop latent fingerprints on aluminium surface. The shelf life of these nanoparticles was assessed by developing latent fingerprints every five days for a total duration of 40 days. By evaluating the performance of the nanoparticles in fingerprint development throughout this period, the study enabled a direct comparison of the shelf lives of both nanoparticles. When considering the efficiency of both nanoparticles, while non modified form was able to reveal ridge details, the APTES-modified ZnO nanoparticles exhibited superior performance with more distinct and well-defined fingerprint patterns, allowing clear visualization of minutiae. The non-modified ZnO nanoparticles were capable of producing clear fingerprint images for up to 30 days of storage, after which the image quality showed a slight decline. In contrast, APTES-modified ZnO nanoparticles produced clear images for up to 40 days of storage. Overall, the findings demonstrate that APTES modification significantly enhances both the efficiency and shelf life of ZnO nanoparticles, establishing them as a durable and practical material for latent fingerprint development in forensic applications.

Keywords: *Zinc oxide, Shelf life, Nanoparticles, Latent fingerprint*

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Evaluation of Physico-Mechanical Properties of Biodegradable Jackfruit Seed Starch–PVA Composite Films for Food Packaging Applications

Manawadu H.C. Panamgama L.A. , Vidana Gamage, H.H.

Department of Chemistry, University of Ruhuna, Matara, Sri Lanka

Biodegradable films have emerged as promising alternatives to conventional plastics, with starch-based polymers gaining particular attention for their renewability and environmental compatibility. Jackfruit seed starch represents a valuable yet underutilized by-product with excellent film-forming and biodegradable properties; nevertheless, minimal work has been published on the usage of seed starch in low-PVA systems in food packaging. This study investigates the potential of jackfruit seed starch as a raw material for biodegradable food packaging films blended with polyvinyl alcohol (PVA). Starch was extracted from jackfruit seeds through washing, peeling, crushing, and filtration, while flour and starch samples were characterized for key physicochemical properties, including moisture content, pH, tapped density, ash content, solubility, swelling power, moisture sorption capacity, oil absorption capacity, water holding capacity, and water absorption capacity. The extracted starch showed a higher yield (25.93%), moisture content (29.56 ± 0.31%), and water absorption (86.79 ± 4.47%), with a low ash content (0.48 ± 0.15%), indicating greater purity and superior swelling behavior and absorption properties and greater availability which will contribute to a uniform, smooth and stronger film compared to Jackfruit seed flour. Starch/PVA blend films were successfully prepared with minimal PVA content, using sorbitol as a plasticizer and citric acid (5% and 10%) as a cross-linking agent. Films with 30–40% sorbitol exhibited optimal characteristics, including moisture content (4.48 ± 1.42–7.86 ± 3.06%), thickness (0.11 ± 0.01–0.15 ± 0.02 mm), solubility (34.70 ± 0.67–42.44 ± 1.04%), and water vapor permeability [(0.35 ± 0.27–3.10 ± 2.36) × 10^{-6} kg/Pa.s.m^2]. Fourier Transform Infrared Spectroscopy (FTIR) confirmed effective crosslinking within the film matrix. The developed films demonstrated sufficient mechanical integrity and biodegradability, maintaining packaging stability for fruits, vegetables, and snack products for up to 11 days without spoilage. The findings highlight jackfruit seed starch as a sustainable and cost-effective resource for eco-friendly packaging applications.

Keywords: *Jackfruit seed starch/flour; Biodegradable films; Plasticizer; Crosslinking*

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Green Synthesis, Characterization, and Pharmacological Evaluation of Copper Oxide Nanoparticles from *Atalantia ceylanica* Leaf Extract

Alahakoon A.M.R.V, Jayasekara H.D*, Bulugahapitiya V.P.

Department of Chemistry, University of Ruhuna, Wellamadama, Matara, Sri Lanka

Green nanotechnology offers an eco-friendly approach for nanoparticle synthesis using plant-derived phytochemicals as reducing and stabilizing agents. This study reports the green synthesis, characterization, and pharmacological activity of copper oxide nanoparticles (CuO NPs) using *Atalantia ceylanica*, a medicinal plant native to Sri Lanka. The leaves of plant were extracted using maceration with a 1:1 ethanol–water mixture as the solvent. The extract was added dropwise to the $CuSO_4 \cdot 5H_2O$ precursor, and nanoparticle formation was facilitated under optimized conditions (pH 7, 60 °C). Characterization of synthesized NPs was done using UV–visible spectroscopy. UV absorption showed a characteristic peak between 220–280 nm range, while IR identified functional groups including –OH, C–O, and C=C indicated supporting of phytochemical involvement, and strong peak at 615 cm^{-1} confirmed the Cu–O group in FT-IR. Morphologies of CuO NPs were observed using Scanning Electron Microscopic (SEM) images which revealed rod, spherical and diamond shapes. Energy Dispersive X-ray Analysis (EDAX) confirmed high copper and oxygen composition. Phytochemical screening of the extract confirmed the presence of alkaloids, flavonoids, terpenoids and saponins. DPPH assay for CuO NPs, demonstrated strong antioxidant activity with an IC_{50} of 53 ± 2 µg/mL, while 35 ± 2 µg/mL in ascorbic acid. Significant antidiabetic activity was observed through increased glucose uptake by yeast cells, and showed moderate cytotoxicity in the brine shrimp lethality assay (LC_{50} value). These results highlight the bioactivity of green synthesized CuO NPs. Further *in-vivo* investigations are needed to investigate biocompatibility and suitability for targeted drug delivery.

Keywords: *Atalantia ceylanica, Copper oxide nanoparticles, green synthesis, antioxidant activity, antidiabetic potential*

**Corresponding author*: himali@chem.ruh.ac.lk

Evaluating Photoreduction Ability of Green Synthesized MgO and CaO Nanoparticles on Textile Dye Degradation

Dissanayake M.Y., Pathirathna S.Y., Rathnayake R.M.A.S.*

Department of Chemistry, Institute of Chemistry Ceylon, Rajagiriya 10107, Sri Lanka.

Recent advances in the field of nanotechnology focus specifically on synthesizing materials that have the ability to remediate environmental pollution caused by organic substances. The current study explored synthesizing MgO and CaO nanoparticles (NPs) using peel extracts of *Citrus sinensis* (orange) and *Musa acuminata* (ambul kesel), respectively, and investigating their photoreduction ability against two textile dyes: methylene blue (MB) and rhodamine B (RhB). With regard to MgO NPs, the maximum MB photodegradation of 91.11% was achieved under optimized conditions of a catalytic load of 9 mg, dye concentration of 5 ppm, and pH of 10, which is ~36% higher than that of the control. As regards CaO NPs, maximum MB dye degradation of 80.57% was recorded using a catalytic load of 6 mg, dye concentration of 5 ppm, and pH of 11. This is ~23% higher removal than the control. Regarding the photodegradation of RhB, under optimized conditions of a catalytic load of 12 mg, a dye concentration of 5 ppm, and a pH of 7, MgO NPs showed a maximum degradation of 23.98%, which is ~12% higher than that of the control. In contrast, CaO NPs showed RhB degradation of 11.93% under optimized conditions of catalytic load of 9 mg, dye concentration of 5 ppm, and pH of 9, which is ~8% higher than the control. Based on the obtained data, MgO showed better photo-reduction ability in removing both textile dyes under the tested conditions, which might be attributed to a relatively low band gap compared to that of CaO NPs. Overall, these findings suggested that standard household waste materials can be utilized to synthesize effective nanomaterials that have the potential to remediate water pollution by degrading common textile dyes under ambient conditions.

Keywords: *Green synthesis; Methylene blue; Nanoparticles; Photoreduction; Rhodamine B*

**Corresponding author*: asankar@ichemc.edu.lk

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Evaluating Catalytic Ability of α-Fe2O3 Nanoparticles on Degradation of Rhodamine B Dye and Transesterification of Sunflower Oil

Divyanjalee K.C., Rathnayake R.M.A.S*.

Institute of Chemistry Ceylon, College of Chemical Sciences, Sri Lanka.

Iron oxide nanoparticles (NPs) are widely investigated in various fields of study due to their, for example, catalytic, electronic, and optical properties. This specific study focuses on evaluating the catalytic potential of α-Fe2O3 NPs in the photo-degradation of Rhodamine B dye and the transesterification of sunflower oil. These NPs were synthesized by utilizing ferric chloride and sodium dodecyl sulfate in basic conditions. The catalytic activity of these NPs in transesterification reactions was investigated under optimum conditions of sunflower oil-to-methanol ratio of 1:3 and catalytic load of 15 mg, followed by heating the reaction mixture at 55 °C, which yields an 89% (w/w) of biodiesel. An alternative approach suggested that this reaction can also be performed under direct solar light with a remarkable 78% (w/w) biodiesel conversion. We postulate that due to the low band gap of α-Fe2O3 NPs, under solar irradiation, photogenerated electrons in the valence band are migrated to the conduction band, facilitating better electron-hole pair formation that accelerating the biodiesel production. These NPs were also evaluated for their photocatalytic ability on degrading Rhodamine B dye under optimized conditions of pH 8, dye concentration of 5 ppm, and a catalytic load of 12 mg over a period of 180 minutes. Under tested conditions, these α-Fe2O3 NPs showed an effective dye degradation of 25.07%, which is 17.67% higher than that of the control. This somewhat low degradation rate is possibly due to the slower degradation pathway of Rhodamine B dye, which typically proceeds in a stepwise manner. Overall, these findings demonstrated that inherited properties of nanomaterials, such as the low band gap of α-Fe2O3 NPs, can successfully be utilized to synthesize multifunctional heterogeneous nano-catalysts that hold potential to act as tools to reverse environmental pollution caused by certain textile dyes, as well as to produce certain renewable fuels even under ambient conditions.

Keywords: *Nanoparticles, iron oxide, transesterification, photocatalysis, dye degradation*

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Defect Engineered Nb_2O_5 nanoparticles for Enhanced Photocatalytic Hydrogen Production

Bandara J.M.S.[1,*], Rajapakse D.C.[1], Wijesiri H.P.G.D.D.[1,2]

[1] National Institute of Fundamental Studies, Hanthana Rd, Kandy, Sri Lanka

[2] Department of Chemistry, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka

Photocatalytic hydrogen production is a promising strategy for sustainable energy generation; however, wide-bandgap semiconductors such as niobium pentoxide (Nb_2O_5) suffer from weak visible-light absorption and rapid charge recombination. In this study, $NaBH_4$-assisted thermal defect engineering was employed to enhance the photocatalytic hydrogen evolution performance of Nb_2O_5. Pristine Nb_2O_5 and $NaBH_4$ treated and thermally processed samples at 450 °C and 850 °C under a nitrogen atmosphere were systematically investigated under dark and illuminated conditions. X-ray diffraction analysis confirmed that pristine and 450 °C-treated samples retained the orthorhombic Nb_2O_5 phase, whereas the 850 °C-treated sample exhibited reduced crystallinity and partial amorphization, indicating a high density of defect sites. UV-Vis diffuse reflectance spectroscopy revealed a red shift in the absorption edge of thermally treated samples, confirming defect-induced mid-gap states extending absorption into the visible and near-infrared regions. Photocatalytic experiments were conducted using 20 mg of catalyst dispersed in 10 mL of distilled water under continuous magnetic stirring in sealed reactors illuminated by tungsten lamps at 75 W and 100 W, and 10% methanol was introduced as a sacrificial agent. Hydrogen evolution was quantified using gas chromatography with a thermal conductivity detector. Under illumination, pristine Nb_2O_5 exhibited a hydrogen evolution rate of 0.5 μmol g^{-1} h^{-1}, while the 450 °C-treated sample showed an improved rate of 2.5 μmol g^{-1} h^{-1}. In contrast, the 850 °C-treated sample achieved 18.53 μmol g^{-1} h^{-1}, representing an 1853% enhancement over pristine Nb_2O_5. Methanol addition increased hydrogen production by 40.41%, while increasing light intensity from 75 W to 100 W resulted in a 196.8% improvement.

Key Words: *Defect Engineering, Niobium Pentoxide (Nb_2O_5), Photocatalytic Hydrogen Evolution, Thermal Treatment, Visible-Light Absorption*

*Corresponding Author:jayasundera.ba@nifs.ac.lk

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Knowledge on safe handling of anti-cancer drugs and associated factors among nurses of four government hospitals in Sri Lanka

Yoganathan T[1*] and Thuvaragan S[2]

[1]Nuclear Medicine Unit, Faculty of Medicine, University of Jaffna, Sri Lanka

[2]Department of Pharmacy, Faculty of Allied Health Sciences, University of Jaffna, Sri Lanka

Adequate knowledge of safe handling of anti-cancer drugs among nurses is crucial in cancer management settings. In this cross-sectional study, knowledge of anti-cancer drugs and their associated factors was evaluated among nurses from four government hospitals in Sri Lanka. Nurses from four government hospitals were included in this study. A stratified random sampling technique was used to select nurses (n=421) from four selected hospitals. A pretested and validated self-administered questionnaire was used to collect data. A twenty-five-item questionnaire was used to assess knowledge on anti-cancer drugs. The highest and lowest attainable scores for practice were 30 and 0, respectively. The median score of the knowledge score was used as the cut-off value, and based on that, the knowledge level was categorized as adequate and inadequate. The Chi-square test was used to assess the association between knowledge and selected variables at 5% level of significance. The response rate among nurses was 93.34% (n = 393). The median score of knowledge was 25 (IQR = 3). Only 33.8% (n=142) of nurses had adequate knowledge in the safe handling of anti-cancer drugs. Factors significantly associated with knowledge were age (p=0.001), professional qualification (p=0.013), work experience (p=0.001), experience in handling anti-neoplastic drugs (p=0.001), and training received (p=0.003). Knowledge of safe handling of anti-cancer drugs was inadequate among the majority of nurses. Knowledge among nurses could be improved by considering the associated factors in this study.

Keywords: *Anti-cancer drugs, Nurses, Knowledge, Sri Lanka*

**Corresponding author*: thiruyoganathan@yahoo.co.in

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Evaluating Methylene Blue Dye Adsorptivity of Pre-modified Rice Husk-Based Biochar–Magnetite Nanocomposite

Akmeemana A.G.A.K.G., Dissanayake M.Y., Rathnayake R.M.A.S. *

Department of Chemistry, Institute of Chemistry Ceylon, Rajagiriya 10107, Sri Lanka.

Discharging synthetic dyes to aquatic environments is becoming a growing environmental concern due to their persistence, toxicity, and low biodegradability. In the current study, Methylene Blue (MB) is used as a model dye to study adsorption-based removal efficiency by utilizing two types of rice husk-based biochar-iron oxide nanocomposites. This magnetic biochar was produced through two different approaches: salt-derived magnetic biochar (SMBC) using Fe^{2+} and Fe^{3+} as precursors, and extraction-derived magnetic biochar (EMBC) using an acidic red clay extraction. Analyzing both composites through Fourier Transform Infrared Spectroscopy and X-ray Diffraction indicated the presence of both Fe^{2+} and Fe^{3+} on the surface of biochar. Point of zero charge (PZC) results showed neutrality near pH 10 for both SMBC and EMBC and that of 8.6 for pristine biochar. Batch adsorption experiments were carried out to study the influence of solution pH, initial dye concentration, and contact time on MB uptake. Overall, removal efficiency of 25% was observed for SMBC and that for EMBC was 22% at 150 mg L^{-1} MB dye concentration. Kinetic modeling revealed that the adsorption process fitted well with the pseudo-second-order model (PSO) with $R^2 \approx 0.99$ for all the materials suggesting chemisorption as the rate limiting step. This high correlation to PSO model might be due to the increased strength of interactions between the adsorbate and the adsorbent upon incorporation of Fe_3O_4 to biochar surface. Both SMBC and EMBC demonstrated efficient removal of MB, with EMBC performing slightly better possibly due to enhanced surface modification. Overall, rice husk–based magnetic biochar shows strong potential as a sustainable material for dye removal in wastewater treatment applications.

Keywords: *Magnetic Biochar; Rice husk; Methylene Blue, Kinetic studies; Pseudo-second-order model*

**Corresponding author*: asankar@ichemc.edu.lk

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Phytate-Mediated Calcium Oxalate Crystallization in Synthetic Urine

Kumari J.L.P.N.P.*[1], *Ranaweera A.S.*[1]

[1] Department of Chemistry, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

The management of calcium oxalate kidney stones in the human urinary system requires expensive treatments. Identifying active compounds to treat calcium oxalate stone formation is a significant area of interest. This study examines the inhibitory effects of phytic acid on calcium oxalate crystal formation in synthetic urine solutions under different $[Ca^{2+}]/ [C_2O_4^{2-}]$ ratios of 8:1, 1:1, and 1:8, which are observed in the urine of patients who are prone to develop kidney stones. Experiments were conducted *in vitro* at 37 °C and pH 6 in the presence of phytic acid concentrations of 1, 3, 5, and 50 ppm, with six independent trials to ensure statistical significance. Solutions of calcium and oxalate ions were prepared separately and added to the synthetic urine solution, and crystal formation was allowed to occur over 24 hours. Control experiments were performed using deionized water. After precipitation, the crystals were separated, dried, weighed, and Characterized. Results revealed that the highest reduced weight percentage of crystals (97.24%) among the tested samples was observed at a phytic acid concentration of 50 ppm at $[Ca^{2+}]/ [C_2O_4^{2-}]$ ratio of 8:1. Calcium oxalate monohydrate (COM) crystals were yielded from the control experiment. Increasing phytic acid concentrations, resulted a higher proportion of calcium oxalate dihydrate (COD) crystals at $[Ca^{2+}]/ [C_2O_4^{2-}]$ ratios of 8:1. Characterizations using light microscopy, scanning electron microscopy (SEM), thermogravimetric analysis (TGA), and X-ray diffraction (XRD) confirmed that the calcium oxalate precipitates obtained in the presence of phytic acid were mixtures of COM, COD, and calcium oxalate trihydrate (COT). These findings highlight the role of phytic acid as a promising agent to promote COD and COT crystals formation, which are less prone to developing into calcium oxalate kidney stones due to their brittle nature.

Keywords: *Calcium oxalate; Inhibition; Kidney stone; Phytic acid; Urine*

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**Corresponding author*: samantharan@chem.ruh.ac.lk

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Extraction and Analysis of Saponins from Cassava (*Manihot esculenta*) Leaves and Evaluation of Its Potential for Value Addition

Duleesha P.G.S[1], Jayasekara H.D.[*], Vajira P. Bulugahapitiya
Department of Chemistry, University of Ruhuna, Matara, Sri Lanka

Manihot esculenta (cassava), which is widely cultivated in Sri Lanka, is known to be rich in secondary metabolites including saponins. However, the leaves are typically discarded as agricultural waste and remain underutilized. There have been only a few studies on transforming *M. esculenta* leaves into value added products in Sri Lanka and no saponins incorporated functional foods have been reported so far. This study focuses on isolating and characterizing saponins from cassava leaves and exploring their potential in functional-food development. Air dried cassava leaves were macerated with methanol; crude extract was subjected to solvent–solvent partitioning using n-butanol. Evaporation of butanol yielded saponin (1.23%). FTIR spectroscopy confirmed the presence of characteristic peaks corresponding to O-H(hydroxyl), C-H, C=C, C=O, and C-O-C bonds, which are typically found in saponins. Four fractions were isolated using flash column chromatography using hexane: methanol: water (25:15:10) as eluent. On TLC analysis three of them gave positive results with vanillin sulfuric acid reagent. Antioxidant activity of saponin fractions was evaluated using DPPH and FRAP assays. Saponin fractions 1, 2, 3 showed IC_{50} values of 208.51, 144.02 and 114.43 mg/mL, respectively, compared to 52.46 mg/mL for ascorbic acid. FRAP values were 1078.76, 1000.09 and 944.18 µmol Fe^{2+}/g. Brine shrimp cytotoxicity assay showed that the crude saponins had an LC_{50} of 738.04 ppm, indicating weak toxicity and suggesting their safe use in food application. Two types of soup cubes were formulated incorporating aqueous saponin extract. Proximate, sensory, and cytotoxicity analyses indicated that soup cube-1 was the most preferred and safest for consumption. In conclusion this study confirmed that Manihot leaves contain a considerable amount of saponins and antioxidants. The developed formulations show potential to provide antioxidant-related health benefits against non-communicable diseases, making them suitable as functional foods; further studies are needed to evaluate long-term safety and sensory properties.

Keywords: *saponins, Manihot esculenta, antioxidants, chromatographic techniques, general cytotoxicity*

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**Corresponding author*:himali@chem.ruh.ac.lk

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Non – Destructive Prediction of Guava pH and Sugar Content Using Multimodal Machine Learning.

***Priyamantha M.P.C.*[1], *Bandara K.D.T.*[1 *], *Prabudhdhi W.A.M.* [1].**

[1] Department of ICT, Faculty of Technology, University of Ruhuna, Sri Lanka

Accurate estimation of internal fruit quality indicators such as pH and sugar content is critical for assessing ripeness, market value, and consumer preference. Traditional laboratory-based methods are destructive, time-consuming, and impractical for large-scale applications. This study proposes a non-destructive, multimodal machine learning framework that integrates visual and acoustic features to predict guava pH and sugar content. A dataset comprising 1,122 RGB images and 914 acoustic tapping recordings was collected across multiple ripeness stages of guava fruit, with ground truth values obtained via standard laboratory analysis. For visual data, convolutional neural networks (CNNs) and transfer learning models (MobileNetV2, EfficientNetB0) were trained on preprocessed images, achieving up to 97.10% accuracy for pH prediction using EfficientNetB0 and 85.49% for sugar prediction using MobileNetV2. Acoustic signals were transformed into Mel-frequency cepstral coefficients (MFCCs) and spectral features, modeled using ensemble regressors (Random Forest, XGBoost), where XGBoost demonstrated superior performance with lower RMSE and higher R^2 scores compared to Linear Regression. A late-fusion strategy combining predictions from both modalities reduced error by 15 - 25% compared to unimodal approaches, confirming that multimodal integration significantly improves internal quality estimation. The proposed system is low-cost, scalable, and non-destructive, enabling real-time fruit quality assessment and offering strong potential for automated agricultural monitoring and precision farming applications.

