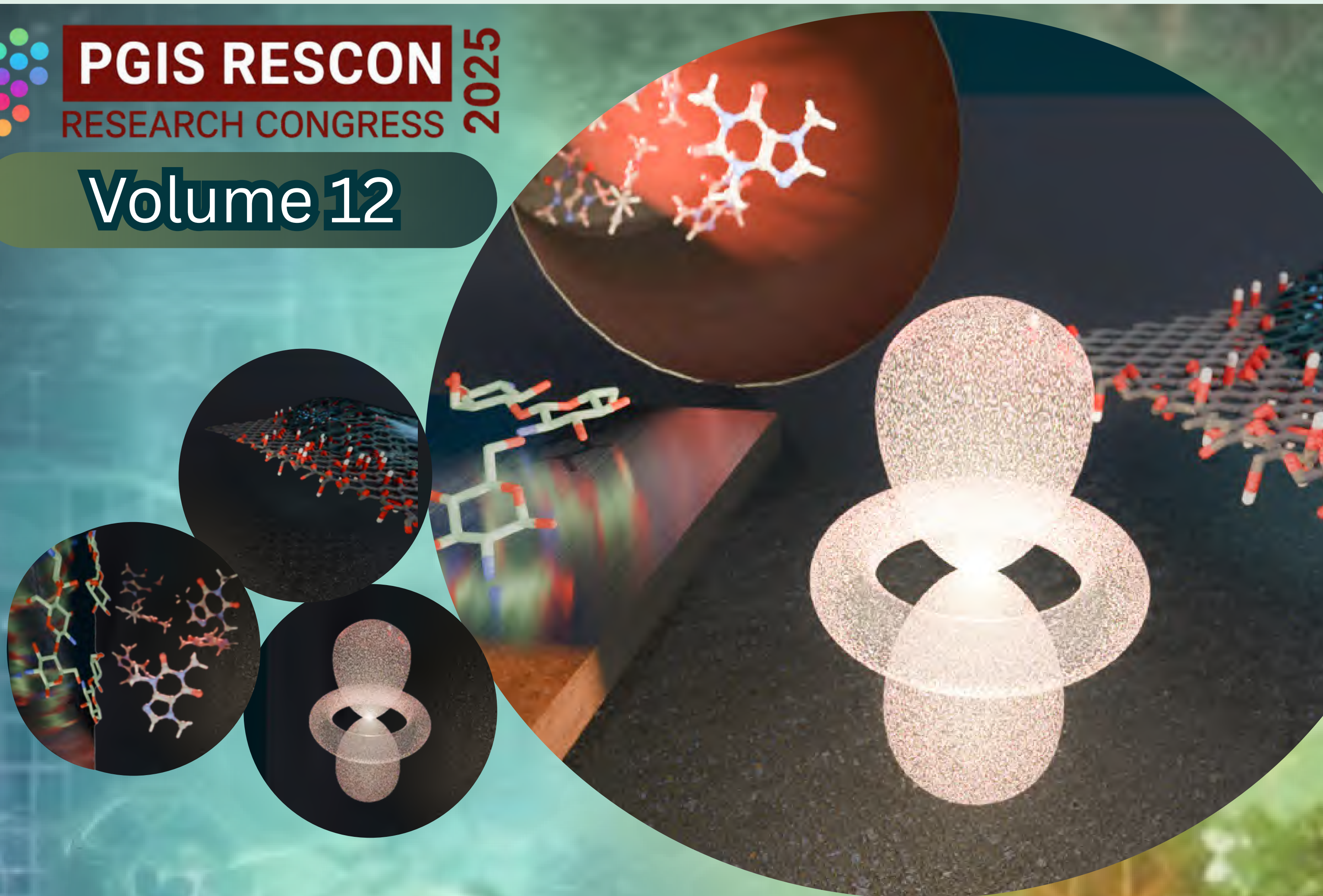
POSTGRADUATE INSTITUTE OF SCIENCE
UNIVERSITY OF PERADENIYA
SRI LANKA

PGIS RESCON
RESEARCH CONGRESS 2025