Keywords: *non-destructive testing, multimodal machine learning, fruit quality assessment, acoustic analysis, computer vision*

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**Corresponding author*: deshanibandarawas@gmail.com

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Deep Learning-Based Diagnosis and Classification of Subtrochanteric Femoral Fractures: A Clinical Evaluation

K.Minuja[1], S. Ibrahim[1], K.Luxshi[2], V.Abishethvarman[1,*], S.Prasanth[3], B.T.G.S.Kumara[1]
[1]Department of Computing & Information Systems, Sabaragamuwa University of Sri Lanka
[2]Department of Physical Science and Technology, Sabaragamuwa University of Sri Lanka
[3]Faculty of Applied Sciences and Engineering, Memorial University of Newfoundland, Canada

Subtrochanteric fractures of the femur are severe, especially among the elderly, because the injury is associated with high morbidity and mortality. Identifying the exact location is crucial for immediate treatment, which can be challenging when interpreting X-rays separately due to anatomical complexity, high deforming forces, and variability. This paper explores deep learning models to improve binary classification of subtrochanteric femur fractures in X-rays. A dataset of approximately 1,000 images from a hospital's PACS was used, including both fracture and non-fracture cases. Convolutional neural networks (CNNs), including ResNet50, ResNet101, InceptionV3, and a custom CNN, were fine-tuned with preprocessing and augmentation to account for clinical variability. Model performance was evaluated based on accuracy, precision, and sensitivity, with ResNet101 achieving the best results (accuracy: 0.8000, precision: 0.8179). Statistical validation included confidence intervals (CI) of 90, 95, and 99 percent for fracture and non-fracture cases. Improved diagnostic accuracy has significant clinical benefits, enabling quicker diagnoses and better outcomes in time-sensitive situations. This analysis demonstrates the potential of deep learning to address diagnostic challenges in identifying subtrochanteric femur fractures, which should be integrated into clinical practice.

Keywords: subtrochanteric femoral fractures; deep learning; x-ray imaging; fracture detection; statistical analysis

**Corresponding author*: abishethvarman@gmail.com

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Assessing Key Anthropometric Indicators for Non-Communicable Disease Prediction Using Machine Learning

Lenuga Mahenthiran[1,2], Banujan Kuhaneshwaran[2,3], Sujair Ibrahim[2], Luxshi Karunaharan[4], Vadivel Abishethvarman[2,*], Senthan Prasanth[4,5], Banage T.G.S Kumara[2]

[1]Department of Computer and Information Sciences, Faculty of Engineering and Environment Northumbria University of London Campus
[2]Department of Computing and Information Systems, Faculty of Computing, Sabaragamuwa University of Sri Lanka
[3]Faculty of Science and Engineering, Southern Cross University, Australia
[3]Teaching Hospital, Jaffna, Sri Lanka
[4]Department of Physical Science and Technology, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka
[5]Faculty of Engineering and Applied Science, Memorial University of Newfoundland, Canada

The most common cause of global mortality is non-communicable diseases (NCDs) because over 70% of deaths worldwide are due to NCDs; therefore, early detection and prevention of these diseases is a critical societal issue. The research paper examines the use of anthropometric indicators as predictive markers for NCD risk assessment using machine learning. The sample consisted of 300 adult participants (>18 years) recruited from Jaffna Teaching Hospital and Sabaragamuwa University in Sri Lanka, including variables such as age, gender, weight, height, muscle body fat (MBF), total body water (TBW), percentage body fat (PBF), body mass index (BMI), visceral fat area (VFA), and waist-hip ratio (WHR). Data preprocessing involved normalization, outlier correction, and categorical encoding before model training. A variety of supervised machine learning models were applied, including Random Forest, XGBoost, Artificial Neural Networks (ANN), Decision Tree, AdaBoost, Logistic Regression, CatBoost, and Support Vector Machine (SVM). Hyperparameter tuning was performed using grid search and cross-validation. Results showed ensemble learning algorithms outperformed traditional classifiers, with the highest accuracy achieved by XGBoost and ANN (98.9%, 97.8%, and 85.2% respectively). Feature importance analysis revealed that visceral fat area, body mass index, and waist-hip ratio were the most significant predictors of NCD presence. These findings suggest that machine learning models utilizing simple anthropometric data could serve as inexpensive, scalable, and accurate tools for early NCD detection, thus supporting preventive healthcare strategies especially in resource-limited settings with high potential.

Keywords: *Non-Communicable Diseases, Anthropometric Indicators, Machine Learning, Random Forest, Visceral Fat Area*

**Corresponding author*: abishethvarman@gmail.com

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Evaluating Aggregate Functions and Machine Learning Integration in Cloud-Based Database Platforms: A Comparative Analysis of MySQL and SQL Server

Karunarathna H.A.R.N [1*]***, Dissanayake K.G.S*** [1]***, Prabuddhi W.A.M.*** [1]***.***
[1] Department of ICT, Faculty of Technology, University of Ruhuna, Sri Lanka.

This paper presents a comparative analysis of aggregate query performance and machine learning (ML) integration in two widely used relational database management systems (RDBMS), MySQL and SQL Server, deployed in the Microsoft Azure cloud environment. For large-scale analytical workloads on cloud data platforms, efficient execution of aggregate operations is critical. This study evaluates query performance using standard aggregate functions (SUM, AVG, COUNT, MIN, and MAX) implemented on the TPC-H benchmark dataset. Performance is assessed based on query execution time, CPU utilization, memory consumption. Tests were conducted within a standard benchmarking framework using separate Azure virtual machines on three hardware configurations with a number of vCPUs ranging from 2 to 8 and RAM ranging from 4 to 16 GB. Baseline metrics were obtained without ML optimization, followed by tests involving ML-based workload analysis, including informed code selection, execution plan evaluation, and workload-aware tuning. The results show that ML integration has varying impacts across platforms. SQL Server showed clear performance improvements, achieving a 12.53% reduction in average execution time, an 18.56% reduction in CPU utilization, and a 19.31% reduction in memory consumption. In contrast, MySQL showed a 15.94% increase in average execution time after ML-guided tuning, indicating limited effectiveness of the applied optimization strategies under the conditions evaluated. Overall, the findings show that ML- assisted optimization can significantly improve aggregate query performance on SQL Server, while its benefits for MySQL are highly sensitive to workload characteristics and configuration. This study highlights the importance of platform-specific optimization strategies when integrating ML techniques into cloud-based database systems.

Keywords: *Relational Database Management Systems, Machine Learning, Aggregate Function, Index, Optimization.*

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**Corresponding author*: rnuwangikarunarathna@gmail.com

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Design and Simulation of an Autonomous Seed-Sowing Robot with Soil-Moisture-Based Depth Adjustment

Rathnayaka R.M.D.S.[1*], Vihangana W.P.D.T.[1], Madhawa H.M.H.[1], Bandara M.U.[1], Ganege H.C[1].

[1] Department of Engineering Technology, University of Ruhuna, Sri Lanka

Conventional seed-sowing practices are constrained by inconsistent seed depth and spacing, which can significantly reduce germination rates and overall crop yield. This research aims to mitigate the labor shortage, seed wastage, lack of precision, and inconsistency of sowing depth and plant spacing. The proposed design incorporates an autonomous navigation system that simultaneously identifies soil moisture conditions and an injector dispensing system with NEMA 17 actuators that dynamically adjust the sowing depth to allow optimal seed placements. After a morphological analysis, a servo-based mechanism was selected, evaluating parameters including accuracy, cost, response time, and integration compatibility. Furthermore, stepper motors drive the ball screw to adjust the injector position vertically. This robot advertises through a GPS program and gets soil moisture samples, mapping them, and adjusts the sowing depth to enhance germination. This novel design ensures an efficient relationship between the soil moisture and seed sowing depth according to seed size. A CAD model was constructed using SolidWorks 2022, and static FEA was run, motion studies were conducted, and interference was checked to ensure structure and kinematics were functioning correctly. Simulation results represented a factor of safety of 6.5, a maximum deflection of 0.85 mm, and seed-placement accuracy of ± 1.5 mm when sowing at 2-4 cm depth. The servo-based mechanism proved most appropriate, providing accuracy and low-cost compared to linear and pneumatic systems. These simulation results demonstrate structural viability and precision potential of the design, establishing a foundation for future prototype development.

Keywords: *Sowing depth; Automation; Seed placement; Soil moisture; Finite element analysis.*

**Corresponding author*: dilrukshehan2000@gmail.com

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Cultural Context Preservation in Translating Sinhala Idioms to English: A Semantic and Contextual Approach

Munasinghe A.D.S.V.[1] *, *Sandeepa J. H. D.*[1], *Prabudhdhi W.A.M.*[1]
[1]Department of ICT, Faculty of Technology, University of Ruhuna, Sri Lanka

Translating idioms is a serious problem in Natural Language Processing especially when it comes to low-resource languages such as Sinhalese. Literary translations can easily lose the semantic meaning and cultural context as a result of literal translation and result in miscommunication and the loss of cultural context. This study is valuable in that it fills the gap that is critical in Sinhalese to English idiom translation by building a detailed framework that maintains semantic faithful translation and cultural setting. The paper builds upon a validated corpus of more than 500 Sinhalese idioms with semantic and cultural labels and then runs two translators: a rule-based system to translate known idioms and a large-scale Language Model (LLM)-based system using SinLlama, a Sinhalese-extended LLaMa model. It is based on the combination of Retrieval- Augmented Generation (RAG) and prompt engineering to improve the accuracy of translation and cultural authenticity. The parameter-efficient fine-tuning parameter-efficiency-based fine-tuning system of the fine-tuned LLM system is based on LoRA (Low-Rank Adaptation) and 4-bit quantization, which is used to optimize performance on a restricted set of computing resources. The system is intended to be an intelligent agent written in Python and LangChain, which ties the dataset of idiom together with the help of embeddings and vector databases to provide efficient retrieval. The ability of the system to maintain semantic meaning and cultural context can be evaluated by using bilingual speaker evaluations and computational measures. The highly integrated solution of incorporating rule-based preciseness with the freedom of the LLM demonstrates some encouraging achievement in solving the sophisticated problem of idiomatic translation. The study is a contribution to the field of developing NLP solutions to Sinhalese and offers a scalable model that can be applied in other low-resource languages that would encounter the same issue in translation.

Keywords: *Sinhala idioms; Cultural preservation; Semantic analysis; Rule-based approach; Large Language Model (LLM)*

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An Advanced Explainable AI-Based Predictive Intrusion Detection System for Smart University Networks

JAR Ariyawansa[1] RLW Koggalage[2], MAPP Dayarathna[3].*

[1] General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka

Smart university networks operate within a unique trade-off, balancing the necessity of open access policies with the imperative to secure heterogeneous "Bring Your Own Device" (BYOD) ecosystems. These academic environments are frequently resource-constrained, rendering traditional, heavy-weight security solutions ineffective against sophisticated cyber threats. This research addresses these specific vulnerabilities by proposing a novel Predictive Intrusion Detection System (PIDS) that integrates Explainable Artificial Intelligence (XAI) with rigorous zero-trust security principles. The proposed lightweight framework leverages a hybrid deep learning architecture, employing optimized Long Short-Term Memory (LSTM) and Convolutional Neural Networks (CNN) for proactive threat forecasting. Unlike opaque "black-box" models, this system ensures transparency by providing interpretable diagnostics through SHAP (SHapley Additive exPlanations) and LIME (Local Interpretable Model-agnostic Explanations), allowing administrators to validate algorithmic decision-making. Performance evaluation on benchmark datasets demonstrates a robust detection accuracy of 92.1%. Significantly, the system is optimized for edge computing; implementation on Raspberry Pi hardware confirms its operational feasibility, achieving a 92% reduction in resource utilization compared to conventional solutions. Consequently, this framework offers a sustainable security architecture while simultaneously serving as a dual-purpose educational tool, enhancing pedagogy in cybersecurity and artificial intelligence within the academic setting.

Keywords: *Intrusion Detection, Explainable AI, Zero Trust, Smart Campus, Predictive Security, LSTM Networks*

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**Corresponding author*: 40-bce-0001@kdu.ac.lk

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A Conceptual IoT and DevOps Automation Framework for Resource-Constrained Agriculture

Jayashan R.M.J[1*], Upethra N.T.P.G.B[2], Dayarathne M.P.P[3], Koggalage R.L.W[4].

[1] Department of Computer Engineering, General Sir John Kotelawala Defence University, Sri Lanka
[2] Department of Computer Science, General Sir John Kotelawala Defence University, Sri Lanka
[3] Department of Computer Engineering, General Sir John Kotelawala Defence University, Sri Lanka
[4] Department of Computer Engineering, General Sir John Kotelawala Defence University, Sri Lanka

Resource-constrained agricultural environments face significant challenges when it comes to adopting IoT technology. These challenges mainly occur from problems with interoperability, energy-latency trade-offs, and weak setups in unstable networks. Most of the current solutions do not provide the flexibility needed for small-holder farming systems. The proposed framework achieves its research targets through four key mechanisms such as open standards (schema.org translators), Reinforcement Learning (RL) based orchestration, GitOps automation, and Zero-Knowledge Proofs (ZKPs) to overcome these architectural issues. This Framework propose architecture which has an Interoperability Layer that uses schema.org translators to combine different sensor streams, such as Modbus and CANbus. It also includes an RL Orchestrator that dynamically balances computational loads between edge and cloud tiers. Also there is DevOps based controller to automate over-the-air (OTA) updates and a privacy preserving layer that uses ZKPs to confirm data integrity without revealing raw sensor values. The research uses an Infrastructure-as-Code (IaC) approach to create environments that can be reproduced and occupy digital twins to test system resilience under simulated weather and network conditions. By moving from static deployments to a more adaptive and automated infrastructure, therefore this framework aims to provide a scalable reference architecture for secure and resilience precision agriculture.

Keywords: *IoT; Precision Agriculture; DevOps; Edge-Cloud; Federated Learning*

* ***Jayashan R.M.J***: janithjayashan018@gmail.com

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Artificial Intelligence-Based Solutions for Gemstone Classification and Evaluation

K.K.V.R.M Kalyanapriya.[12,*], M.A.P.P Dayarathne.[2], R.L.W Koggalage [3]

[1] Department of Computer Engineering, Faculty of Computing,
General Sir John Kotelawala Defence University, Sri Lanka

Gemstones have historically been grouped, evaluated, and confirmed by expert visual inspection and physical or chemical tests. These traditional techniques are constrained by subjectivity, scalability issues, and inconsistent outcomes. Recent advances in artificial intelligence (AI), deep learning, and machine learning have enabled automated methods that improve accuracy and objectivity in gemstone analysis. The current literature on AI- based studies is still disjointed and scattered into a variety of data modalities, algorithms, and metrics of evaluation therefore a unified overview of the existing methods is required. This paper is a systematic review of the artificial intelligence based techniques used in the classification, grading, valuation in gems. Peer-reviewed articles were used to complete a structured literature review and were located in IEEE Xplore, Scopus, and Web of Science covering the years 2019–2025. This review summarizes recent research using AI models, including convolutional neural networks (CNNs) for imaging, machine learning for spectroscopy, and hybrid approaches combining natural language processing and visual data. The results show that convolutional neural networks are always high in accuracy for the classification of images of gemstones, and machine learning models based on spectroscopy are effective especially in measuring the quality and in identifying materials. Hybrid strategies are shown to have potential to be more robust with various types of gem stones. Results indicate that AI enhances gemstone identification, grading, valuation, and fraud detection, though challenges remain in dataset limitations, model explainability, and integration of expert domain knowledge. This review provides one comparative perspective of other modalities of AI and other fields of application. Future research opportunities include augmented reality devices, mobile applications, and blockchain-based traceability, highlighting the disruptive potential of AI in the gemstone market.

Keywords: *Artificial Intelligence; Gemstone Classification; Smart Gemology; Gemstone Evaluation; Convolutional Neural Networks(CNNs)*

**Corresponding author*: 40-bce-0005@kdu.ac.lk

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Development of an Advertisement Module for "Widya Ruhuna Govi-Nena" Mobile App

Jayasinghe A.R.[1*], Silva W.D.S. [1], Indika W.A. [1], Shanadi A.T.[1]

[1]Department of Computer Science, Faculty of Science, University of Ruhuna, Sri Lanka.

"Widya Ruhuna Govi-Nena" mobile application (https://govinena.lk/) is one of the well-established mobile platforms available for Sri Lankan agriculture sector. It has been developed through research and continuous engagement with stakeholders, and the app has provided important features like *crop guidance*, *activity calendar*, *pest and disease management*, *weather forecasting*, and *market insights*. With these features, the app has become a robust, reliable, trustworthy platform and has improved the users' involvement with the app significantly. To keep the app always up to the users' requirements, regular feedback sessions have been conducted, and through collected feedback, necessary changes to the app have been made, new features have been introduced, and unnecessary complications have been removed. Most users highlighted the absence of a dedicated platform to buy or sell agriculture-related products, including harvest by-products, harvesting machinery, planting materials, fertilizers, pesticides, and related inputs. Moreover, there is no digital platform specifically focused on agriculture that addresses these requirements. To fulfil this gap, an advertisement module was carefully designed and developed by analyzing requirements collected via questionnaires from stakeholders (mainly farmers and input suppliers) and reviewing similar systems for reference. Developed module enables users to perform key functionalities like posting an advertisement, viewing advertisements, filtering and sorting results, searching with keywords, and managing posted advertisements like updating, deleting, and temporarily deactivating through the user dashboard. The evaluation was mainly conducted with farmers and agricultural input suppliers by getting their feedback, comments and suggestions on developed prototype. Based on this feedback, the user interface designs were refined further. The evaluation of the new module demonstrated that it is simple, easy to understand, and also can be easily adopted by users.

Keywords: Advertisement Module, Digital Agriculture, Govi-Nena App, Farmers

Corresponding author: ashanjr@outlook.com

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Readiness Assessment and Barriers Identification in Adopting Sustainable Smart Warehousing Practices in Sri Lanka's FMCG Sector

Pramodya Nethmini[1], Dr Amila Withanaarachchi[2], Dr Chathumi Kavirathna[2]*
[1] Department of Industrial Management, Faculty of Science, University of Kelaniya, Sri Lanka
[2] Department of Industrial Management, Faculty of Science, University of Kelaniya, Sri Lanka

The rising demand on supply chains to enhance both operational performance and environmental sustainability has heightened interest in Sustainable Smart Warehousing (SSW). However, the adoption rates are still limited in developing countries because of several structural and situational barriers. This research combines a systematic literature review with empirical validation to evaluate organizational preparedness and pinpoint significant barriers to SSW implementation in Sri Lanka's Fast-Moving Consumer Goods (FMCG) industry. Firstly, a systematic literature review based on the PRISMA framework was performed on 51 peer-reviewed articles published between 2018 and 2025 to compile global trends, enabling technologies, and obstacles to adoption. The review highlighted financial, technological, operational, human resource, and industry-specific factors as the most commonly mentioned limitations, while also indicating a lack of cohesive readiness assessment frameworks that incorporate sustainability dimensions. To enhance practical relevance, the identified constructs were validated using survey data collected from 144 FMCG and logistics professionals. Partial Least Squares Structural Equation Modeling (PLS-SEM) was employed to test the relationships between barriers and SSW adoption. The results indicate that financial and economic barriers and technological infrastructure limitations exert significant negative effects, while warehouse operational efficiency and industry alignment positively influence adoption. The proposed model demonstrates moderate explanatory power ($R^2 = 0.512$), confirming its suitability for behavioral and sustainability oriented research. The study contributes by bridging theoretical insights from literature with real-world validation and by proposing a context specific SSW readiness assessment model. The findings offer actionable guidance for practitioners and policymakers to prioritize investments and develop phased strategies for sustainable, technology driven warehouse transformation in emerging economies.

Keywords: *Sustainable smart warehousing; readiness assessment; Industry 4.0; FMCG; adoption barriers*

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***Corresponding author:** nethminipramodya@gmail.com

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A Comparative Study on Deep Transfer Learning Based Rice Leaf Disease Detection

Gomes P.M.K.[1,*], Supul V.A.[1], Shenal W.A. [1], Rodrigo U.L.T [1], Pathirana K.P.U.L.[1], Vidanagamachchi C.S.[1], Chathurangi K.A.A.[2]

[1] Department of Computer Science, University of Ruhuna, Sri Lanka
[2] Department of Computer Science & Informatics, Faculty of Applied Sciences, Uva Wellassa University of Sri Lanka, Sri Lanka

Rice, a global staple, supplies one-fifth of the calories for over 3.5 billion people. In Sri Lanka, it feeds over 65% of the population and supports 1.8 million farming families. Diseases, including bacterial leaf blight, brown spot, leaf scald, and narrow brown spot, are challenges to cultivation. These are especially severe in the humid wet zone, often causing over 50% yield loss. Current identification relies on visual inspection, leading to delayed detection and pesticide overuse. This highlights a clear need for automated, Sri Lanka-specific disease detection systems to protect yields and livelihoods. This study examines the application of Machine Learning (ML) and Deep Learning (DL) techniques for the automated classification of rice leaf diseases. Four models, a custom Convolutional Neural Network (CNN), transfer learning models using VGG16 and VGG19, and a hybrid CNN-Support Vector Machine (CNN+SVM) were developed and evaluated. Open-source data were collected, and images representing the Sri Lankan context were selected, applied preprocessing and augmentation, and trained a model using over 3000 images, split into 70% training, 15% testing, and 15% validation for the overall model training process. Among the models, VGG19 achieved the best performance, with 0.9944 training accuracy and 0.9886 testing accuracy. These results demonstrate the effectiveness of deep transfer learning in enhancing rice disease detection, minimizing pesticide misuse, and promoting sustainable agriculture in Sri Lanka. Future efforts will focus on enlarging the dataset with local images and developing mobile-based diagnostic tools.

Keywords: *Rice Leaf Disease, Deep Learning, Convolutional Neural Network, Transfer Learning, Sri Lankan Agriculture*

**Gomes P.M.K*: gomesmilindu@gmail.com

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A preliminary study on the *in vitro* antioxidant activity of nine species of the lichen genus *Heterodermia* (family Physciaceae) collected from tea plantations in Sri Lanka

Bandara M.A.B.C.N.[1], Kariyawasam I.U.[1*], Jayalal R.G.U.[2]

[1] Department of Botany, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[2] Department of Natural Resources, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka

Since research on the antioxidant activity of Sri Lankan *Heterodermia* species is limited, the study focused on determining the antioxidant activity of nine *Heterodermia* species collected from tea plantations. The 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay was performed to evaluate the antioxidant activity of selected species. The study was carried out on *H. comosa*, *H. dactyliza*, *H. isidiophora*, *H. japonica*, *H. microphylla*, *H. obscurata*, *H. pellucida*, *H. propagulifera*, and *H. speciosa.* Methanolic extracts of the lichen samples were prepared by microscale extraction and tested at four concentrations (25, 50, 100, and 200 µg/mL), with ascorbic acid as the positive control. All assays were duplicated, and results were statistically analyzed using one-way ANOVA followed by Tukey's post hoc test ($p < 0.05$). Percentage inhibition and the IC_{50} values were calculated for all species. The highest percentage inhibition across all concentrations and the lowest IC_{50} value were exhibited by *Heterodermia propagulifera*. Among the species tested, *Heterodermia obscurata* showed the lowest percentage inhibition, whereas *Heterodermia dactyliza* showed the highest IC_{50} value. The remaining lichen extracts showed different IC_{50} values, indicating varying antioxidant activity across the *Heterodermia* genus. Ascorbic acid (positive control) displayed a higher percentage inhibition than all the lichen extracts and showed the lowest IC_{50} value, indicating strong antioxidant activity. The present study showed that the antioxidant activity of the tested *Heterodermia* lichen species varied considerably. While some species, such as *H. obscurata* and *H. dactyliza*, exhibited relatively low activity (high IC_{50}), others demonstrated stronger antioxidant potential, highlighting differences in bioactivity across species.

Keywords: *Lichens, Heterodermia, DPPH, Antioxidant*

**Corresponding author*: isurufasi@sjp.ac.lk

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Community Knowledge, Attitudes, and Practices (KAP) toward the conservation of common wild rice (*Oryza rufipogon*) in Matara District, Sri Lanka

Madushanka, K.S.J.[1], Bandara, D.M.A.D.[1], Arosha, K.P.L.[1], Thilakarathne, W.L.S.M.I.D.M.[1], Jayasooriya, W.J.A.P.M.[1], Ratnasekera, D.[2]*

[1]Faculty of Graduate Studies, University of Ruhuna, Matara, Sri Lanka
[2]Department of Agricultural Biology, Faculty of Agriculture, University of Ruhuna, Kamburupitiya, Sri Lanka

Oryza rufipogon is the primary ancestor and closely related germplasm resources of the cultivated rice (*Oryza sativa L.*). They inhabit unprotected areas causing risk of extinction due to various anthropogenic activities. This study aimed to assess the current population status, public awareness, and habitat conditions of common wild rice in Matara District to develop conservation practices through increased awareness. In Matara District, 96 natural habitats of *O.rufipogon* were identified and KAP-based questionnaire surveys were conducted with 480 individuals across 16 Divisional Secretariats. The sample size was determined using Cochran's formula with a 95% confidence level and purposive sampling method, data were analyzed using SPSS v25.0. Totally 480 respondents were involved and 57.9% were female. Three age categories included individuals aged ≥60 years (22.1%), between 51-60 years (21.9%) and young-adults aged 18-30 years (19.8%). Occupationally, 26.7% were engaged in agriculture, an equivalent 26.7% were in government service and 24.2% in business. Chi-square analysis showed significant relationship between occupation and knowledge of wild rice ($p<0.05$), 12.5% of agricultural workers being awareness of wild rice. A significant relationship was identified between age and knowledge of wild rice ($p<0.05$), with the highest level of knowledge (9.5%) recorded among respondents aged 51–60 years. Overall, 96.7% respondents had no prior knowledge of wild rice, while only 3.3% were aware of its conservation. According to the results, minimal awareness was observed among the associated communities inferring risk of extinction due to human activities. Proper awareness program should be adopted among the associated communities, especially, focusing farming community to fill the knowledge gap and ensure successful conservation strategies.

Keywords: *Conservation status; Public awareness; Extinction; Genetic diversity; Natural habitat*

**Corresponding author: disnar@agbio.ruh.ac.lk*

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Prospects and Challenges of Implementing Geographic Indication Certification along the Cinnamon Value Chain

Sarangi, M.M.[1*] and De Silva W.N.[2]

[1,2] Department of Agricultural Economics and Agribusiness, Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitiya, Sri Lanka

The cinnamon industry in Sri Lanka is internationally recognized for producing high-quality Ceylon cinnamon with significant economic value. The granting of Geographic Indication (GI) status for Ceylon cinnamon offers a strategic opportunity for Sri Lanka to differentiate authentic (true) cinnamon from cassia and expand its share in the global market. This study assesses the prospects and challenges of implementing Geographic Indication (GI) certification along the Ceylon cinnamon value chain. The study was conducted in four Divisional Secretariats in the Galle District. Data were collected from a purposively selected sample of cinnamon growers (30), processors (30), value addition actors (05), and exporters (05) using pre-tested questionnaires and focus group discussions. Both primary and secondary data were used to analyse the cinnamon industry, and a SWOT analysis was employed to examine the strengths, weaknesses, opportunities, and threats related to GI certification implementation. The findings reveal that obtaining GI certification is a time-consuming process, which discourages many value chain actors from applying. This is mainly due to three key requirements: membership in the Ceylon Cinnamon Protected Geographical Indication Association (CCPGIA), approval through internal and external audits, and compliance with Good Agricultural Practices (GAP) and Good Manufacturing Practices (GMP). Although GAP and GMP are essential for maintaining quality, their adoption remains moderate due to high compliance and documentation costs. The SWOT analysis further highlights limited awareness of GI certification, inadequate technology for value addition, weak institutional coordination, and insufficient financial resources as major constraints. Overall, the study provides insights to support policymakers and value chain actors in enhancing the export value of Ceylon cinnamon through effective GI implementation.

Keywords: *Geographic Indication, Cinnamon industry, Good Agricultural practices, Good Manufacturing Practices, Value Chain*

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Natural Allies against Iron Toxicity in Soil: Exploring Iron-Tolerant Bacteria from Selected Sri Lankan Soils

N.K.P. Bandara[1], I. U. Kariyawasam[1*]

[1] Department of Botany, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka

In agricultural soils, iron toxicity is an increasing problem, particularly in regions with naturally iron-rich geologies or those affected by excessive fertilizer and industrial runoff. Iron-tolerant bacteria offer promising biotechnological solutions for the bioremediation of such polluted environments. The present study focused on the isolation, morphological characterization, and assessment of iron tolerance in bacteria from selected iron-rich soils in Sri Lanka. Soil samples were collected from Bombuwala in Western Province and Dela in Sabaragamuwa Province. Sites were selected based on recent studies that reported the presence of iron-rich soils in Sri Lanka. Ten (10) soil samples from each site were collected using simple random sampling method, and serial dilutions were plated in triplicate for bacterial isolation. Nine (09) morphologically distinct bacterial isolates were obtained using nutrient agar supplemented with ferrous ions at 100 mg/L and 300 mg/L. The isolates were characterized based on colony morphology and Gram staining results. Gram staining results indicated that all isolates were Gram-positive. Iron tolerance was assessed using a nutrient agar plate assay with graded ferrous ion concentrations (0-800 mg/L), and growth was evaluated qualitatively across triplicate plates. All isolates exhibited growth at ferrous ion concentrations up to 500 mg/L Fe^{2+}, with varying tolerance levels observed among isolates. Notably, one isolate (S2HH) demonstrated exceptional tolerance, sustaining growth at the highest tested concentration. These findings highlight the presence of diverse iron-tolerant bacteria in sampled Sri Lankan soils. It may also highlight their possible role in the natural mitigation of iron toxicity in soil, warranting further investigation.

Keywords: *Iron-tolerant bacteria, Ferrous ion, Soil microbiology, Iron toxicity, Bioremediation*

**Corresponding author*: isurufasi@sjp.ac.lk

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Assessment of the extent of shoreline change in Arugam Bay, Eastern Province, Sri Lanka

***K. Arjunan*[1] [*], *Jelshe Sellar*[1].**

[1] Department of Bio Science, University of Vavuniya, Sri Lanka

Shorelines are dynamic and altering at high rate in Coastal region, posing is a significant environmental and socio-economic concern worldwide. Arugam Bay, located in the Ampara district of the Eastern Province, is a coastal region and a surfing destination for tourists, vulnerable to coastal erosion due to natural and anthropogenic factors. The aim of the study was to assess the extent of shoreline change in Arugam Bay between 2000 and 2024. To assess the shoreline changes, Landsat 5, Landsat 7, Landsat 8 and Landsat 9 were used, and the Modified Normalized Difference Water Index (MNDWI) was applied to differentiate land from water for shoreline delineation. The Digital Shoreline Analysis System (DSAS) 5.1 toolbar (extension) in ArcGIS 10.4.1 software was employed to analyze shoreline changes, using Shoreline Change Envelope (SCE), Net Shoreline Movement (NSM), End Point Rate (EPR), and Linear Regression Rate (LRR). The highest SCE was 253.44 m and NSM values ranged from -203.91 to 11.62m. The EPR results reveal that accretion occurred at a rate of 1.04 m y^{-1}, while the highest rate of erosion reached -8.5 m y^{-1}. The LRR rates indicate significant shoreline retreat and anomalous erosion trends, ranging from -1.87 m y^{-1} to -6.57 m y^{-1}. These results reveal a significant rate of shoreline change along the stretch of Arugam Bay shoreline. Thus, more appropriate, feasible, and sustainable coastal management practices are needed to protect coastal habitats, safeguard livelihoods, and reduce the progress of coastal erosion.

Key words: *Coastal erosion; Shoreline change; Arugam Bay; Remote sensing; DSAS*

**Corresponding Author*: ksarjunan@vau.ac.lk

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Production of Organic Fertilizer from Shrimp Waste and Evaluate its Effect on the Growth of Chili (*Capsicum* spp.) Plants

***Praboda M.G.G.S.*[1*], *Senaarachchi W.A.R.K.*[2], *De Silva M.P.K.S.K.*[1].**

[1] Department of Zoology, University of Ruhuna, Sri Lanka
[2] Agri Farm Elevators (Pvt) Ltd, 302, D/1, Alubadda, Awkana, Sri Lanka

Shrimp processing industry generates large amounts of waste, rich in proteins (approximately 50%) lipids, and carotenoids. Present study evaluated the effect of organic fertilizer produced using shrimp waste on growth of chili plants. Shrimp waste was blended, autolyzed, filtered and fermented for 24 hours using commercially available bacteria (*Nitrosomonas*, *Nitrococcus* and *Bacillus*) to produce an organic fertilizer (T1). Effectiveness of T1 as an organic fertilizer on growth of chili plants was compared with commercial urea fertilizer with 46% nitrogen (T2) and water (Control). 25 days old uniform size thirteen chili pots were used for each treatment and placed them according to a randomized design. Fertilizers were applied weekly as foliar spray over 11 weeks, according to standards given by Agriculture Department of Sri Lanka for chili plants. During that period vegetative parameters were measured weekly and after 10 weeks, reproductive parameters were measured for one week. One-way ANOVA and Kruskal-wallis test were used for post- hoc statistical analysis. Nitrogen content of shrimp waste fertilizer was determined as crude protein (9.4%), free ammonia (2.30 mg/L) and nitrate (0.09 mg/L). Fermentation had reduced the crude protein content of the organic fertilizer. Most vegetative growth parameters did not show a significant difference among the three treatments except in root lengths of plants ($P<0.05$). However, plants treated with T1 had higher vegetative growth for all parameters. Number of pods and fresh pods weight in T1 were also higher than the other two treatments. The study reveals that shrimp waste-derived fertilizer has a possibility to be used as an eco-friendly alternative for urea with sufficient field trials.

Keywords: *foliar application, organic fertilizer, plant growth, Shrimp waste*

**Corresponding author*: sajinigamage24@gmail.com

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Assessment of Early Growth Performance of Rice Genotypes under Submergence Conditions

Kariyawasam S.T.[1*], Nedijalian S.[1], Jayawardena M.N.[1], Weerasinghe D.P.[2], Jayatilake D.V.[1]

[1]Department of Agricultural Biology, Faculty of Agriculture, University of Peradeniya, Sri Lanka
[2]Regional Rice Research and Development Centre, Bombuwela, Sri Lanka

Rice is a staple for over half of the world's population, but production is constrained by submergence stress as climate change increases flooding. Rapid germination and vigorous early growth enable seedlings to escape or withstand submergence. We evaluated seventeen rice accessions for early-stage growth under submergence. Ten pre-germinated seeds were sown per replicate, with three replicates per variety, and maintained in a growth chamber. In the treatment, trays were immersed in 3 cm of water. Seedlings were removed on day five and shoot and root lengths measured. Percentage decreases in root and shoot lengths relative to the control were calculated and the data were analysed using one-way ANOVA, followed by Dunnett's test ($p < 0.05$) comparing accessions against tolerant (*Godaheenati*) and susceptible (IR 42) references. *Godaheenati* exhibited the lowest percentage decrease in shoot length, while IR 42 showed the highest. At 362 recorded the lowest percentage decrease in root length, whereas IR 42 recorded the highest. Considering both traits, At 362, Bw IRLON 237 and Bw IRLON-104 were not significantly different from *Godaheenati*, while At 311 and Bw14-509 were not significantly different from IR 42. Other accessions showed intermediate performance, reflecting diverse early growth strategies. These results highlight genetic variation in seedling vigour under submergence and suggest links between early growth of *Godaheenati* and IR 42 to their later-stage tolerance or susceptibility. The findings provide a basis for selecting rice genotypes with enhanced submergence tolerance, promoting rapid establishment and improved productivity in flood-prone lowlands in climate-vulnerable regions.

Keywords: *Submergence tolerance, Oryza sativa (L), Seedling vigour, Climate change*

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**Corresponding author*: thamali@agri.pdn.ac.lk

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Isolation and Identification of Candidate Fungi for Developing a Micro Algal-Fungal Biofilm for Biotreatment of Palm Oil Mill Effluent

Warnakulasooriya S.P.D.A., Balasooriya B.L.W.K., Indumini U.A.R.

Department of Biotechnology, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP), 60170, Sri Lanka

Palm Oil Mill effluent (POME), generated during the extraction process of palm oil, contains higher levels of pollutants. This study aimed to isolate candidate fungi for developing a microalgal–fungal biofilm for bioremediation of POME using wastewater samples from a palm oil mill in Nakiyadeniya, Sri Lanka. Several fungi were isolated in Potato Dextrose Agar and *Aspergillus* sp. was selected for the study due to its bioremediation potential. DNA extraction by modified CTAB method and sequencing confirmed the species as *Aspergillus aculeatus* (99.26%). *Chlorella vulgaris*, previously isolated from POME was applied as the microalgae for biofilm development. First, compatibility between the species were monitored by cross-streak culturing on modified PDA, modified BG11 (+ Glucose), and combined media (PDA+BG11) and 66.7% of plates indicated compatible growth except in modified PDA. Biofilm formation was further assessed using a microtiter plate assay. *C. vulgaris*, *A. aculeatus,* their mixed culture in modified BG11 and the growth media as control were poured into the wells in triplicate. After six days of incubation (pH 7.0, 26±2 °C, 2000 lux, 16/8 hr. light/ dark), biofilms were detected by crystal violet staining and monitoring absorbance at 620 nm. ANOVA and DUNCAN analysis resulted significantly higher average absorbance of the mixed culture (1.1017) compared with the monocultures of *C. vulgaris* (0.3790, p=0.05) and *A. aculeatus* (0.8020, p=0.05) indicating potential biofilm formation in the mixed culture. The study successfully isolated *A. aculeatus* from POME as an effective candidate fungus to develop biofilms with *C. vulgaris* highlighting their potential for biotreatment of POME.

Keywords: *Biofilms, Biotreatment, Chlorella, Fungi, Palm oil mill effluent*

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**Corresponding author*: wajira.balasooriya@gmail.com

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Effect of Various Cooking Methods on the Physicochemical, Nutritional, and Functional Properties of Two Different Rice Varieties Grown in Sri Lanka

Safana A.M.F., Perumpuli P.A.B.N.* and Ravindi S.M.A.

Department of Food Science and Technology, University of Ruhuna, Wellamadama, Matara, 81100, Sri Lanka.

Rice (*Oryza sativa L.*) is the staple food of Sri Lanka, and cooking method specifically influence its nutritional qualities, yet limited studies have examined these qualities on improved local varieties. This study evaluated the impact of four different cooking methods; conventional boiling, rice cooker, pressure cooker, and microwave oven on a physicochemical, nutritional, and functional properties of two widely consumed local rice varieties; White *Nadu* (Bg 300) and *Rathu Kekulu* (At 362). Samples were collected from the same rice mill located in Kamburupitiya and analyzed in triplicates (CRD design) for above characteristics. One-way ANOVA with Tukey's test ($p < 0.05$) determined the statistical significance**.** Results revealed that *At 362* exhibited significantly higher fiber (0.171±0.02 g/100 g), carbohydrates (79.138±0.84 g/100 g), flavonoids (20.758±0.07 mg QE/100 g), phenolics (6.761±0.00 mg GAE/100 g), and antioxidants (32.004±2.03 %) compared to *Bg 300* in raw form. All cooking methods caused nutrient losses in different magnitudes. The rice cooker method achieved the highest nutrient retention and maintained desirable functional properties in both varieties (*At 362* and *Bg 300*), retaining significantly higher ($p < 0.05$) flavonoids (14.869±0.09 and 8.153±0.07 mg QE/100 g), phenolics (3.89±0.04 and 1.73±0.05 mg GAE/100 g), and antioxidants (22.67±2.03 % and 13.33±2.03 %) respectively. Water absorption and swelling power also best preserved with rice cooker and conventional boiling, while microwave showed the lowest values. Two rice varieties exhibited distinct properties that influenced their response to cooking, in raw state, and rice cooker cooking best preserved bioactive compounds due to controlled heating and limited water contact.

Keywords: *Cooking methods; Functional, Nutritional and physicochemical properties; Rice varieties*

**Corresponding author*: buddhikap@fst.agri.ruh.ac.lk

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Assessment of Environmental and Socio-Economic Benefits of Home Garden: A Case Study in Vavuniya District

N. Jasika[1], K. Arjunan[1].*

[1]Department of Bio-science, Faculty of Applied Science, University of Vavuniya, Sri Lanka

Strengthening local food systems and enhancing livelihoods are becoming more important as communities face global food crises and high food prices. Home gardening methods are useful to increase household food security and generate income by producing food. Empirical research on household perceptions and acceptance of home gardening methods remains limited. Therefore, this study addresses the gap by examining household perceptions, acceptance, and use of home gardening in Vavuniya. A simple random sampling technique was used to select 150 respondents from urban (34%; Vavuniya town, Vairavarpuliyankulam, Kovilkulam, Moonrumuripu, Thaandikulam), suburban (33%; Veppankulam, Kurumankadu, Nelukulam, Irattapetiyakulam, Pandarikulam), and rural areas (33%; Koomankulam, Puthukulam, Suntharapuram, Cheddikulam, Kangankulam). Data were collected through semi-structured questionnaires, interviews, and field observations, and analyzed using Minitab version 20.4. The results revealed that 61% do not practice home gardening due to a lack of space, a lack of time, and pest and disease damage, while 39% of respondents experience that using home gardening techniques would increase their household food security. Socio-economic benefits of home gardens included contribution to household food supply (48%), additional income (35%), health improvement (12%), and recreational or hobby purposes (5%). The study also found that home gardens provide significant environmental benefits, such as expanded biodiversity (37%), cooling of surroundings (32%), recycling of organic waste (7%), soil protection (4%), and improved air quality (19%). This study underscores the need for initiatives to promote home gardening practices, highlighting the necessity of improving household nutrition, supporting sustainable livelihoods, and providing environmental and socio-economic benefits in the Vavuniya district.

Keywords: Environmental and socio-economic benefits, Food Security, Home gardening

*Corresponding author: jasikanavanesan@gmail.com

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Assessment of Abundance and Diversity of Aquatic Weeds in Major Tanks of Northern Sri Lanka

T. Banupriya[1]*, K. Arjunan[1].

[1] Department of Bio-science, Faculty of Applied Science, University of Vavuniya, Sri Lanka

Freshwater ecosystems are essential for biodiversity, agriculture, and rural livelihoods, however aquatic weed infestations in tank based freshwater systems reduce irrigation efficiency, disrupt inland fisheries, and alter ecological dynamics, leading to biodiversity loss. This study focused on assessing the abundance and diversity of aquatic weeds in five major irrigation tanks of the Northern Province, Sri Lanka, namely Paavatkulam Tank, Vavuniya Tank, Vavunikulam Tank, Muththuiyankaddu Tank, and Vanneri Tank. Field surveys were conducted between June and July 2025, using random quadrat sampling in weed-infested areas, and the species data were analyzed using Shannon–Wiener and Simpson diversity indices. A total of 19 aquatic weed species were recorded, which include 11 native and 8 exotic species. Species diversity varied across the tanks, with the highest diversity observed in Paavatkulam and Vavuniya (H′=1.62–1.75; 1–D = 0.77–0.82), the lowest in Vavunikulam and Muththuiyankaddu (H′ = 0.66–0.73; 1–D = 0.36–0.47), and moderate diversity in Vanneri Tank. These results highlight considerable variation in aquatic weed communities among the studied tanks, with few of the tanks dominated by invasive species such as *Eichhornia crassipes*, *Salvinia molesta*, *Hydrilla verticillata*, and *Najas marina*. These data can support prioritizing invasive species control and guide sustainable tank and inland water resources management strategies in the Northern Province of Sri Lanka and provide data to support future ecological monitoring and management planning.

Key words: Aquatic weeds, diversity, abundance, impacts, management

**Corresponding author*: banuvat2000@gmail.com

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Isolation and Characterization of Oil-degrading Bacteria Associated with Kalpitiya and Ettalai Seagrass Meadows

N.T. Muthumuni, R.A.S. Udayangani, H.W.M. Navanjali, E.P.D.N. Thilakarathne, W.M.L.A. Wanasinghe*

Department of Animal Science, Faculty of Animal Science and Export Agriculture, Uva Wellassa University, Badulla, Sri Lanka

Seagrass meadows represent one of the most vital marine ecosystems and are significantly exposed to anthropogenic pressures, particularly tourism and fishing. This study focused on the isolation and characterization of oil-degrading bacteria associated with *Enhalus acoroides* and *Halophila* spp. seagrass beds in the Kalpitiya and Ettalai regions of Sri Lanka, with the aim of exploring potential bacteria for oil bioremediation. Water, and sediment samples were collected and cultured on R2A agar media by using serial dilution method. Isolated bacteria were identified by using biochemical tests and 16S rRNA gene sequencing. Selected eight isolates were streaked on Bushnell-Hass (BH) agar medium and supplemented with 1% (v/v) diesel as the sole carbon source. Biochemical and molecular characterization revealed that the isolates belong to the genus *Bacillus*. Finally, out of the eight isolates tested, six bacteria (*Priestia aryabhattai*, *Priestia flexa*, *Bacillus altitudinis*, *Fictibacillus phosphorivorans*, *Metabacillus indicus,* and *Bacillus stratosphericus*) demonstrated the ability to utilize diesel, indicating oil degradation ability. Among them, *Bacillus altitudinis* and *Bacillus stratosphericus* exihibited the highest biosurfactant activity, with emulsification indices of 31.07±9.58% and 38.86±10.19%, respectively. These biosurfactant are capable of enhancing hydrocarbon bioavailability and accelerating degradation. The findings emphasize the potential application of indigenous bacterial strains in environmentally sustainable bioremediation strategies for oil-polluted coastal ecosystems.

Key words: *Bacillus spp.*; *Biosurfactants*; *Bioremediation*; *Oil-degrading bacteria*; *Seagrass beds*

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Role of Asian Elephants (*Elephas maximus*) as Seed Dispersers in and Around Udawalawe National Park, Sri Lanka.

Chathuranga, W.G.D.*, Guruge, W.A.H.P

Department of Zoology, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

Asian elephants (*Elephas maximus*) are renowned as key seed dispersers in tropical ecosystems, often referred to as the mega-gardeners of the forest. Despite their ecological significance, only a few studies have inspected their seed dispersal capability in Sri Lanka. This study was conducted between September and November 2024 to evaluate the seed dispersal potential of Asian elephants. A total of 46 elephant dung piles were identified from the interior (n = 18) and exterior of the park (n = 28). From the dung piles, one dung ball each was collected and examined for the presence of seeds of various plant species. Of the 46 dung boli, 43 (93%) contained seeds, with a total of 39 seed groups. Of them, 23 were taxonomically categorized into seven plant families: Fabaceae, Poaceae, Verbenaceae, Myrtaceae, Asteraceae, Solanaceae, and Cucurbitaceae. The Fabaceae family accounted for the highest proportion of seed groups (20/39; 51.3%). The abundance of seeds was considerably greater in dung piles collected from the forest edge (n = 728) compared to those from the interior (n = 228) of the forest ($p < 0.05$), suggesting increased seed dispersal activity outside the park boundary. Family Poaceae had the highest number of seeds of an individual family (392/956; 41%), followed by Fabaceae (258/956; 27%) and Verbenaceae (210/956; 22%). These findings highlighted the ecological role of elephants in the Udawalawe landscape as seed dispersers. However, continued and long-term research is crucial to fully understand their contribution to forest regeneration. Especially, integrating habitat enrichment with existing mitigatory measures may compromise a more effective and sustainable approach to conserving elephants while reducing HEC.

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Keywords: Crop raiding, Elephant dung, Fabaceae, Habitat enrichment, Mega-gardeners

Corresponding author: chathurangawgd@zoo.ruh.ac.lk

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Effect of Water Salinity on the Lifecycle Progression of *Aedes Albopictus* Mosquitoes

Rajapaksha, R.P.M.N., Dhananjaya, D.G.S., and Chathuranga, W.G.D.

Department of Zoology, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

Mosquitoes, particularly *Aedes albopictus*, are key vectors in the transmission of vector-borne diseases such as dengue, which poses a significant public health risk in various regions worldwide. Understanding the relationship between mosquito fauna and the physico-chemical properties of their breeding habitats is essential for assessing the risks associated with these diseases. This study aimed to evaluate the impact of five naturally occurring water types; *i.e.*, marine, brackish, pond, rain, and distilled water (Used as the control), on the life cycle of *Aedes albopictus*, one of the secondary dengue vectors in Sri Lanka. The water types represented distinct salinity conditions, with marine water showing high salinity (33.99 ppt), brackish water moderate salinity (9.86 ppt), pond water low salinity (0.06 ppt), rainwater very low salinity (0.01 ppt), and distilled water having no detectable salinity (0.00 ppt), which served as the control water sample in the study. A total of 1,100 *Ae. albopictus* eggs were monitored across five replicates, with 20 eggs placed in each of the five water types. The study focused on tracking survival rates and the progression of the mosquito life cycle, from egg hatching to adult emergence. Data were analyzed using SPSS and Minitab (V.21) software. The results revealed significant variations ($p < 0.05$) in hatching success (HA) and larvae emergence (EM) across the different water types, underscoring the importance of water composition in mosquito breeding success. Rainwater demonstrated the highest levels of both hatching (HA: 16.6 ± 1.20) and larvae emergence (EM: 16.2 ± 1.17), making it the most favorable environment for mosquito development, followed by pond water (HA: 10.2 ± 0.98; EM: 9.8 ± 0.75) and brackish water (HA: 9.0 ± 0.63; EM: 4.2 ± 0.40). In contrast, marine and distilled water showed no hatching or larval emergence, indicating their unsuitability for mosquito survival. Complementary controlled-salinity experiments (6 ppt, 10 ppt, 14 ppt, 18 ppt, 22 ppt, and 26 ppt) were conducted using pond water as the base medium revealed that eggs hatched only at 6 ppt, 10 ppt, and 14 ppt, with the highest hatching at 6 ppt (HA: 12.2 ± 1.3; EM: 86.9 ± 12.8) followed by 10 ppt (HA: 5.4 ± 0.5; EM: 18.5 ± 18.7). Breeding success of *Aedes albopictus is* tightly regulated by salinity, with high hatching success (HA) and larval emergence (EM) occurring only below 14 ppt. Optimal development occurred at 6 ppt, while ≥14 ppt caused larval mortality, and ≥18 ppt completely inhibited hatching, identifying low-salinity rain-fed and weakly brackish waters as the primary ecological niches for dengue vector proliferation.

Keywords: *Aedes albopictus*; *Dengue control; Hatching success; Mosquito breeding sites; Salinity tolerance.*

**Corresponding author*: *chathurangawgd@zoo.ruh.ac.lk*

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Macroplastic and Microplastic Contamination at SK Town Beach, Matara, Southern Sri Lanka

Abekoon, M.M.S.R; Wijesooriya, M.G.M.; Deshapriya, K.L.S.L.; Mendis, G.S.R.; Chathuranga, W.G.D.
Faculty of Science, University of Ruhuna, Matara, Sri Lanka

Plastic pollution is a growing environmental problem, with plastic debris from both land and ocean sources accumulating on coastal beaches. This study assessed the degree of macroplastic and microplastic contamination at SK Town Beach, Matara, Sri Lanka, a popular tourist destination during the off-season months of May and June 2025. A quadrat sampling approach was used to collect macroplastics over four weeks across five designated 10 m × 10 m quadrats at 50 m intervals along a 'length of the transect or length of the beach stretch'.Nine Sand samples for microplastic analysis were collected from the same 10 m × 10 m quadrats. Macroplastics were manually sorted, categorized, and weighed, while microplastics were isolated from surface sand through density separation, oxidative digestion, and counting through a stereomicroscope. Across all quadrats, regiform and fishing-related debris (6.86 kg) represented the highest total macroplastic mass, and stationery-related plastics (0.65 kg) accounted for the lowest amount. A one-way ANOVA showed no significant difference in macroplastic mass across all sampling dates ($p = 0.873$). Although all sites were exposed to similar coastal conditions, differences in macroplastic accumulation abundance were mainly driven by varying levels of human interaction. Results also showed a high level of contamination, with microplastic concentrations ranging from 1,388.9 to 2,177.8 particles per kg of dry sand. Fragment, film, and microbeads were found to be the types of microplastics with very high quantities, while the amount of fiber was relatively lower. Specifically, microplastic abundance did not consistently correlate with the macroplastic mass. It also means that factors like historical deposition, rates of degradation, and environmental transport mechanisms may have an impact on the migration of microplastics. This study emphasizes the importance of improved coastal waste management and long-term monitoring to reduce both visible (macroplastics) and invisible (microplastics) plastic pollution.

Keywords: Beach pollution, Plastic debris, Marine litter, Regiform

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Estimation of Palm Surface Area as a Percentage of Body Surface Area – A Preliminary Cadaveric Study

Ilayperuma I.[1*], Suranga A.D.S.[1], Prabodha L.B.L.[1], Nanayakkara B.C.I.J.[2], Warusahennadi J.[3]

[1] *Department of Anatomy, Faculty of Medicine, University of Ruhuna, Sri Lanka*

[2] *Department of Surgery, Faculty of Medicine, Kotalawala Defense University, Sri Lanka*

[3] *Department of Forensic Medicine, Faculty of Medicine, University of Ruhuna, Sri Lanka*

Body surface area (BSA) plays a vital role in burn therapy, cancer chemotherapy and critical care management. In critical care settings, hand surface area (HSA) and palm surface area (PSA) are used to estimate BSA on the assumption that HSA and PSA accounts for 1% and 0.5% BSA respectively. It has been shown that 1% HSA rule results in an overestimation for Sri Lankan adults. The objective of the study was to explore the %PSA in relation to BSA. The study was conducted on cadavers (n=65: 34 male & 31 female; age 58–76 years) donated to the Department of Anatomy, University of Ruhuna. Height, weight, palm length and palm width were measured using standard anthropometric procedures. Body surface area was calculated using the DuBois formula and PSA was calculated by multiplying palm length by palm width and % PSA was calculated by dividing PSA by BSA. Mean weight (male:63.26 ± 12.59kg; female:50.42 ± 11.46kg), height (male:167.23 ± 6.91cm; female:156.61 ± 6.20cm), palm length (male:10.56 ± 0.76cm; female:9.35 ± 0.69cm), palm width (male:8.34±0.53cm; female:7.52 ± 0.46cm), PSA (male:0.009 ± 0.001m^2; female:0.007 ± 0.001m^2), BSA (male:1.71±0.18m^2; female:1.48± 0.17m^2) were significantly higher in males ($p<0.01$). The percentage PSA was 0.52% in males and 0.47% in females. This study confirms % PSA is not significantly different from conventional 0.5% rule. Importantly, our results are in agreement with evidence from other populations that, 0.5% rule for PSA is a better estimate of BSA to minimize potential errors that may be encountered in emergency patient care settings.

Key words: *Palm, Body, Surface area; Sri Lanka; Adults*

[*]*Corresponding author:iisurani@yahoo.com*

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Diversity and abundance of zooplankton in relation to water quality parameters of two freshwater lakes in Matara district Sri Lanka.

W.D.P Jayarathna, W.A.H.P.Guruge, K.A.M.Sudarshani

Department of Zoology, Faculty of Science, University of Ruhuna, Sri Lanka

Diversity and abundance of zooplankton are crucial indicators of freshwater ecosystem health, as they are highly sensitive to changes in water quality. This study investigates the relationship between zooplankton diversity and abundance and water quality parameters in Kubalgama (5.944239, 80.580312) and Makawita (5.954647, 80.585975) freshwater lake ecosystems in Matara District, Sri Lanka. These two lakes consist of two different types of trophic status. Sampling of water was conducted at three sites over five months. Zooplankton samples were collected using a mesh 0.3 mm plankton net, preserved in 70 % Alcohol solution and identified to the lowest possible taxonomic level under a microscope. Diversity indices (Shannon-Weiner, Evenness, Margalef indexes, Species richness, Taxonomic Dominance) were calculated. The strength and direction of the zooplankton diversity and abundance according to water quality parameters were estimated Pearson's correlation analysis. There were 29 Zooplankton genera were identified. Major groups encountered were Protozoa (8 species), Rotifera (17 species), Cladocera (3 species), and copepods (1 species). *Arcella* sp., *Centropyxis* sp., *Coleps* sp., *Corythion* sp., *Diffugia* sp., were protozoans and *Colurella* sp., *Squatinella* sp., *Asplancha* sp., *Brachionus* sp., *Keratella* sp., *Lecane* sp., *Lacinularia* sp., *Patiyas* sp., *Adineta* sp.,*Pationus* sp., *Rotaria* spp., *Sinantherina* sp., *Testudinella* sp., were Rotifers and *Karualona* sp., *Ceriodaphnia* sp., *Chydorus* sp. were Cladocerans and unknown species of copepods were identified as Zooplankton. During the study period range of mean values ± SE of physicochemical parameters of Kubalgama Lake were temperature: 29.11 ± 0.61°C, conductivity: 203.04 ± 3.2 µS/cm, pH: 7.86 ± 0.14, DO: 3.25 ± 0.52 mg/L, BOD: 1.48 ± 0.32 mg/L, salinity: 0.07 ± 0.02 ppt, alkalinity: 0.01 ± 0.007 mg/L, nitrate 0.47 ± 0.08 mg/L, orthophosphate: 0.1 ± 0.05 mg/L, chlorophyll: 0.14 ± 0.05 µg/L and range of mean values of physicochemical parameters of Makawita Lake were temperature: 29.22 ± 0.48°C, conductivity: 105.00 ± 2.4 µS/cm, pH: 7.90 ± 0.37, DO: 6.18 ± 0.24 mg/L, BOD: 3.17 ± 0.43 mg/L, salinity: 0.11 ± 0.09ppt, alkalinity: 0.01 ± 0.007, nitrate: 0.39 ± 0.04 mg/L, orthophosphate: 0.99 ± 0.07 mg/L, Chlorophyll: 0.23 ± 0.08 µg/L. According to the t-test, conductivity, DO, BOD, salinity, nitrate, and chlorophyll concentrations were significantly different between the two lakes. According to tropic state index which was calculated mainly base on orthophosphate and chlorophyll concentrations, Kubalgama Lake was categorized as oligotrophic and Makawita Lake was categorized as an hypereutrophic lake.

Keywords: *Zooplankton, Diversity, Abundance, Water quality, Fresh water*

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Ectoparasite diversity and abundance in Nile tilapia, *Oreochromis niloticus* in relation to water quality parameters in two selected lakes in the Matara District, Sri Lanka

Rasindi R.K.A.I., Sudarshani K.A.M.*

Department of Zoology, University of Ruhuna, Matara, Sri Lanka

Parasites are important indicators of aquatic ecosystem health, with their abundance often reflecting water quality. This study assessed ectoparasite diversity and abundance in Nile tilapia, *Oreochromis niloticus,* from two lakes in the Matara District, Sri Lanka, one relatively pristine (Uyan Wewa) and the other more affected by human activities (Heendaliya Lake). Between August and November 2024, sixty-four live fish were collected (34 from Uyan Wewa and 30 from Heendaliya), following the ethical approval. Skin and gill samples were examined microscopically, and parasites were identified using standard keys. Parasitic abundance and water quality parameters were compared with t-tests and correlation analysis. Three ectoparasite species were recorded: *Trichodina* sp., *Dactylogyrus* sp., and *Gyrodactylus* sp. Parasite prevalence and abundance differed significantly between the lakes, with Heendaliya showing a higher total count (1,699; mean load 56.60 ± 2.96) than Uyan Wewa (1,253; 36.32 ± 3.03). Student's t-tests confirmed these differences (*Trichodina* p = 0.006; *Dactylogyrus* p = 0.001; overall count p = 0.001), indicating that Heendaliya lake's conditions may promote greater parasitic pressure. Water quality differed significantly between the lakes, with Heendaliya showing higher nitrates (p = 0.007), phosphates (p = 0.005), BOD (p = 0.003), COD (p = 0.03), and conductivity (p = 0.001), and lower DO (p = 0.009), indicating poorer conditions. Parasite abundance in Heendaliya correlated positively with nutrients; nitrates (r = 0.87), phosphates (r = 0.60) and negatively with DO (r = -0.88), while *Dactylogyrus* sp. was slightly more prevalent in Uyan Wewa, suggesting a preference for less polluted waters. Overall, the findings emphasize the influence of water quality on parasite distribution and highlight the need for pollution control to support fish health and ecosystem sustainability.

Keywords – *Oreochromis niloticus*, *ectoparasites, freshwater, water quality, pollution*

**Corresponding author*: *mangalas@zoo.ruh.ac.lk*

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Evaluation of Fenbendazole Efficacy and Potential Anthelmintic Resistance in a Selected Goat Farm within the Dambulla Veterinary Range

Muhmina M.M.F.[1]*, Sumith M.M.P.[1], Dissanayaka N.D.S.[2]

[1]Department of Livestock Production, Faculty of Agricultural Sciences, Sabaragamuwa University of Sri Lanka
[2] Veterinary Research Institute, Gannoruwa, Peradeniya, Sri Lanka

Goats play a crucial role in Sri Lanka's livestock farming sector and contribute significantly to the country's economic development. However, gastrointestinal nematode (GIN) infections pose a challenge in goats, on their health and productivity. The imprudent use of anthelmintics has led to increasing resistance for GIN goats. The objective of this study was to evaluate the efficacy of Fenbendazole and assess the potential development of anthelmintic resistance in a selected goat farm in Dambulla Veterinary Range using the modified McMaster technique to determine eggs per gram (EPG) of feces. A Fecal Egg Count Reduction Test (FECRT) was conducted on this semi-intensively managed farm, using twenty Jamunapari crossbred goats (n=20) aged between 4 and 36 months. According to animal age, body weight and initial (pretreatment) fecal egg counts, they were randomly allocated into treatment and control groups. The mean EPG of pre-treatment control and treatment groups were 820(±679.41) and 890(±716.17) respectively. Goats in the treatment group received Fenbendazole oral suspension (100 mg/mL, Febenol 100 Oral) at 5 mg/kg body weight, while the control group remained untreated. Fecal samples were collected 14 days after treatment (post treatment), examined. The mean EPG of Control and treatment groups were 1150(±884.59) and 90(±151.32) respectively. FECRT results indicated a significant reduction ($p<0.05$) in EPG in treated group. The results showed that Fenbendazole achieved a 92.17% efficacy rate. It can be stated that the GIN in goats in the selected farm were not resistant to Fenbendazole, hence it is effective in controlling GIN infections in goats in this area.

Keywords: *Anthelmintic resistance, Fecal Egg Count Reduction Test, Fenbendazole, Gastrointestinal nematode, Goa*

**Corresponding author*: mmfmuhmina@std.agri.sab.ac.lk

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Species diversity, abundance and distribution of intertidal molluscs in Kamburugamuwa and Tangalle beaches of Sri Lanka

Mandira R.A.T.K., Premachandra W.T.S.D.*

Department of Zoology, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

This study was conducted to identify the diversity, abundance and distribution of molluscs inhabiting in supralittoral fringe, eulittoral zone and infralittoral fringe of the intertidal zone at Kamburugamuwa and Tangalle beaches in Sri Lanka. Each habitat was observed from 8:00 a.m. to 12 noon during the low tide period twice a month from September to November 2024. Nine quadrats (60cm×60 cm) were randomly placed at each of the habitats along a 30m long line transect. At these two locations, over six sampling occasions, a total of 49 molluscs species, representing 23 families belonging to 12 orders were identified. The highest percentage, 37%, represented the order Neogastropoda. Of the total species recorded, 35 and 33 species were belonged to the Kamburugamuwa and Tangalle intertidal zones, respectively. *Chiton* sp., *,Littoraria undulata, Nodilittorina pyramidalis, Nodilittorina quandrica, Drupa granulata, Muricodrupa fenestrata, Saccostrea cucullata* and *Cellana radiata* showed 100% occurrence during all sampling occasions in both locations. The highest Shannon – Weiner index (2.251) and Pielou's evenness index (0.633) were recorded at Kamburugamuwa. Mean species abundance in Tangalle was significantly higher ($p<0.05$) than in Kamburugamuwa. The mean abundance of order Littornimorpha (365.22 ± 139.64) was significantly higher ($p<0.05$) compared to other orders. Family Littorinidae showed the highest abundance (378 ± 118) in both locations. The highest species abundance was recorded in the supralittoral fringe of Tangalle. The most abundant (157.27±53.75) species at the Tangalle beach was *Littoraria undulata*. Only the infralittoral fringe of Kamburugamuwa showed temporal variation during the 03 months study period. This research shows that intertidal molluscs diversity and abundance highly varies across the supralittoral fringe, eulittoral zone and infralittoral fringe.

Keywords: *Abundance, Diversity, Intertidal zone, Molluscs,*

*Corresponding author: dammini@zoo.ruh.ac.lk

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Soil nematode assemblage in supralittoral zone of Matara and Mirissa beaches

Premathunge W.A.M.M*, Premachandra W.T.S.D

Department of Zoology, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

Nematodes are predominating meiofaunal group present in the coastal ecosystem and are widely used as an indicator for evaluating the status of the coastal ecosystems. In this study, soil nematodes assemblage in the supralittoral zone of Matara and Mirissa beaches are comparatively analyzed across three different soil depths. Nematodes were sampled twice a month from five sub-sampling sites (10 ×10 m) having *Ipomoea pes-caprae* plants, for three months, starting from August 2024. Nematode abundance was determined at three depths, 0 - 5, 5 - 10, 10 - 15 cm using a soil corer with a diameter of 2 cm. At each depth, five soil cores were taken, mixed well and three, one-hundred-gram sub-samples were taken to extract the nematodes. Modified Baermann funnel was used to extract nematodes and identified using taxonomical keys up to the genus level. Two sample T-test and one-way ANOVA were used for the statistical analysis. Overall nematode abundance was higher (P<0.05) in Matara (5.70±0.34) than Mirissa (3.25±0.11). Larval counts outnumbered the adults (P<0.05) at both locations. Nematode abundance decreased (P<0.05) with the increasing depth and the maximum abundance was detected in 0 - 5 cm depth as (6.45±0.27) and (3.77±0.06) at Matara and Mirissa, respectively. Five feeding groups of 14 nematode genera, including five bacterial feeders; *Acrobeles, Eucephalobus, Pelodera, Rhabditis, Cephalobus*, three omnivorous; *Eudorylaimus, Aporcelaimellus, Discolaimium*, three plant feeding nematodes; *Hoplolaimus, Tylenchus, Helicotylenchus* and three genera of predators; *Anatonchus, Prismatolaimus, Onchulus* were detected. Omnivorous nematodes were the predominant feeding group (P<0.05) whereas fungal feeding nematodes was rarely recorded. Among the six sampling occasions, highest nematode abundance was recorded at the 3rd sampling occasion in both beaches. This study indicated that the nematodes inhabiting in the supralittoral zone of both beaches represented substantial diversity which is important to maintain the stability.

Keywords: *Abundance, Beach, Depth, Genera, Nematodes*

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Immunoinformatic Prediction and Characterization of Epitopes of T2SS Protein M in *Vibrio harveyi*

Dhananjaya Gamage G.K[1], Madushani W.G.I[2], Dias M.K.H.M[1], Nikapitiya C[1], De Zoysa M[1*]

[1] College of Veterinary Medicine and Research Institute of Veterinary Medicine, Chungnam National University, Yuseong-gu, Daejeon 34134, Republic of Korea
[2] Faculty of Agriculture, University of Ruhuna, Mapalana, Matara–Kamburupitiya Road, 81100, Sri Lanka

Vibrio harveyi causes major losses in marine aquaculture and rising antibiotic resistance necessitates the development of effective vaccines for sustainable disease control. The type II secretion system (T2SS) protein M in *V. harveyi* is a core component of the T2SS that involved in the trans-envelope protein machinery found in many Gram-negative bacteria. The objective of the present study was to predict the immunogenic epitopes targeting T cells [cytotoxic T lymphocytes (CTLs) and helper T lymphocytes (HTLs)] and linear B lymphocytes (LBLs) from *V. harveyi* T2SS protein M using an immunoinformatic approach to development of multiepitope vaccine. The protein sequence was retrieved from extracellular vesicles (EVs) proteomics data of *V. harveyi*. The protein was first analyzed for allergenicity (AllerTOP v2.0) and physicochemical properties (ProtParam). CTL epitopes were predicted using NetCTL v1.2 [with threshold level of 0.75, sensitivity of 0.80 and specificity of 0.97]. HTL and B-cell epitopes were predicted using Immune Epitope Database (IEDB) MHC II server (a percentile rank: <20% and IC_{50} values: <500 nM) and IEDB B-cell epitope prediction tools, respectively. Predicted epitopes were subsequently screened for antigenicity (VaxiJen v2.0, >0.4), immunogenicity (IEDB), toxicity (ToxinPred) and allergenicity. HTL epitopes were further evaluated for cytokine-inducing potential (IL4, IFN-γ, IL-10). The protein consists of 164 amino acids, has a molecular weight of 18.93284 kDa and theoretical isoelectric point of 9.75. Finally, two CTLs (IAVLGIIYW, VLGIIYWGL), one HTL (QQGIEVEFLDIDRTE), three LBLs (LAFNQMVD, SVQVWIKPL, PMNQRAE) were selected. In conclusion, this approach identified highly antigenic epitopes for future vaccine development.

Keywords: *Antigenicity, Aquaculture, T2SS, Vaccine design, Vibrio harveyi*

**Corresponding author*: mahanama@cnu.ac.kr

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Assessment of Tetrapod Diversity in Kowtharimunai Mangrove System, Northern Sri Lanka

K. Arjunan*, T. Keerthanaram
[1] *Department of Bio-science, Faculty of Applied Science, University of Vavuniya, Sri Lanka*

Mangrove ecosystems are of greater ecological significance as they provide essential ecological services, including shoreline stabilization, carbon sequestration, nutrient cycling, habitat for diverse aquatic and terrestrial species, and socio-economic benefits. Sri Lanka has an extensive mangrove cover of approximately *15,670* hectares. In recent times, various anthropogenic stresses, including the expansion of aquaculture and urban agriculture, habitat fragmentation, and degradation, have posed significant challenges to the sustainability and dynamic balance of mangrove systems. Mangrove systems in Northern Sri Lanka are not comprehensively studied. This study aims to assess the faunal diversity of the Kowtharimunai Mangrove System during the dry period of the year (May-September). Avian species diversity and abundance were quantified using the variable-radius point count method, and rapid assessment survey methods were deployed for other fauna. Under results, systematic survey recorded a total of 24 avifaunal species encompassing 21 families, alongside 3 mammalian and 6 reptilian species. Beyond avifauna, the rapid assessment survey recorded a suite of mammals and reptiles characteristic of Sri Lankan dry zone coastal forests, including the Indian Grey Mongoose *(Urva edwardsii)*, Asian Palm Civet *(Paradoxurus hermaphroditus)*, and several reptiles including Oriental Rat snake *(Ptyas mucosa)*, Indian Cobra *(Naja naja)*, and Bengal Monitor Lizard *(Varanus bengalensis)*. This study highlights the ecological significance of the Kowtharimunai mangrove system and emphasizes the need for focused management and conservation to maintain its environmental, socio-economic and functional integrity. Moreover, this study revealed the possibilities of establishing the ecotourism ventures in the Kowtharimunai area as a measure for ensuring conservation and uplifting the socio-economic status of nearby communities.

Keywords: *conservation; ecological and economical; mangroves; tetrapod diversity*

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**Corresponding author*: ksarjunan@vau.ac.lk

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Efficacy of Sodium Dodecyl Sulphate (SDS) in controlling *Dactylogyrus* spp. (Monogenea, Dactylogyridae) infestations in laboratory-reared Tilapia (*Oreochromis niloticus*) juveniles

Bandara M.M.M.C.[1*], Gunawickrama S.H.N.P.[2] and Gunawickrama K.B.S.[1]

[1] *Department of Zoology, University of Ruhuna, Matara, Sri Lanka.*

[2] *Institute for Combinatorial Advance Research and Education, General Sir John Kotelawala Defense University, Ratmalana, Sri Lanka*

Monogenean trematodes such as *Dactylogyrus* spp. are common ectoparasites on gills and skin of freshwater fish. They can damage gills, reduce growth and enhance mortality in intensive aquaculture systems. These parasites have been controlled with traditional chemotherapeutics and management techniques despite issues with cost and safety. Sodium Dodecyl Sulphate (SDS), an anionic surfactant has shown a potential for disrupting monogenean teguments, suggesting both a morphological and anti-parasitic effect. This study assessed the efficacy of SDS as an acute effective method for controlling *Dactylogyrus spp.* infestations in pond-reared Nile Tilapia (*Oreochromis niloticus*) juveniles. After three days of acclimatization in freshwater, initial *Dactylogyrus* spp. loads were estimated in gill arches and skin scrapings of 30 randomly selected fish. Ninety infected Tilapia (5–7 cm) were randomly allocated in to three groups: Control (C), Treatment 1 (T1; 500 µg/L SDS) and Treatment 2 (T2; 1000 µg/L SDS) with three replicates each. Fish were maintained under SDS exposure in T1 and T2, and in the control without SDS under moderate aeration and feeding for 96 hours. Parasite abundance after treatment was assessed by microscopic examination of gill arches and skin scrapings similarly to the initial estimation. There was a significantly lower abundance ($p<0.05$) of *Dactylogyrus* spp. in SDS-treated groups compared to the control, with no fish mortality observed. Among treatments, T2 showed the highest reduction of *Dactylogyrus* from the pre-exposure counts (37.3%), while T1 had moderate reductions (31.1%). These results suggest SDS may be an effective short-term dip treatment against heavy gill fluke infestations in Tilapia. Further studies are recommended to assess long-term safety, sub-lethal effects on fish and environmental impacts before routine application in fish culture practices.

Key words: *Dactylogyrus spp., Oreochromis, Sodium Dodecyl Sulfate, Trematodes,*

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Factors Affecting Delayed Hospitalization of Stroke Patients at District General Hospital, Hambantota

Lasanthi H.N.N.[1], Madhushani H.G.L.D.[1], De Silva J.B.R.A.[1], Edirithanthri A.P.[1], Gunasekare M.K.C.P.[2*], Priyanthi W.N.[1].

[1]Department of Nursing, Faculty of Health Sciences, The Open University of Sri Lanka, Sri Lanka
[2]Department of Clinical Nursing, Faculty of Nursing, University of Colombo, Sri Lanka

Stroke is a serious neurological disease that can be effectively managed with timely hospitalization and treatment. It is the second leading cause of death worldwide and continues to be a significant healthcare challenge in Sri Lanka, where the hospital-related mortality rate is 8.3%. The study aimed to investigate factors associated with the delayed hospitalization of stroke patients at the Hambantota District General Hospital. The study was a descriptive, cross-sectional design that was conducted among 208 conveniently selected stroke patients admitted more than 4.5 hours after symptom onset. Data were collected using an interview-administered structured questionnaire and analyzed using SPSS for descriptive statistics and chi-square test for the associated factors. Ethical clearance was obtained from the National Institute of Mental Health, Kalutara. Most of the participants (41.1%) were between 46-55 years old and male (71.4%). Most of them were unaware of stroke and its symptoms, 67.9% and 67.3% respectively. Nearly half (45.2%) delayed in seeking care until the symptoms disappeared. Strong associations were found with rural residence ($P<0.001$) and the absence of their own transport ($P<0.001$). Emergency access to ambulance services ($p=0.034$) and distance to hospital ($P<0.001$) were significantly correlated with financial issues in arranging transport, and it was statistically related to the delayed hospitalization. The findings show that there are both patient-related and service-related factors for the delays. Public awareness programs, developing emergency care facilities, and action plans to ensure accessibility to hospitals within a short span of time are vital to minimize stroke management delays in rural Sri Lanka.

Keywords: *Factors; Delayed hospitalization; Stroke; Patients*

**Corresponding author*: chamodyapraneeth21@gmail.com

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Modelling Value-at-Risk using Tukey's *g*-and-*h* Distribution with Approximated Likelihood Estimation

Abeygunasekara S.M, Dr.De Mel W.A.R.*

Department of Mathematics, University of Moratuwa, Sri Lanka

The goal of this study is to use Tukey's g-and-h distribution to better model Value-at-Risk (VaR) under non-normal financial return distributions. The study models financial returns using Tukey's g-and-h distribution, which enables flexible modeling of skewness and heavy tails. Because the loss is computationally challenging to manually calculate the financial loss or risk for a large portfolio, the value-at-risk approach is helpful for quantifying the risk or loss of portfolios. We utilize this distribution to better describe financial risk in light of the limitations of traditional risk models under non-normality. The efficacy of one estimating technique—Maximum Approximated Likelihood Estimator (MALE)—is methodically examined. The study is conducted using historical daily return data from January 1, 2003, to January 17, 2011. To assess performance at various confidence levels, VaR estimations from the suggested model are contrasted with those from classical parametric and historical simulation methods. The accuracy and robustness of the Maximum Approximated Likelihood Estimation (MALE) method are consistently higher than those of the Classical and Historical Simulation methodologies. In times of market stress, it shows increased sensitivity to tail activity, allowing for more accurate risk assessment. Furthermore, compared to classical and historical VaR models, Tukey's g-and-h distribution better fits non-normal return distributions and captures high losses. The results indicate that by using Tukey's g-and-h distribution, risk managers and financial institutions can enhance downside risk assessment. In volatile and non-normal market environments, this method promotes more robust risk management decisions and helps prevent underestimating excessive losses.

Keywords: *Classical approach; Maximum Approximated Likelihood Estimator; Tukey's g-and-h distribution; Value-at-Risk*

**Corresponding author:* ajith@maths.ruh.ac.lk

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Fuzzy-Semi-*h*-Open Sets in Fuzzy Topological Spaces and Their Properties

Piriyalucksan P., Arunmaran M.*

Department of Mathematics and Statistics, University of Jaffna, Sri Lanka

C. L. Chang began studying fuzzy topological spaces in 1968, building on L. A. Zadeh's fuzzy set theory. This abstract presents the fuzzy semi-*h*-open set, a novel fuzzy open set, and explores its properties. To date, different types of open and closed sets within fuzzy topological spaces have been studied. This abstract introduces the fuzzy semi-*h*-open set, a new type of fuzzy open set, and explores its properties. For a non-empty set X, a fuzzy topology is defined as a collection τ of fuzzy subsets in X satisfying the following conditions: $0_X, 1_X \in \tau$; finite intersections of elements of τ and an arbitrary union of elements of τ are in τ. The pair (X, τ) is a fuzzy topological space. Now, we define the fuzzy *h*-open and fuzzy semi-*h*-open sets. A fuzzy set A is called fuzzy h-open, if $A \leq int(A \vee U)$ for every non-empty fuzzy open set U $(\neq 1_X)$ in X. Similarly, a subset A is called fuzzy semi-*h*-open if there exists a fuzzy *h*-open set such that $H \leq A \leq cl(H)$. This study proves that a set A in a fuzzy topological space is fuzzy semi-*h*-open if $A \leq cl(int_h(A))$. It establishes that several types of fuzzy sets are fuzzy semi-*h*-open, while counterexamples show that the converse is false. The study aims to explore *h*-continuity and semi-*h*-continuity in the future.

Keywords: *Fuzzy topology; fuzzy h-open set; fuzzy semi-h-open set.*

**Corresponding author*: marunmaran03@gmail.com

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Spatial Distribution of Cancer Cells Through a Time Fractional Reaction Diffusion System

Silva K.K.C.T.*, Somathilake L.W.

Department of Mathematics, University of Ruhuna, Sri Lanka.

Cancer growth shows complex behavior in both space and time, which is influenced by past biological states. Fractional-order reaction–diffusion models are advantageous because they explicitly account for these memory effects, which are absent in conventional models. This study aims to understand how time-fractional dynamics affect the spatial distribution of cancer cells and the formation of patterns. We consider a time-fractional reaction–diffusion model that describes the interaction between cancer cells and immune cells. To study spatial temporal pattern formation behaviour, a stability analysis is performed to obtain the conditions for Turing instability conditions under fractional-order dynamics. This analysis explains how interactions between reaction and diffusion processes can lead to spatial pattern formation in cancer cell density. The model is solved numerically using a finite difference scheme, and simulations are carried out for different fractional orders in the range $0 < \gamma \leq 1$. The results show that the fractional order plays an important role in cancer growth behavior. Lower fractional orders slow down the diffusion process and introduce memory-driven persistence, which delays pattern formation and leads to more stable and localized spatial structures compared to the classical integer-order case. In addition, a preliminary visual comparison between the simulation results and representative images of real cancer growth over time is presented as a preliminary validation of the model. Overall, the results suggest that fractional-order reaction–diffusion models can help explain certain features of cancer spatial complexity and heterogeneity by incorporating memory effects.

Keywords: *Fractional-order reaction-diffusion, Turing instability, Pattern formation*

**Corresponding author*: chamoditharuni20@gmail.com

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A Weighted Multiplex Centrality Framework for Identifying Structurally Critical Nodes in Complex Multiplex Networks

Rajapaksha R.W.K.T [1,2*], Lanel G.H.J[3], Athapattu A.M.C.U.M[4] and Sanjeewa R[3]

[1] Department of Computer and Data Science, Faculty of Computing, NSBM Green University, Sri Lanka
[2] Faculty of Graduate Studies, University of Sri Jayewardenepura, Sri Lanka
[3] Department of Mathematics, Faculty of Applied Sciences, University of Sri Jayewardenepura, Sri Lanka
[4] Department of Mathematics, Faculty of Science, University of Peradeniya, Sri Lanka

This study proposes a weighted multiplex centrality framework for identifying structurally critical nodes in complex multiplex networks by integrating intralayer connectivity and interlayer dependencies. At the intralayer level, degree and eigenvector centralities are combined using adaptive scaling to balance local and global influence, while interlayer coupling is quantified through Pearson correlations between eigenvector centrality distributions across layers. Layer importance is incorporated via density-based weighting to reflect heterogeneous structural contributions. The evaluation is conducted on synthetically generated multiplex networks consisting of three layers and node sizes ranging from 1,000 to 5,000. The proposed composite measure is assessed using independent and sequential node-removal experiments and compared against benchmark metrics, namely average degree centrality and average eigenvector centrality. In the independent removal scenario, all methods exhibit minor density increases when peripheral nodes are removed; however, the proposed metric produces smoother and more stable density responses, avoiding volatility observed in eigenvector-based rankings. In the sequential removal scenario, which simulates progressive failures, the proposed metric yields consistent degradation patterns in network density and average path length, indicating balanced identification of structurally relevant nodes across layers rather than overemphasis on marginal or localized nodes. These results demonstrate that the proposed framework offers a stable and interpretable multiplex ranking that complements traditional centrality measures in robustness and vulnerability analysis.

Keywords: *Degree Centrality, Eigenvector Centrality, Multiplex Networks, Network Resilience*

**Corresponding author*: kavishka.r@nsbm.ac.lk

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Development of Virtual Environment for Hybrid Electro Magnetic Levitation System

Dinendra S.M.S. [1*], ***Muthukumarana P.M.*** [2], ***Ilangarathna I.P.R.R.*** [3], ***Hewawasam H.E.T.S.*** [4], ***Annasiwaththa A.W.B.I.*** [5].

Department of Mechanical and Manufacturing Engineering, University of Ruhuna,

Sri Lanka

This abstract presents the simulation of virtual controller for controlling the force generated by a hybrid electro magnet focusing on validating the system behavior prior to hardware fabrication. The aim is to accurately represent the hybrid electromagnet integrated with the mechanical system and noise filtering equivalent to real world conditions, through which the authors expect to minimize the challenges of investigating magnetic levitation systems due to its high cost. A three dimensional computer aided design of the hybrid electromagnet was designed consisted of a permanent magnet and an electromagnet under defined geometry. Finite Element Analysis was performed for the hybrid electromagnetic system to determine how the magnetic force varied with the air gap distance and the coil current in electromagnet where primary force was generated by the permanent magnet and force control was achieved by the electromagnet. The mathematical representation of the system was done using the system's state space model, which is a single input – multiple output system where voltage is the input and the air gap distance and coil current are the output. The virtual system was developed based on three key subsystems, namely, mechanical system, electrical system and the magnetic system. The mechanical system was modelled using the CAD model. The electrical system was modelled as a RL circuit. The controller consisted of a PD controller and an I controller. The simulation results confirmed the convergence of both the air gap distance and the coil current under both with and without sensor noise providing a reliable platform for validating HEMs.

Keywords: *HEM, Virtual environment, State-space modelling, FEA, Kalman filter*

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**Corresponding author*: salilasam2000@gmail.com

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Optimized Tourism Route Planning Using Goal Programming and Traveling Salesman Problem in Sri Lanka

Bandara L.R.S.G., Samarathunga D.M.

Department of Mathematics, University of Ruhuna, Sri Lanka

This study presents an optimization-based approach for creating an efficient travel itinerary covering most popular tourism destinations in Sri Lanka. Proposed approach consists of two phases. Phase I is devoted to find the places to be visited and phase II is employed to find the best route to visit those places. A goal programming model is employed to select places to be visited while balancing preferences among categories (Historical, Nature, and Coastal), travel days, and budgetary constraints. Binary decision variables are utilized to determine whether each destination is included, and deviation variables assess underperformance or overperformance against predetermined goals. Some of the places to be visited are pre assigned and then specific constraints ensure that other selected destination is located within 50 km of at least one other destination being visited, promoting coherent and easily navigable routes, with Katunayake designated as a required stop. The objective function seeks to minimize variations from category, time, and budget targets while simultaneously maximizing overall attractiveness based on location ratings. After the phase I, selection stage, a Traveling Salesman Problem (TSP) formulation is used to determine the best order of visits. To solve the TSP exact solution techniques is used and the model is implemented and solved using MATLAB's integer linear programming tool. The results reveal that this method effectively identifies a set of strategically connected destinations and devises an efficient route, highlighting the advantages of combining goal programming for site selection with TSP for route optimization in tourism itinerary planning.

Keywords: *Tourism route planning; Goal programming; Traveling Salesman Problem; Sri Lanka; Itinerary optimization*

**Corresponding author*: bsamadhie@gmail.com

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Exploring the Impacts of Value Chain Models on Coffee Quality and Production Efficiency in Sri Lanka

Yapa Y.M.M.C.K* *and De Siva W.N*

Department of Agricultural Economics and Agribusiness, Faculty of Agriculture, University of Ruhuna, Kamburupitiya, Sri Lanka

Sri Lanka possesses a rich coffee heritage and favorable agro-climatic conditions for coffee production; however, the industry remains underdeveloped and is unable to consistently meet required quality standards. In this context, the study assesses the two prevailing coffee processing models—single-actor and multiple-actor (farmer–trader–roaster and intermediary-driven) value chains—to examine their implications for product quality and production efficiency. A mixed-methods approach was employed in the Kotmale Divisional Secretariat Division. The study sample comprised 30 commercial-scale coffee farmers, five pulper operators, and one roaster, selected primarily through snowball sampling due to the absence of a formal sampling frame. Primary data were collected using semi-structured questionnaires and complemented by secondary sources. Financial and quantitative value chain analyses were integrated with Likert-scale assessments of the adoption of Good Agricultural Practices (GAP) and Good Manufacturing Practices (GMP), alongside a qualitative analysis of key constraints and enabling factors. The findings reveal notable differences between value chain models. Multiple-actor chains are associated with lower production costs, lower price realization, and comparatively lower product quality. In contrast, single-actor chains demonstrate greater potential for improved quality and higher economic returns. The adoption of GAP and GMP remains moderate across both models, constrained by limited infrastructure, inadequate technical knowledge, weak institutional support, and low education levels among value chain actors. The study concludes that strengthening human capital, improving processing infrastructure, and promoting more coordinated value chain models are essential for enhancing quality, efficiency, and the long-term sustainability of Sri Lanka's coffee industry.

Keywords: *Coffee processing, GAP and GMP adoption, Quality compliance, Profitability, Sustainability*

**Corresponding author*: yapa2ab@ags.ruh.ac.lk

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Modelling Confidence Intervals for Value-at-Risk using Influence Functions

Abeygunasekara S.M, Dr.De Mel W.A.R.*

Department of Mathematics, University of Ruhuna, Sri Lanka

With an emphasis on contrasting the Classical and Historical Simulation approaches, this paper examines the creation of confidence intervals for Value-at-Risk (VaR) estimates using influence functions. The Historical technique uses the simulated return data directly without making any distributional assumptions, whereas the Classical approach assumes returns follow a normal distribution in order to estimate risk. This study focuses on two research questions since VaR estimation uncertainty is challenging under non-normal market circumstances: how influence-function-based VaR confidence intervals compare to historical simulation and classical parametric techniques, and how these confidence intervals are impacted by distributional features like skewness and kurtosis. The study's main goal is to model confidence intervals for VaR using influence functions, and its secondary goal is to assess how well they work in comparison to results from classical and historical methodologies. The findings show that the Historical method consistently yields larger negative VaR values, especially at higher confidence levels, indicating a higher evaluated risk. This behavior is explained by its dependence on empirical return distributions, which enable it to more accurately capture tail events and extreme losses, particularly when skewness and heavy tails are present. Because of its parametric assumptions, the Classical method, on the other hand, produces less negative VaR estimations and narrower confidence ranges, exhibiting higher stability and smoothness. At higher confidence levels, tail risk may be underestimated as a result of this stability. Overall, when predicting VaR in complicated markets, the results assist risk managers in striking a compromise between accuracy, stability, and robustness.

Keywords: *Classical method; Historical Simulation method; Influence Functions; Value-at-Risk*

**Corresponding author:* ajith@maths.ruh.ac.lk

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Effect of English Proficiency on Science Undergraduates' Academic Performance, University of Ruhuna

Bandara S.M.G.S*, Perera K.T.A.K.D.T.S.B, Gunathilake M.K.G.K, Rathnayaka R.M.S.I.

Department of Mathematics, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

English proficiency plays a key role in higher education in Sri Lanka. This study focuses on determining the impact of English proficiency on the academic performance of science undergraduates at the University of Ruhuna, Sri Lanka. In total, 627 observations were analyzed using the R programming language. The analysis examined the relationship between Grade Point Average (GPA) with English proficiency results at the University Level, G.C.E. Advanced Level and G.C.E. Ordinary Level English results, medium of secondary education, completing diploma or certificate courses after G.C.E. Advanced Level, and living province. In the normality test, the P-value was 4.93e-11 (< 0.05), indicating that the English proficiency results at the university level did not follow a normal distribution. Accordingly, the non-parametric Kruskal-Wallis test for University Level I and Level II English results shows that both p-values are less than 0.05 (2.2e-16). Therefore, English proficiency at the university level significantly affects GPA. Analysis of variance (ANOVA) results indicated that G.C.E. Advanced Level English results, G.C.E. Ordinary Level English results and medium of secondary education have a statistically significant effect on GPA. However, completing diploma or certificate courses after G.C.E. Advanced Level does not significantly affect GPA. The results provide strong evidence of the importance of improving English proficiency to enhance academic performance.

Keywords: Academic Performance, ANOVA, English Proficiency, Grade Point Average (GPA), Kruskal-Wallis Test

*Corresponding author: gayan@maths.ruh.ac.lk

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Modeling and Prediction of Volatility of All Share Price Index: Evidence from the Colombo Stock Market.

Samarawansha D., Yapa A.W.D..'*.

Department of Mathematics, Faculty of Science, University of Ruhuna, Sri Lanka

The All Share Price Index (ASPI) is the main benchmark for the Sri Lankan stock market. It shows how major sectors like banking, manufacturing, and agriculture are performing. Because it is sensitive to market liquidity and is an important indicator of the national economy, understanding ASPI volatility is crucial for managing risk and making investment decisions. This study aims to evaluate and compare different symmetric and asymmetric volatility models, specifically ARCH, GARCH, EGARCH, TGARCH, and ARMA-GARCH, to find the best model for predicting market changes.

Using daily ASPI return data from January 1, 2014, to December 31, 2023, we divided the dataset into training (in-sample) and testing (out-of-sample) sets to assess forecasting performance thoroughly. We evaluated model accuracy with various metrics, focusing mainly on the Mean Absolute Percentage Error (MAPE), along with RMSE, MAE, and Theil's U. The results show that simple symmetric models are not enough to capture the complex volatility behavior of the ASPI. The asymmetric ARMA-GARCH (2,2) model proved to be the best choice, achieving a MAPE of 1.019 and ranking the highest across all evaluation metrics. Our findings confirm the presence of leverage effects and volatility clustering in the Colombo stock market. This study concludes that asymmetric models offer significantly better predictive power, providing valuable insights for policymakers and investors looking to optimize portfolios and improve market stability regulations.

Keywords: *Stock Market , Errors, Volatility, asymmetric, GARCH Models*

Corresponding author: aneesha@maths.ruh.ac.lk

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Identifying Climatic Factors on Paddy Production in North Central Province of Sri Lanka: A Comparative Analysis Using Random Forest and LSTM Models

Prasangika K.D.* , Jayarathna B.K.V.

Department of Mathematics, University of Ruhuna, Matara, Sri Lanka

Paddy cultivation holds a major position in Sri Lanka's agriculture, serving as the primary livelihood for a significant proportion of the country's farming population. This study focuses on the development of models for paddy production in the North Central Province of Sri Lanka, considering the climatic factors, namely, rainfall, sunshine hours, minimum temperature, maximum temperature, evaporation, day relative humidity, morning wind speed, and evening wind speed. The monthly climatic variables and seasonal paddy production data from 2012 to 2022 were used in this study. The random sample technique was used to impute the missing data in the Polonnaruwa District. Pearson's correlation and Spearman's correlation were used to identify the behavior of the correlation. Random Forest (RF) and Long Short-Term Memory (LSTM) models were used to build models for paddy production. The performance of the models was compared in terms of the Mean Absolute Percentage Error (MAPE), the Mean Absolute Error (MAE), and the Root Mean Squared Error (RMSE). By the Random Forest method, day relative humidity, evening wind speed, and morning wind speed were identified as the most important climatic variables for the Anuradhapura district, while for the Polonnaruwa district, they were sunshine hours, evening wind speed, and morning wind speed. The Random Forest model achieved MAPE values of 21.52% and 11.17%, while the LSTM model recorded MAPE values of 29.12% and 12.52% for the Anuradhapura and Polonnaruwa Districts, respectively. Key climatic factors affecting paddy yield included sunshine hours, relative humidity during the day, and wind speeds in the morning and evening. Both models successfully captured seasonal variations in paddy production related to the Yala and Maha seasons, emphasizing the seasonal dependence on climate.

Keywords: *Paddy Production, Climatic factors, Random Forest, Long Short-Term Memory*

**Corresponding author*: kdprasangika79@gmail.com

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Prevalence of propranolol and pizotifen use and their side effects among migraine patients at Teaching Hospital, Jaffna

Parkavi R.[1*], Kalki P.[1], Kishajiny I.[1], Kajanitha K.[1], Ajantha K.[2]

[1] Department of pharmacy, Faculty of Allied Health Sciences, University of Jaffna
[2] Teaching Hospital, Jaffna

Introduction: Migraine is a unilateral headache accompanied by nausea, vomiting, photophobia and phonophobia. Propranolol and pizotifen are widely used in migraine prevention but their side effects (SE) often influence the therapeutic outcomes Objectives: To estimate the prevalence of propranolol and pizotifen and its side effects. Methodology: Descriptive cross-sectional study with 8 weeks of data collection. Data were collected at neurology clinic as an interviewer-administered validated questionnaire. Participants are identified with migraine and not previously prescribed with the preventive medication and patients were followed for 01 month. Likert scale,0-4 (0=No effect, 4= Severe), was used to collect data related to severity SEs score and total score for each patients' SEs were calculated. Results: Of 270 migraine patients, 104 were selected and used both drugs. Prevalence of propranolol was 22% and 59 patients reported SEs (mean =2) which were palpitation (48%), postural hypotension (42%), dizziness (53%) and sleep disturbances (53%). And pizotifen prevalence was 17 %. 45 patients reported SE (mean=2.5) which were increase appetite (29%), dizziness (53%), drowsiness (27%), dry mouth (53%), nausea (56%), weight gain (7%) fatigue (29%) and prolonged sleep (13%). Pizotifen participants, dry mouth was significantly higher in male (p=0.025) and unemployed (p=0.038) and fatigue was higher in income below Rs.35,000.00 (p=0.026).Pizotifen had a significantly higher mean score (4.58) than propranolol (3.63), (p = 0.019). Conclusions: Pizotifen's side-effects are more severe than propranolol. Clinical education on pizotifen side effects severity will improve awareness and adherence of the patients.

Keywords: Migraine-patient, Pizotifen, Propranolol Prevalence, Side effects

**Corresponding author*: parkavishanthi06@gmail.com

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Adherence, Knowledge to Epilepsy Medication and their Associated Factors Among Caregivers of Epileptic Children Followed up at the Paediatric Clinic at TH, Jaffna

***K. Thenuka.*[1*], *P. Kalki*[1], *U.Nilukshika*[1], *N.Saranja*[1], *Dr.K.Sanchayan*[2]**

[1] Department of Pharmacy, Faculty of Allied Health Sciences, University of Jaffna

[2] Department of Pharmacology, Faculty of Medicine, University of Jaffna

Epilepsy affects both adults and children and requires long-term medication control, with antiepileptic drugs as the first-line therapy. Good adherence to anti-epileptic medication (AEM) is essential for optimal treatment outcomes, particularly in children who may not require lifelong treatment. Caregiver awareness and knowledge play a critical role, as non-adherence to AEM has become a significant concern. This hospital-based descriptive cross-sectional study aimed to assess caregiver knowledge and medication adherence among caregivers of children with epilepsy attending the Paediatric Clinic at Teaching Hospital Jaffna. A total of 127 caregivers aged over 18 years, caring for children under 14 years with epilepsy, participated in the study, with a response rate of 97%. Data were collected using a knowledge questionnaire (score range: 0–13), numerical, and the MARS-5 (Parent Version) adherence scale (score range: 6–30), categorized into good and poor adherence. Statistical analysis included Chi-square or Fisher's exact tests, Mann–Whitney U, and Kruskal–Wallis tests, with significance set at $p \leq 0.05$. Most caregivers were parents (96%). The mean caregiver knowledge score was moderate (8.43/13). Good adherence was significantly associated with higher knowledge scores, regular clinic attendance, fewer seizure episodes, family history of epilepsy, parental factors, and awareness of medication side effects. Higher knowledge levels were associated with being married, having a middle household income, a better understanding of epilepsy, and awareness of AEM side effects. The findings highlight the need for ongoing caregiver education and consistent support from healthcare professionals to ensure effective epilepsy management in children.

Keywords: *Antiepileptic medications, caregiver, knowledge, adherence.*

**Corresponding author*: kirupathenu99@gmail.com

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Phytochemical Profiling and *In vitro* Anti-Inflammatory Activity of Different Parts of *Hellenia speciosa* (Thebu)

Perera N.D.N.[1], Eranga B.G.A.[1], Madhushani I.W.M.[1], Nawarathna T.K.[2], Peiris M.M.K.[1*]

[1]Department of Medical Laboratory Sciences, Faculty of Allied Health Sciences, General Sir John Kotelawala Defence University, Sri Lanka
[2]Bandaranaike Memorial Ayurveda Research Institute, Department of Ayurveda, Nawinna, Maharagama, Sri Lanka

Hellenia speciosa (Thebu), which belongs to the Costaceae family, is a medicinal plant useful to control diseases such as diabetes, bronchitis, and arthritis. Although its' rhizome has been widely explored, a comprehensive analysis of the anti-inflammatory activity of various plant parts remains confined. This study was conducted to compare the anti-inflammatory potential of various plant parts of *H. speciosa* (rhizome, root, leaves, stem, flower) using the egg albumin denaturation assay, using Diclofenac (50 mg/mL) as the positive control. Aqueous and methanolic extracts were prepared using the maceration method. Phytochemical analysis was performed quantitatively and qualitatively. Aqueous and methanolic extracts contained saponins, tannins, alkaloids, phenols, flavonoids, terpenoids, glycosides, and steroids, while chalcones and phlobatannins were not present in any of the extracts. Total phenolic content of methanolic crude extracts indicated that the root extract exhibited maximum phenolic content (41.50 ± 0.37 mg/GAE/g) followed by stem, rhizome, leaf, and flower extract (12.87 ± 0.43, 12.52 ± 0.06, 7.93 ± 0.38, 5.20 ± 0.24 mg/GAE/g). The lowest IC_{50} among methanolic extracts was reported from the rhizome (0.29 mg/mL), followed by stem (2.03 mg/mL), root (2.17 mg/mL), flower (2.19 mg/mL), and leaf (3.22 mg/mL). Among the aqueous extracts, stem (2.82 mg/mL) exhibited the lowest IC_{50} inhibition, followed by rhizome (3.06 mg/mL), root (4.53 mg/mL), leaf (4.57 mg/mL), and flower (6.04 mg/mL). Methanolic rhizome extract demonstrated the highest anti-inflammatory activity and aqueous extracts showed lower anti-inflammatory activity. Future investigations are required to identify bioactive compounds and to discover their applications.

Keywords: *Hellenia speciosa, Anti-inflammatory activity, Egg albumin denaturation assay, Phytochemical analysis*

*Corresponding author: mudarapeiris@gmail.com, peirismmk@kdu.ac.lk

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Formulation and Evaluation of the Orally Disintegrating Tablets (ODTs) of Paracetamol

Nayanathara H.P.A.N[2]*, *Thuvaragan S.*[2], *Perera M.T.L.M*[2], *Erandi H.V.H*[2]

[1]State Pharmaceutical Manufacturing Cooperation, Sri Lanka

[2]Department of Pharmacy, Faculty of Allied Health Sciences, University of Jaffna, Sri Lanka

Orally disintegrating tablets (ODTs) facilitates to take medication easily for Dysphagia patients, pediatrics and geriatrics to improve their compliance. This research aimed to formulate and evaluate orally disintegrating tablets (ODTs) of paracetamol using different superdisintegrants and find out the most effective superdisintegrant for paracetamol ODTs. Three formulations of Paracetamol Orally Disintegrating Tablets (PODTs) were prepared by wet granulation using 0.28 % of different superdisintegrants :- (crospovidone, croscarmellose sodium and sodium starch glycolate (SSG)). Different parameters of PODTs including weight variation, content uniformity, hardness, friability, dissolution, disintegrating time, wetting time and water absorption ratio were evaluated. All tests were triplicated. The independent sample t-test was used to compare three-formulations. P value less than 0.05, was considered as significance. Ten PODTs from three formulations were used, for testing thickness, diameter, weight variation and hardness. Three PODTs from three formulations were used in test for wetting time and water absorption ratio and six PODTs from three formulations were used in test for disintegrating time. Independent sample t-test revealed significant difference between three formulations in disintegrating times, wetting times and water absorption ratio. Crospovidone had the low disintegrating time and wetting time and higher water absorption ratio compare to croscarmellose sodium and SSG. Friability of all the formulations were less than 1% and hardness of all the formulations were within 4 to 8N. The dissolution test showed 94% to 98 % within 30 minutes for all the formulations. PODTs formulated with crospovidone are more effective than croscarmellose sodium and SSG.

Key words: *Orally disintegrating tablets, superdisintegrants, paracetamol, independent sample t-test*

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*Corresponding author: nethminayanathara99@gmail.com

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Synthesis and Functionalization of Graphene Oxide for Removal of Cr (VI) from Water

Weerasinghe W.A.H.L., Kalutharage N.K.*

Department of Chemistry, University of Ruhuna, Sri Lanka

Removal of hexavalent chromium from the metal contaminated water is essential due to the carcinogenic activity of Cr (VI). In this study, Graphene oxide (GN) was synthesized using graphite obtained from Bogala Graphite Lanka Limited. Surface of GO was modified with the N,N-diethanolamine molecules binding. The synthesized GO and amino functionalized graphene oxide (GO-NH) were characterized by using UV-Visible spectroscopy and Fourier transform infrared (FT-IR) spectroscopy. Chromium (VI) concentrations were determined by UV-Visible spectrophotometrically using 1,5-diphenylcarbazide as the complexing agent at λ_{max} = 560 nm. The Cr (VI) adsorption experiments showed that 0.10 g / 100 mL of GO-NH had a maximum adsorption capacity of 1.2 ppm. of Cr concentration. The adsorption results showed that GO-NH performs excellent adsorption capacity at pH 2.0 and reached the equilibrium concentration at 30 min of minimum contact time. It was also observed that adsorbent efficiency of GO-NH increases with the increase in temperature. Regeneration studies with the GO-NH composite revealed that the adsorbent retained >80 % of its activity up to 4 cycles. This method has 85.87 % recovery at a spiking level of 1.2 mg/L. This method can be successfully applied in the removal of Cr (VI) in the metal contaminated water samples.

Keywords: *Hexavalent Chromium; Adsorbents; Graphene Oxide; Amino Functionalized Graphene Oxide; Diethanol Amine*

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**Corresponding author*: knishantha@chem.ruh.ac.lk

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Network Pharmacology-Based Insights into the Anti-Rheumatoid Potential of *Zingiber officinale* Decoction

Lakshan S.H.N., Wasana P.W.D.*

Department of Pharmacy, Faculty of Allied Health Sciences, University of Ruhuna, Sri Lanka

Rheumatoid arthritis (RA) is a chronic autoimmune disease characterized by persistent inflammation and progressive joint damage. The hot-water decoction of *Zingiber officinale* (ZO; ginger) has long been used in traditional medicine to manage inflammatory conditions; however, the molecular basis of its effects in RA remains poorly understood. This study aimed to elucidate the molecular targets and signaling pathways associated with bioactive compounds in the aqueous ZO rhizome extract using a network pharmacology approach. Bioactive compounds reported in ZO decoction were retrieved from the literature and screened for drug-likeness properties using SwissADME, resulting in the identification of 10 suitable compounds from 16 candidates. Potential protein targets (n=987) were predicted using SwissTargetPrediction, SEA, and PharmMapper. In parallel, 551 RA-associated genes were collected from GeneCards, OMIM, and DisGeNET, of which 133 overlapped with ZO-related targets. A protein–protein interaction (PPI) network constructed using STRING and analyzed in Cytoscape comprised 133 nodes and 2,044 edges, identifying key hub genes including *IL6, TNF, STAT3, NFKB1, ICAM1, MMP9, TLR4, PTGS2, ALB,* and *JUN*. Gene ontology enrichment analyses revealed that these targets were significantly associated with immune and inflammatory biological processes. KEGG pathway analysis identified 157 enriched pathways, notably Toll-like receptor signaling, TNF signaling, and Th17 cell differentiation. Collectively, these findings indicate that ZO decoction exerts multi target and multi-pathway effects relevant to RA pathogenesis, providing mechanistic support for its traditional use and highlighting its potential as a complementary therapeutic strategy. Further experimental validation is required to substantiate these computational predictions.

Keywords: *Rheumatoid Arthritis; Zingiber officinale; rhizome; decoction; network pharmacology*

**Corresponding author*: dasuniwasana@ahs.ruh.ac.lk

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Antimicrobial Activity of Silver Nanoparticles Biosynthesized Using *Lannea coromandelica* and *Pothos scandens*

Kotawalagedara S.K [1], Kalansuriya P [1*], Thabrew H [2].

[1] Department of Biochemistry, Faculty of Medicine, University of Ruhuna, Sri Lanka.

[2] Department of Microbiology, Faculty of Medicine, University of Ruhuna, Sri Lanka.

Diabetic foot ulcer (DFU) is a complication of diabetes mellitus that can be worsen with microbial infections. Biosynthesized silver nanoparticles (AgNPs) would be promising therapeutic agents to treat DFU associated infections. Ayurvedic medicinal plants *Lannea coromandelica* (LC, bark) and *Pothos scandens* (PS, stems and leaves) are known to be useful in treatment of microbial infections. This study evaluated *in vitro* antimicrobial activity of LC and PS crude extracts, extract coated AgNPs (LCAgNP and PSAgNP), and uncoated AgNPs (UAgNP). Antimicrobial activities were screened using broth micro dilution method, against the standard strains *Staphylococcus aureus* (ATCC 25923) and *Pseudomonas aeruginosa* (ATCC 27853) in duplicate, using gentamicin as the positive control. Minimum inhibitory concentration (MIC), minimum bactericidal concentration (MBC), half-maximal inhibitory concentration (IC_{50}) were calculated using Prism 10.0 (GraphPad Software). PSAgNP showed MIC against *S. aureus* (3.125 mg/mL) and *P. aeruginosa* (0.78 mg/mL). LCAgNP showed MIC against *S. aureus* (10 mg/mL). Gentamicin showed MIC against *S. aureus* (0.001 mg/mL) and *P. aeruginosa* (0.004 mg/mL). Crude extracts and UAgNP did not show antimicrobial activity. MBC values of PSAgNP against *S. aureus and P. aeruginosa* were 3.125 mg/mL and 1.56 mg/mL, respectively, while for LCAgNP, against *S. aureus* was 10 mg/mL. IC_{50} values of PSAgNP against *S. aureus and P. aeruginosa* were 0.771±6.5 mg/mL and 1.629±25.2 mg/mL, respectively. LCAgNP against *S. aureus* was 0.657±10.8 mg/mL. In conclusion, LCAgNP and PSAgNP exhibited enhanced antibacterial activity compared to their crude extracts and UAgNP.

Keywords: *Silver nanoparticles, Lannea coromandelica, Pothos scandens, antimicrobial activity, MIC*

**Corresponding author*: p_kalansuriya@med.ruh.ac.lk

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Effect of Heat Moisture Treatment, Acetylation and Dual Modification on Properties of Cassava Starch

Gunarathna H.I.S. and Samarakoon E.R.J.*

Department of Food Science and Technology,
Faculty of Agriculture, University of Peradeniya, Sri Lanka

This study aimed to investigate the effects of single and dual modifications using heat moisture treatment (HMT) and acetylation on the morphology, structure, and physicochemical properties of cassava starch. The starch was extracted from the roots of MU 51 Sri Lankan cassava variety and modified by HMT at 22 % moisture content and 120 °C for 2 h, by acetylation using 8 % of acetic anhydride and by combinations of HMT and acetylation. The percent acetylation of modified starches was ranged from 1.5 % to 2.5 %. Polygonal shaped granules were observed under the light microscope (×1000 magnification). Fourier Transform Infrared Spectroscopy (FTIR) showed two new peaks at 1725 cm^{-1} and 1245 cm^{-1} assigned to carbonyl –C=O and carbonyl –C-O stretch vibration respectively, on acetylated and dual modified starches. Bulk density was significantly ($p<0.05$) decreased after the HMT while, it was significantly ($p<0.05$) increased after the acetylation and dual modifications. Water holding capacity was significantly ($p<0.05$) increased after all modifications. Oil holding capacity was significantly ($p<0.05$) increased only on acetylation followed by HMT. All individual samples showed their highest solubility at 90 °C and, at that temperature, solubility of acetylated starch was significantly ($p<0.05$) increased and HMT and dual modified starches were significantly ($p<0.05$) decreased compared to native starch. Swelling power of HMT and dual modified samples were significantly ($p<0.05$) decreased at 90 °C compared to native starch. HMT, acetylation, and their combination significantly modify the properties of cassava starch, highlighting their potential as functional modification strategies.

Keywords: *Heat Moisture Treatment, Acetylation, Dual modification, Cassava starch, Physicochemical properties*

**Corresponding Author*:rasanjalis@agri.pdn.ac.lk

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Green Synthesis of Silver Nanoparticles from *Manihot esculenta* Peels and *Osbeckia octandra* Flowers for Potential Conductive Textile Applications

N.P.A.M.De Silva, Kumudu Siriwardana*

Department of Chemistry, University of Ruhuna

Development of electronic textiles (e-textiles) is an emerging field of research in the modern world. Silver nanoparticles (AgNPs) show excellent conductivity along with other desired properties, including antibacterial and optical properties. Various hazardous chemicals are used in chemical synthesis of AgNPs, which have a considerable impact on human health and the environment. In this study, AgNPs were synthesized using a green approach with cassava peels (CP) (*Manihot esculenta*), an agro-industrial waste material, and heenbovitiya (HB) flower (*Osbeckia octandra*) extracts. Phytochemicals in plant extracts function simultaneously as reducing and stabilizing agents, thereby minimizing the need for hazardous chemicals. Synthesis was performed at the optimized temperature, 80 °C. Characteristic localized surface plasmon resonance peak (λ_{lSPR}) at ~ 420 nm confirmed the formation of AgNPs. The optimized concentrations of $AgNO_3$ to CP and HB were 5 and 8 mM, respectively. Furthermore, the optimal $AgNO_3$: plant extract volume ratios were 1:1 for CP and 2:1 for HB. Conductive textiles were fabricated via *in situ* synthesis by embedding AgNPs into a linen fabric using a polypyrrole binder, achieving a conductance of ~1.25 mS. FTIR analysis validated that the molecular integrity of treated fabrics remained unchanged. The findings demonstrate that the synthesized AgNPs effectively enhance textile conductance while maintaining eco-sustainability, highlighting their potential applications in wearable electronics and smart textiles.

Keywords: Conductive *fabrics; green synthesis; silver nanoparticles*

**Corresponding author*: wkkdsiriwardana@chem.ruh.ac.lk

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Development of Biodegradable Coatings for Paper-Based Food Packaging Using PLA, PBAT, and PLA–PBAT Blends

Fernando W.K.T.[2], Milani M.D.Y.[1*], Nayanajith L.D.C.[1], Arachchige R.C.W.[1], Ratnaweera C.N.[2]

[1] Industrial Technology Institute, Colombo, Sri Lanka

[2] Department of Chemistry, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

Food packaging ensures safety, quality, and shelf life of food. As this industry widely uses petroleum-based polymers, environmental concerns have driven society toward sustainable alternatives like paper. Its poor barrier properties are commonly controlled by applying petroleum-based derivatives, such as polyethylene (PE), as coatings, making it less biodegradable. There are sustainable polymers like poly(lactic acid) (PLA), poly(butylene adipate-co-terephthalate) (PBAT), and PLA-PBAT polymer blends that can be used as a coating replacing PE. However, locally available food packaging still relies on non-biodegradable petroleum-based coatings. This study explores the development of biodegradable polymer coatings using 20% PLA, 30% PBAT, and 20% PLA-PBAT polymer blend. Coatings were prepared by solvent casting using chloroform as the solvent and evaluated in terms of thickness, water absorption (WA), water vapor transmission rate (WVTR), overall migration and characterized by FTIR, and SEM analysis. The results indicated a significant reduction in water absorption and WVTR compared to uncoated Kraft paper (WA 31.11%, WVTR 32.53%). PBAT coated paper exhibited the lowest WA (14.69%) and WVTR (11.22%). PLA showed moderate barrier properties (WA 21.00%, WVTR 13.70%), and the PLA-PBAT blend exhibited intermediate performance (WA 19.18%, WVTR 13.80%). The migration resulted for the PLA-PBAT polymer blend coated paper was 12.4 $mgdm^2$. SEM confirmed reduced surface porosity and strong adhesion of polymers to the paper, while FTIR verified the structural integrity of the coated papers. According to the study, PBAT offers the best barrier resistance, PLA provides remarkable sustainability, and PLA-PBAT polymer blends offer an optimal balance of properties.

Keywords: *paper; biodegradable coating; PLA; PBAT*

**Corresponding author*: yogamilani@gmail.com

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Development of *Aegle marmelos* (Bael) Fruit powder incorporated Cookies

Wickramananda R.M.D.S.[1], Vajira. P. Bulugahapitiya [1 *], Hashini I. Abeysuriya [2].

[1] Department of Chemistry, Faculty of Science, University of Ruhuna

[2] Department of Food Science and Technology, Faculty of Agriculture, University of Ruhuna

Bael fruit is an underutilized fruit and it is known to possess many nutritional and healthcare properties. This study aimed to formulate cookies incorporating Bael fruit (*A. marmelos*) powder, as an alternative to conventional baked cookies. Different ratios of mature bael fruit powder (BP) and wheat flour (WF) were used to prepare cookies formulation. Washed fruits were used to prepare pulp after deseeding, and degumming followed by blanching at 60 °C for 5 min. After dehydrating at 65 °C for 3 h, the pulp was ground into a fine powder. The following ratios of bael fruit powder (BP) to wheat flour (WF) were used; Control (0:100 BP: WF), BW1 (12:88 BP: WF), BW2 (15:85 BP: WF), BW3 (20:80 BP: WF), BW4 (25:75 BP: WF), and BW5 (30:70 BP: WF). The proximate composition, such as moisture, ash, fat, crude fiber, and crude protein content of cookie samples were determined through AOAC procedures. All values were significantly different ($p<0.001$) among the six-cookie formulations. The highest moisture was in the control (3.15 ± 0.08%) and BW1 (3.13 ± 0.09%), with BW3 (2.11 ± 0.08%) having the lowest moisture. BW5 contained the highest amount of ash (14.72 ± 0.24%) and fat (11.74 ± 0.23%), with BW2 (8.18 ± 0.18%) containing the least amount of fat; the greatest amount of protein was in BW5 (11.10 ± 0.082%) and BW4 (10.56 ± 0.064%) and the least in BW1 (8.53 ± 0.062%) and BW2(8.35 ± 0.960%). The amount of crude fiber was significantly different, showing the highest in BW4 (20.15 ± 0.70%) and BW5 (20.39 ± 0.80%). Sensory attributes, including taste, smell, appearance, texture, and overall acceptability, indicated that BW5 has good attributes over the other particularly in terms of taste and overall acceptability. This study shows the development of bael cookies as functional food products using underutilized fruit, bael. This product has potential to be used as a solution for reducing postharvest waste of bael and enhancing rural economy through underutilized bael fruits.

Keywords: *Bael cookies; Bael fruit; Sensory attributes; underutilized fruit*

**Corresponding author*: vajira@chem.ruh.ac.lk

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Groundwater Hardness Removal Using Lemon and Pomegranate Peel Biosorbents

***Samama N.F.*[1,*]*, Devaisy S.*[1]*.**

[1] Department of Bio-Science, University of Vavuniya, Vavuniya, Sri Lanka.

Reverse Osmosis (RO) is widely used to remove hardness from drinking water, but it has major drawbacks such as high energy demand, excessive brine waste and loss of beneficial minerals. This study investigates the use of fruit peel biosorbents as a sustainable and low-cost alternative for groundwater hardness reduction. Groundwater collected from a dug well at the University of Vavuniya, with an initial hardness of 650 ± 20 mg/L (as $CaCO_3$), was used as the feed water. In preliminary screening, five fruit peels—beetroot, lemon, orange, banana and pomegranate were tested in both raw and phosphoric acid-activated forms at a biosorbent dose of 2 g/L and a contact time of 360 minutes. Lemon and pomegranate peels showed the highest removal efficiency and were selected for detailed studies. Batch experiments were performed at doses ranging from 0.1–10 g/L and contact times of 15–1440 minutes. Optimum conditions were observed at 5 g/L for lemon peel (67% hardness removal, 300 min) and 8 g/L for pomegranate peel (73% removal, 240 min). Adsorption data fitted the Freundlich isotherm (R^2 = 0.78 for lemon, 0.82 for pomegranate) and pseudo-second-order kinetics (R^2 = 0.88 and 0.92), suggesting chemisorption as the dominant mechanism. Column experiments confirmed these results, with breakthrough curves matching the Yoon-Nelson and Thomas models, though performance slightly decreased at higher flow rates. Overall, phosphoric acid activation enhanced the adsorption capacity of all biosorbents. The findings highlight fruit peel-based biosorbents as a practical, eco-friendly solution for reducing groundwater hardness in rural communities.

Keywords: *Biosorption; Breakthrough; Column adsorption; Fruit peel adsorbents; Water hardness*

**Corresponding author*: fsamama1999@gmail.com

Metal Oxide-Modified Beaded Sawdust for the Removal of Methylene Blue from Wastewater

Rodrigo D. and Wanniarachchi S.*

Department of Chemistry, University of Ruhuna, Sri Lanka

The increasing release of dye pollutants into water poses a severe environmental threat, necessitating the improvement of cost-effective and viable remediation techniques. This study investigates the capacity of metal oxide-modified beaded sawdust as efficient adsorbents for the elimination of dyes from wastewater. Titanium dioxide (TiO_2), zinc oxide (ZnO), and aluminum oxide (Al_2O_3) were utilized to prepare metal oxide modified sawdust beads. The modified sawdust beads were characterized by SEM and FT-IR techniques. The performance of sawdust beads modified with TiO_2 (STB) was evaluated for the elimination of methylene blue (MB) dye under varying operational parameters such as adsorbent dose, temperature, pH, initial dye concentration and contact time by batch tests and adsorption–desorption test. The results revealed that STB exhibited superior adsorption efficiency compared to unmodified sawdust beads or beads modified with ZnO and Al_2O_3, attributed to the large surface area, strong photocatalytic property, and favorable surface charge interactions. The parameters of 3.0 g, 30 ℃, pH 11, 10 ppm dye concentration and 6 hours of stirring showed the highest MB dye removals of more than 87% for STB while the unmodified sawdust beads and those modified with ZnO and Al_2O_3 showed dye removal efficiencies of 75.20%, 77.88%, and 76.18%, respectively. Thus, the material modification by TiO_2 improved the MB dye removal efficiency of sawdust. Also, they are capable of reuse for more than three cycles with MB dye removal of 71%. In addition, since STB are beaded materials, they are not difficult to separate from treated wastewater and reduce the operating cost of wastewater treatment.

Keywords: *Adsorption, Dye removal, Methylene Blue, Sawdust beads, Titanium dioxide*

**Corresponding author*: sarathwan@chem.ruh.ac.lk

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Development & Evaluation of Mushroom Soup Powder: Nutritional, Physicochemical & Microbial Properties

Pabasara G.V.S.[1,*], Fernando M.D.M.[1], Abeysekera W.K.S.M.[2].

[1] Faculty of Medicine, University of Colombo, Sri Lanka
[2] Faculty of Technology, University of Colombo, Sri Lanka

Mushrooms, being rich in protein and bioactive compounds, represent a promising ingredient for functional food formulations with broad dietary applicability. This study developed a ready-to-prepare protein-rich mushroom soup powder formulated using *Agaricus bisporus* and *Lentinula edodes* and evaluated its sensory, nutritional, physicochemical, and microbial properties. Fresh mushrooms were cleaned, sliced, oven-dried at 60 °C, and milled into a fine powder. Three formulations containing 40%, 50%, and 60% of the combined mushroom powder, along with supplementary ingredients, were prepared. Sensory evaluation by a trained panel (n = 12) using a nine-point hedonic scale showed no significant differences ($p > 0.05$) for colour, appearance, odour, mouthfeel, or overall acceptability. The 60% mushroom formulation scored significantly higher for taste (7.58, $p < 0.05$) and was selected for further analyses. Nutritional analysis of selected formulation indicated 24.87 ± 0.15% protein, 37.69 ± 1.37% carbohydrate, 6.25 ± 0.41% fat, 8.48 ± 0.57% crude fibre, 15.80 ± 0.70% ash, and 6.91 ± 0.14% moisture per 100 g, corresponding to ~307 kcal per 100 g. Physicochemical analysis showed pH 5.47 ± 0.02, water activity 0.37 ± 0.00, total soluble solids 4.17 ± 0.29 °Brix, and uniform reconstitution with minimal sedimentation. Microbial analysis confirmed safety, with total plate counts $5.27 \times 10^2 \pm 0.49 \times 10^2$ CFU/g and yeast/mould 0.5×10^2 CFU/g as per ICMSF. In conclusion, the developed mushroom soup powder has high protein content and acceptable sensory, physicochemical and microbial properties, supporting its potential as a convenient, nutrient-rich functional food.

Keywords: *Mushroom soup powder; Sensory evaluation; Nutritional composition; Physicochemical properties; Microbial quality*

**Corresponding author*: sachinipabasarav@gmail.com

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Formulation and Evaluation of Eco - Friendly Shampoo Bars as Sustainable Alternatives to Conventional Hair Cleansers

R. M. N. P. Rathnayake, S.A. Senevirathne, N. B. Jayaratna*

Department of Chemical Sciences, Faculty of Applied Sciences, Rajarata University of Sri Lanka, Mihintale

Shampoo bars offer an eco-friendly alternative to liquid shampoos by eliminating the need for plastic packaging and minimizing waste. They are also more cost-effective, offering greater longevity and improved value. This study aims to formulate and evaluate efficient shampoo bars that provide an optimal balance between hair care benefits and economic feasibility. Converting liquid shampoo directly into a bar compromises its consistency and appearance. Instead, shampoo bars were prepared using the heat saponification method with EDTA and citric acid, incorporating 40–50% (w/w) commercial liquid shampoo. In a separate formulation, sodium lauryl sulphate (SLS) was employed as the primary surfactant, together with citric acid, EDTA, and glycerol. Due to the adverse effects of SLS, a third formulation used natural ingredients, primarily soap nut. Rice husk powder, used as a natural filler, improved the mechanical strength of bars and reduced cracking by enhancing uniformity and minimizing internal stress. Scum formation, common in formulations with traditional soaps or SLS in hard water, was minimized using EDTA and citric acid, which chelate calcium and magnesium ions, enhancing clarity, foaming, and rinsability. All formulations maintained a pH value between 8.1 to 8.5 and water content between 10–15% which did not exceed the maximum value (15%). Solubility tests showed moderate solubility in all bars, except those with rice husk. Lathering power and stability ranged from 60–75%, and sebum removal tests confirmed effective cleansing. In conclusion, shampoo bars provide cleansing performance comparable to liquid shampoos while significantly reducing plastic waste, supporting sustainable personal care practices.

Keywords: *Shampoo Bar; Scum formation; Biodegradability; Cleansing; Saponification*

**Corresponding author*: *naleen@as.rjt.ac.lk

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Comparative Analysis of the Phytochemical Profiles, Antimicrobial Activity, and Antioxidant Properties of Selected Mangrove Species from the Southern Coast of Sri Lanka

K.D.T.Chandima [1] **, *Y.M.A.L.W.Yapa.*** [1,*]**, *Vajira P. Bulugahapitiya*** [1]

[1] Department of Chemistry, University of Ruhuna, Matara, Sri Lanka.

Mangrove plants grow in unique ecosystems and can survive under extremely harsh environmental conditions, including high salinity, low oxygen levels, drought, and water scarcity. They produce various secondary metabolites with significant ecological and pharmaceutical importance. Despite this, only a limited number of studies have examined the phytochemistry and bioactivities of mangrove species in Sri Lanka. Therefore, this study focuses on the phytochemical analysis and the evaluation of antibacterial and antioxidant properties of leaf extracts from selected mangrove species collected from the southern coast of Sri Lanka. Four well-known mangrove species were selected: *Rhizophora apiculata* (Kadol), *Sonnaratia caseolaris* (Kirala), *Avicennia marina* (Manda), and *Lumnitzera racemosa* (Weraniya). Methanol extracts of the dried leaf powders were prepared using cold maceration. Phytochemical screening of the extracts using standard methods revealed the presence of alkaloids, saponins, flavonoids, quinones, betacyanins, phenols, tannins, diterpenes, phytosterols, and glycosides in all species. Alkaloids and saponins were quantified gravimetrically, while phenols, tannins, and flavonoids were determined spectroscopically. Antioxidant activities were evaluated using DPPH radical scavenging and FRAP assays. Phenolic, tannin, alkaloid, and saponin contents were highest in *S. caseolaris*, while flavonoid content was highest in *R. apiculata*. The strongest radical scavenging activity, indicated by the lowest IC_{50} value (65.23 µg/mL), was observed for *S. caseolaris*. FRAP values were highest in *R. apiculata* (8829.91 µmol Fe^{2+}/g), followed by *S. caseolaris* (13,111.84 µmol Fe^{2+}/g), *A. marina* (4080 µmol Fe^{2+}/g), and *L. racemosa* (3915.19 µmol Fe^{2+}/g). The findings of this study indicate that the selected mangrove plants contain a diverse range of phytochemicals and exhibit significant antibacterial and antioxidant properties, suggesting their potential as valuable sources of biologically active compounds for use in various applications.

Keywords: *Mangroves*; *Antimicrobial activity; Antioxidants; Maceration; Phytochemicals*

**Corresponding author*: lalithyapa@chem.ruh.ac.lk

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Comparative Investigation of Anti-diabetic Properties, Taxonomical Characteristics and Phytochemical Differences between *Costus speciosus and Costus afer*

P.S. Haputhanthri [1], M. Edussuriya [2], K.G.P. Hansani [3*]
[1,2] Department of Chemistry, Faculty of Science, University of Ruhuna, Sri Lanka
[3] Department of Mathematics, Faculty of Science, University of Ruhuna, Sri Lanka

Costus afer and *Costus speciosus* (Thebu in Sinhala) are used in traditional medicine to treat diabetic mellitus. This research focused on scientifically comparing and contrasting their therapeutic potential, phytochemical profiles and taxonomical characteristics. The 95% ethanolic leaf extracts of the two species were assessed qualitatively in a phytochemical screening test to identify the presence of important bioactive compounds. Herbarium sheets and the results of the taxonomic study were used to differentiate the herbs based on distinct morphological characters, such as sheath color and corolla color. *In vitro* enzyme inhibition assays involved in the hydrolysis of carbohydrates (alpha-amylase and alpha-glucosidase) were conducted to evaluate their effectiveness. The findings established a strong variation in strength, indicating that the two species differ considerably in their enzyme-inhibitory activity. When compared to *Costus afer* (IC_{50} = 582.64 and 213.13 µg/mL in alpha-amylase and alpha-glucosidase, respectively), *C. speciosus* exhibited a notably higher inhibitory power towards the alpha-amylase (IC_{50} = 421.92 µg/mL) and, above all, alpha-glucosidase (IC_{50} = 18.99 µg/mL) as well. Significantly lower IC_{50} values in *C. speciosus* imply stronger enzyme-inhibitory activity, which indicates a better chance of controlling postprandial hyperglycemia. According to the results of phytochemical analysis, most of the compounds are present in both plant species. Finally, although the two plants have antidiabetic properties, this paper provides strong evidence that *Costus speciosus* is the most appropriate plant for producing novel, plant-based antidiabetic products. The findings of this study provide a strong scientific basis for prioritizing this species in future pharmacological investigations.

Keywords: *Antidiabetic activity, Costus afer, Costus speciosus, Phytochemical screening, Taxonomy*

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**Corresponding author*: prasadi@maths.ruh.ac.lk

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Comparative Analysis of Chitosan_β-lactoglobulin and Chitosan_ethyl cellulose Nanocomposites for Desferrioxamine Encapsulation: Evaluation of Physicochemical, Pharmacokinetic, Hemocompatibility and Antioxidant Properties

Wimalasiri A.K.D.V.K [1], Kalansuriya P. [1*], Perera D.K.M. [1], Espósito B.P [2], Siriwardhana K. [3], Mohotti M. [4]

[1]Department of Biochemistry, Faculty of Medicine, University of Ruhuna, Sri Lanka.
[2]Department of Fundamental Chemistry, University of São Paulo, São Paulo, Brazil.
[3]Department of Chemistry, Faculty of Science, University of Ruhuna, Sri Lanka.
[4]Department of Hematology, Teaching Hospital Karapitiya, Karapitiya, Sri Lanka.

Iron overload damages vital organs, including the heart and central nervous system. Despite desferrioxamine (DFO) being used therapeutically, its effectiveness is limited by poor cell permeability and short plasma half-life. This study investigates the synthesis of two chitosan-based DFO nanocomposites for controlled drug release and comparatively evaluates their physicochemical properties, pharmacokinetics, hemocompatibility, and antioxidant activity. Chitosan–β lactoglobulin (DFO_CN_CTS_β-Lac) and chitosan–ethyl cellulose (DFO_PEO_EC_CTS_TPP_1) nanocomposites were prepared and characterized using scanning electron microscopy (SEM), particle size analysis (PSA) and Fourier transform infrared spectrophotometry (FTIR). PSA data reveals the formation of average 293.1±52.9 nm (PDI: 0.795) sized particles for DFO_PEO_EC_CTS_TPP_1 and 412.7±119 (PDI: 0.445) for DFO_CN_CTS_β-Lac. DFO_CN_CTS_β-Lac exhibited a high drug loading capacity (298±8.6 mg/g) and drug entrapment efficiency (89.4±2.6%) compared to DFO_PEO_EC_CTS_TPP_1. Drug release kinetic was studied at physiological (7.4) and intestinal pH (5.8), revealing a more sustained and controlled release of DFO from DFO_CN_CTS_β-Lac than DFO_PEO_EC_CTS_TPP_1. Moreover, the antioxidant activity was better preserved in DFO_PEO_EC_CTS_TPP_1, possibly due to slower DFO release in DFO_CN_CTS_β-Lac. *In vitro* screening of blood compatibility of the nanocomposites confirmed the hemocompatibility. These findings suggest that the DFO_CN_CTS_β-Lac nanocomposite shows superior controlled-release properties, enhancing the therapeutic efficacy of DFO.

Keywords: *desferrioxamine, drug loading, chitosan, ethyl cellulose, β-lactoglobulin*

**Corresponding author*: *p_kalansuriya@med.ruh.ac.lk,

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Mitigation of Delays in Sri Lankan Construction Industry

Mallawa.R.M.D.U. [*]***, Srivishagan.V. , Thalpage R., Liyanagama.S.S***

[1]Department of Civil Engineering, University College of Matara,
University of Vocational Technology, Sri Lanka.

This research investigates the crucial factors contributing to delays in Sri Lankan construction industry and focuses on developing effective mitigation strategies. Construction delays remain a major challenge, impacting project delivery, stakeholder relationships, and the overall performance of the industry. The study aims to offer practical solutions to reduce delays and improve project efficiency in the Sri Lankan context. This study adopted quantitative approach using questionnaire survey targeting the construction professionals, such as project managers, contractors, consultants, and other key stakeholders. This approach gathers firsthand insights from individuals directly involved in managing and experiencing construction delays. Moreover, this study employed convenient sampling to obtain a broad perspective on the causes, effects, and potential mitigation strategies for delays. Through rigorous quantitative analysis, this study investigates relationships most significant causes of delay, their impacts with different categories, and existing mitigation measures. This analysis helps identify key trends and prioritize the most significant causes of delays and corresponding solutions. The findings contribute valuable knowledge to construction management and offer practical recommendations for industry professionals. This reveals the most significant causes of delays were poor project planning (83.30%), lack of skill labors (40.90%), financial issues or delay payment (71.20%), weather condition (48.50%) and regulatory approval and permit (47%). Moreover, those delays identified in the various types of delays such as excusable (40%), compensable (50%), critical (40%) and concurrent delays (43.30%). Future more, the finding reveal that the most appropriate mitigation methods, such as, early identification of risk (77.30%), adequate resource allocation (62.10%), Regular communication and updates among stakeholders (56.10%), Training and skill development for workers (54.50%) and used project management software (48.50%). These disruptions often have a ripple effect stalling procurement, labor engagement, and subcontractor activities. By focusing specifically on the Sri Lankan construction industry, the research addresses challenges unique to the region, considering the economic, social, and technical factors influencing project delivery. Ultimately, the study seeks to enhance project outcomes by providing tailored insights and strategies to tackle construction delays effectively.

Keywords: *Delays, Sri Lankan construction Industry, Mitigation*

[*]*Corresponding author*: dewangiupamali69@gmail.com

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Investigate MEP Quantity Surveying Errors in High-Rise buildings in Sri Lanka

Rajaputhra.K.C., Srivishagan.V., Thalpage R., Liyanagama.S.S

Department of Civil Engineering, University College of Matara, University of Vocational Technology, Sri Lanka.

The rapid expansion of high-rise development in Sri Lanka has intensified the demand for accurate Mechanical, Electrical, and Plumbing (MEP) quantity surveying, but recurring errors negatively affect project performance. This research investigates the causes and impacts of MEP quantity surveying errors in Sri Lankan high-rise projects. Using a mixed-method approach questionnaire survey, interviews, and case study. The study identifies frequent errors such as BOQ inaccuracies 83.90%, incorrect quantity take-offs 77.40%, misunderstanding of design drawings 32.30%, and coordination failures. Key contributory factors include in sufficient technical experience, limited timing and time pressure leading to cost overrun, delayed projects, and reduced construction quality, and lower client satisfaction. The findings highlight the potential of emerging digital technologies, particularly Building Information Modeling (BIM) 81.30% and automated take-off software 40.60 %, to minimize errors by improving visualization, coordination, and real-time detection of inconsistencies. However, Implementation barriers such as high investment costs 75%, resistance to change 46.90%, and 53.90 % deficiencies in skills remain relevant. The research highlights that training, standardized procedures, and improved stakeholder communication can reduce errors. This study proposes an integrated model that incorporates technology adoption, training, and teamwork practices. Also, this study presents practical recommendations to reduce errors, improve project performance, and facilitate the sustainable delivery of high-rise buildings in Sri Lanka.

Keywords: *MEP Quantity Surveying, High-Rise Buildings, Building Information Modeling (BIM), Error Mitigation Strategies Sri-Lanka, 5D BIM*

**Corresponding Author:* kushanxchamara@gmail.com

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Quantity Surveyors' Role in Claims and Disputes Management in the Sri Lankan Construction Industry

Wijerathne.W.N.M, Srivishagan.V., Thalpage R., Liyanagama.S.S

Department of Civil Engineering, University College of Matara, University of Vocational Technology, Sri Lanka.

The rapid growth and increasing complexity of the construction industry have led to an increase in disputes and claims, which negatively impact projects such as timelines, budgets and outcomes. Quantity Surveyors (QSs) play a special role in managing these challenges. However, many professionals have faced problems due to a lack of adequate expertise in claims and disputes management. This research aims to explore the role of QSs in the resolution of claims and disputes and to propose strategies to enhance their knowledge and practical application in the context of the Sri Lankan construction industry. The study employed the mixed methods approach, incorporating an extensive literature review and structured surveys of key construction professionals, such as contractors, project managers, and QSs. The findings indicated significant knowledge gaps among QSs in the area of claims and disputes resolution such as, delays, changes, unforeseen site conditions and lack of training. On the other hand, the study reveal insufficient practical experience (42.20%) consists of most significant challenge to the construction claim management, while poor communication (28.10%) and 23.40 percentage lack of training are also identified as key challenges. Future more, the study identified various factors affecting the QSs understanding the claim management, such as, experience level (35.80%), access to training (23.50%), project complexity (23.50%) and organization support (17.30%). The study recommends that the educational framework for QSs include comprehensive training, professional development and promote on-the-job opportunities. Moreover, by addressing these gaps, QSs can significantly reduce risks, improve project outcomes and contribute to the overall efficiency of the construction sector in Sri Lanka. The research highlights the importance of a proactive approach to claims and disputes management and emphasizes the need for collaboration among industry stakeholders to effectively address these issues.

Keywords: *Quantity Surveyor, Claims, Disputes, Construction, Roles of QS*

**Corresponding Author*: minushankiw@gmail.com

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Discrete Wavelet Transform based Image Noise Filtering using a Novel Level-dependent Shrinkage Function

Ajward A.M.*

Faculty of Technology, University of Ruhuna, Kamburupitiya, Sri Lanka.

In the process of acquiring and transmitting, images are often contaminated with different noise interferences, and noise filtering improves image clarity and proper analysis of them. Among other noise removal techniques, the Discrete Wavelet Transform (DWT) based shrinkage methods are well-suited for image noise removal. This is because the DWT shrinkage function's ability to filter noise contaminations at multiple resolutions by applying the appropriate level of cutoff between noise and significant features by deciding on which are the noise characteristics of an image that should be removed and which are the important features that should be preserved within the sub-bands. Thus, the noise in the sub-bands would be suppressed without losing any significant features of the filtered image. However, the noise filtering efficiencies of the output images are highly dependent on the specific shrinkage function being applied. Thus, in this work, a novel and more efficient DWT-based wavelet shrinkage function is proposed and developed by a level-independent parameter optimization technique. Then it was tested using experimental techniques for its higher image noise filtering performance compared to an existing superior shrinkage function. The experiments were performed on images contaminated with Gaussian noise. Experimental results indicate that, as compared to the existing wavelet shrinkage function for the same image with different noise contamination levels, the newly proposed and developed shrinkage function gives a higher output Peak Signal to Noise Ratio (PSNR) on average by 1.4 dB and better visual quality for the noise-filtered images. The novel image noise filtering function can be applied to overcome deficiencies in existing ones.

Keywords: *Gaussian Noise-filtering, Wavelet-shrinkage, Image PSNR*

**Corresponding author*: ajwardma@gmail.com

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Evaluating the thermal comfort properties of herbal-treated Cotton Fabric

Wijekoon O.C [1]***, Dissanayake I.A.J.K.*** [1*]***, Gopura S.*** [2]***, Madhavi W. A. M.*** [3]***, Kaumal M.N.*** [4]
[1] Department of Plant Sciences, University of Colombo, Sri Lanka
[2] Department of Textile and Apparel Engineering, University of Moratuwa, Sri Lanka
[3] Department of Physics, University of Colombo, Sri Lanka
[4] Department of Chemistry, University of Colombo, Sri Lanka

High ambient temperatures in tropical regions cause thermal discomfort, and clothing plays a critical role in thermoregulation. Fabrics can be functionally enhanced through sustainable surface treatments. This study investigates the effect of selected herbal treatments derived from Sri Lankan medicinal plants on the thermal comfort properties of cotton fabric. Five plant species: *Aloe vera* (Aloe), *Azadirachta indica* (Neem), *Chrysopogon zizanioides* (Vetiver), *Mentha piperita* (Mint), and *Santalum album* (White Sandalwood) were selected for herbal treatments. Aloe was extracted using the shaker method, while the remaining plants were extracted using the Soxhlet extraction. The cotton fabric was mordanted, soaked in the plant extract (treated), and dried. The treated fabrics were examined for wicking property, thermal conductivity, air permeability, and moisture management properties. One-way ANOVA and Dunnett tests were conducted to give statistical inferences. Vetiver demonstrated the greatest improvement in wicking, with a 2.7 cm mean increase over the control. Aloe recorded the highest thermal conductivity, significantly exceeding that of Neem, which showed a 0.127 W/m °C mean difference. Vetiver presents the highest air permeability with a significant mean difference of 1.67 $cm^3/cm^2.s$ compared to the control. Considering moisture management properties, Neem showed a significant performance in the one-way transport index compared to Aloe, with a 216.45 mean difference. However, overall moisture management capability did not differ significantly among different treatments. These findings suggest that no single plant extract shows superior characteristics over all the properties, and further studies are required to identify a potential plant extract that can be used in textile thermoregulation.

Keywords: *Thermal comfort, herbal treatment, cotton fabric, air permeability*

**Corresponding author*: jkdissanayake@pts.cmb.ac.lk

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A Battery-Free Two-Phase Inverter for Mobile Solar-Powered Water Pumping in Agriculture

Kahawalage Ishadi Navodya Perera[1], S.S. Abeywickrama[1], J. A. P. Bodhika[1,*]

[1] Department of Physics, University of Ruhuna, Matara, Sri Lanka

Reliable irrigation remains a critical challenge in regions with limited access to electrical grids or high fuel costs. Conventional solar-powered pumping systems often rely on batteries, motor-start capacitors, or three-phase inverters, increasing system cost, complexity, and maintenance requirements. This study presents the design and field demonstration of a battery-free, mobile two-phase inverter that directly operates a 2 HP single-phase induction water pump using only real-time solar photovoltaic (PV) energy. The proposed system utilizes five series-connected portable PV panels delivering approximately 200–250 V DC at up to 13.75 A, feeding a custom inverter topology based on four power FET switches and a capacitive phase-shift network. A 1500 µF DC-link capacitor is employed to stabilize the input voltage, while the phase-shift circuit replaces conventional motor-start capacitors by generating two square-wave outputs with a controlled temporal displacement. These outputs are voltage-matched through transformer coupling to emulate a two-phase supply suitable for induction motor operation. Field experiments under varying solar irradiance conditions confirmed reliable motor startup and sustained operation without batteries or auxiliary starting components, demonstrating the practical feasibility of the concept. Measured voltage and current waveforms verified stable inverter operation and consistent phase separation during pumping operation. The results indicate that battery-free two-phase inverter architectures can offer a low-cost, low-maintenance, and portable solution for small-scale agricultural irrigation. While this work primarily focuses on experimental validation and system-level feasibility, detailed analytical modeling and comparative simulation studies with conventional inverter topologies are identified as necessary future work to fully characterize performance trade-offs.

Keywords: *Battery-free inverter, Two-phase power conversion, Solar photovoltaic irrigation, Single-phase induction motor drive, Mobile solar pumping system*

**Corresponding author*: jbodhika@phy.ruh.ac.lk

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Preliminary Study on Simulating Arterial Blood Flow Dynamics Using COMSOL: Velocity, Pressure, and Shear Stress Analysis

***Chandrasekara I.M.K.T.*[1], *Jayasooriya C.C.*[2], *Bodhika J.A.P.*[1*]**

[1]Department of Physics, University of Ruhuna, Wellamadama, Matara, Sri Lanka.
[2] University of Westminster, London, UK

Studying blood flow dynamics and pulse wave propagation in human arteries is fundamental to cardiovascular health. The study focuses on the numerical simulation of blood flow dynamics in a simplified arterial model using COMSOL Multiphysics. Arteries transport oxygen-rich blood from the heart under pulsatile conditions, and the propagation of pulse waves plays a significant role in cardiovascular health. In this research, an idealized arterial geometry was constructed, consisting of concentric cylindrical layers representing the arterial wall and lumen. Blood was modeled as an incompressible, Newtonian fluid, with Laminar flow, and time-dependent pulsatile inlet velocity boundary conditions were applied to simulate realistic physiological flow. The computational domain was discretized using a physics-controlled tetrahedral mesh. The simulation results include velocity profiles, pressure distributions, and variations in wall shear stress within the artery. The predicted velocity value obtained for the carotid artery lies within the physiological range of 0.01–0.15 ms^{-1}. As expected, the velocity distribution exhibited a parabolic profile, with peak velocity at the lumen center and reduction toward the arterial wall due to the no-slip boundary condition. The contour map confirmed this pattern, showing maximum values of ~0.147 ms^{-1} at the core and markedly lower velocities at the boundaries. These results enhance understanding of normal arterial hemodynamics and provide a basis for future studies on pathological conditions such as plaque formation.

Keywords-: Blood flow dynamics, COMSOL, Arteries, Blood flow velocity, Pressure distribution

**Corresponding author*: jbodhika@phy.ruh.ac.lk

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Acoustic Evaluation of a Lecture Hall: A Case Study of the Mathematics Lecture Theatre I at the University of Ruhuna, Sri Lanka

Korala S.K.D.C.H, Senanayake N.A.H.C., Bodhika J.A.P.*

Department of Physics, Faculty of Science, University of Ruhuna, Sri Lanka

Vocal communication is a crucial method for knowledge transfer, making acoustically responsive learning environments essential in higher education. This study evaluates the acoustic performance of Mathematics Lecture Theatre I (MLT I) at the Faculty of Science, University of Ruhuna, with particular emphasis on speech clarity and reverberation behaviour. Measurements were conducted in accordance with ISO 3382-1:2009 using a Brüel & Kjær 2250 Sound Level Meter and an omnidirectional pink-noise source. Reverberation parameters RT20, RT30, and Early Decay Time (EDT) were measured under both unoccupied and fully occupied conditions to assess the influence of audience presence on sound decay. The lecture hall has a volume of approximately 768 m^3 and predominantly hard reflective wall surfaces with non-upholstered seating. The results show that occupancy significantly reduces mid-frequency reverberation times, particularly at 500 Hz, where values decrease from 3.2 s to 1.2 s, thereby improving speech intelligibility and listening comfort. At low frequencies (100-160 Hz), changes are minimal, indicating limited absorption by occupants. Total sound absorption, estimated using Sabine's equation, ranges from 21 to 25 Sabins across speech-relevant frequencies, suggesting a balanced acoustic environment. Overall, the findings highlight the importance of room geometry, material properties, and occupancy in achieving suitable acoustic conditions for lecture-based activities.

Keywords: *acoustic performance, early decay time (EDT), reverberation time, sound absorption, speech intelligibility*

**Corresponding author*: jbodhika@phy.ruh.ac.lk

Design and Thermal Analysis of a Vegetable Dehydrator for Small-Scale Producers in Sri Lanka

Kariyawasam P.T.M.**, De Silva K.T.K.M.

Department of Mechanical and Manufacturing Engineering, University of Ruhuna, Sri Lanka

Post-harvest losses are a critical challenge in the Sri Lankan agricultural sector, as approximately 370,000 metric tons of vegetables, which account for nearly 20%-40% of the total harvest, are lost annually during post-harvest operations. Dehydration has become popular as a solution for reducing food waste by preserving agricultural produce through controlled drying methods. This study presents an energy-efficient vegetable dehydrator tailored for small-scale producers in Sri Lanka. The proposed dehydrator features a cubic drying chamber with the capability of processing up to 10 kg of vegetable slices per batch. In comparison to conventional dehydrators, this design integrates a heat exchanger to recover exhaust heat and consists of two parallel air inlets for uniform drying while the use of food-grade, corrosion-resistant materials ensure food safety. The development methodology incorporated detailed thermal and air flow calculations, 3D CAD modelling and CFD based airflow, thermal and structural simulations. Simulation results confirmed uniform air distribution with sufficient velocity and temperatures and also, structurally safe under full loading conditions. Based on a preliminary experiment the size of the drying chamber was selected. Based on thermal simulation results, the required heating capacity of the system was determined to be 1500 W to maintain the desired drying temperature within chamber. Therefore, this dehydrator design offers drying uniformity, improved energy efficiency and reduced operational cost. Overall, this study is expected to contribute significantly to a sustainable and resilient food preservation trend. Future work will focus on experimental validation and optimization for a broader range of agricultural products.

Keywords: *Vegetable dehydrator, Post-harvest losses, Uniform drying, Food safety*

**Corresponding author*: teenuhansi@gmail.com

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Simulation-Based Design of a Boiler Chimney Heat Recovery System

Ilangarathna I.P.R.R.*, De Silva K.T.K.M.

Faculty of Engineering, University of Ruhuna, Sri Lanka.

This project focuses on the design and simulation of a gas-to-gas heat recovery system specifically developed for integration with small-scale industrial boiler chimneys. The system aims to harness waste heat from boiler exhaust gases to improve overall energy efficiency while addressing one of the key challenges in such environments fouling. A major design consideration was the mitigation of fouling, which was addressed through the incorporation of easily replaceable particulate filters and a quick-wash system to facilitate regular maintenance and sustained performance. Computational simulations were carried out using ANSYS software to analyse the behaviour of flue gases. Additionally, a review of current fouling reduction techniques informed the selection of materials and filter designs. The final system demonstrates the potential for significant energy savings with a practical approach to long-term maintenance in small-scale industrial settings. With a target effectiveness of 0.7 and 11 plates, the proposed compact plate heat exchanger is sized to deliver the required 300 kW of heat recovery. It heats the air from 27 °C (inlet) to 200 °C (outlet) while cooling the flue gas from 450 °C (inlet) to 250 °C (outlet), meeting the thermal performance goals within the compact plate configuration. Based on LMTD and NTU–effectiveness analyses, the compact plate heat exchanger was evaluated for air velocities of 0.3–1.0 m s^{-1} at a constant flue gas velocity of 5 m s^{-1}. The system reliably recovered 20–25 kW of waste heat, enhancing drying efficiency. Optimal performance occurred at 0.5–0.6 m s^{-1}, providing a balanced trade-off between effectiveness and energy recovery.

Keywords: *Gas-to-gas heat recovery, Waste heat utilization, Compact plate heat exchanger, Fouling*

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**Corresponding author*: ravindyailangarathna@gmail.com

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Design of an Automatic Flour Purifying Machine for Small–Scale Bakery Industry

Rathnayaka R. M. H. M. [1*]

[1] Department of Mechanical and Manufacturing Engineering, Faculty of Engineering, University of Ruhuna, Sri Lanka

This project presents the design of an Automatic Flour Purifying Machine with a replaceable mesh, specifically developed for small-scale bakery industries, with strong emphasis on hygiene, energy efficiency, ease of cleaning, and modular construction. The design integrates both a vibration system and a reciprocation system to overcome key limitations found in traditional flour purifying machines. A major issue identified through the literature review is the lack of detachable mesh screens in conventional machines, which complicates cleaning and leads to hygiene concerns, contamination risks, and microbial growth. To overcome challenges, the proposed machine includes detachable mesh screens for easy cleaning and is made entirely of food-grade Stainless Steel 304 for durability and safety. It has a 5 kg hopper capacity and a throughput of 1 kg per minute, ensuring higher productivity within a compact timeframe. The operating mechanism consists of a vibratory motor and an electric motor driving a gear system. The hopper vibrates at a frequency of 8 Hz to facilitate pre-purification, while the sieving chamber undergoes reciprocating motion at a velocity of 0.48 m/s to enhance separation efficiency. A 1 mm mesh opening is used in the hopper, followed by a finer 0.25 mm mesh in the sieving chamber, allowing effective separation of impurities and ensuring flour quality suitable for bakery applications. Quick-connect fittings further enhance ease of maintenance. Structural integrity was validated using SolidWorks simulations, confirming a safety factor of 3 for the hopper and overall mechanical stability under operational loads.

Keywords: *Automated flour purifier, small–scale bakery, Replaceable mesh*, *Modular system*

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Design and Control of a Modular Rotary Double Inverted Pendulum System for Engineering Educational Applications

Wijerathna R.M.A.S.[1*], Annasiwaththa A.W.B.I.[1]

[1] Department of Mechanical & Manufacturing Engineering, Faculty of Engineering, University of Ruhuna, Sri Lanka

This paper presents the design of the Modular Rotary Double Inverted Pendulum (RDIP) System using Proportional-Integral-Derivative (PID) Controllers for control engineering experiments. Due to its instability, underactuated nature and high nonlinearity, the RDIP is a challenging system and it requires complex controller design. This study aims to design a robust and adaptable pendulum system with an optimized modular mechanical design, and effective control strategies to address the high-cost and lack of modularity of existing commercial RDIP systems, which present a significant gap in teaching non-linear dynamics. The novelty of this work is the application of slip-rings to prevent wire entanglement, a modular design for easy configuration of single and double pendulum experiments and the adjustable pendulum lengths to enhance flexibility by modification of system dynamics. The methodology followed detailed mechanical and electronic design, mathematical modeling based on the Euler–Lagrange method, and control system design and simulation. The dynamic model of the RDIP system is modeled in MATLAB Simulink and PID control demonstrated stabilization of the pendulums under certain conditions. The system stabilizes with settling time under 20 seconds and small steady-state errors. However, system instability and oscillations were observed under strong nonlinear effects highlighting the limitation of conventional PID control, motivating future implementation of optimal control strategies. The results indicate the PID-controlled Modular RDIP system is effective for educational demonstrations and system design ensures safety, durability and flexibility for laboratory use, making it a versatile platform for teaching nonlinear dynamics and modern control strategies.

Keywords: *Inverted pendulum, Rotary double inverted pendulum, Nonlinear control, PID control*

**Corresponding author*: rmaswijerathna@gmail.com

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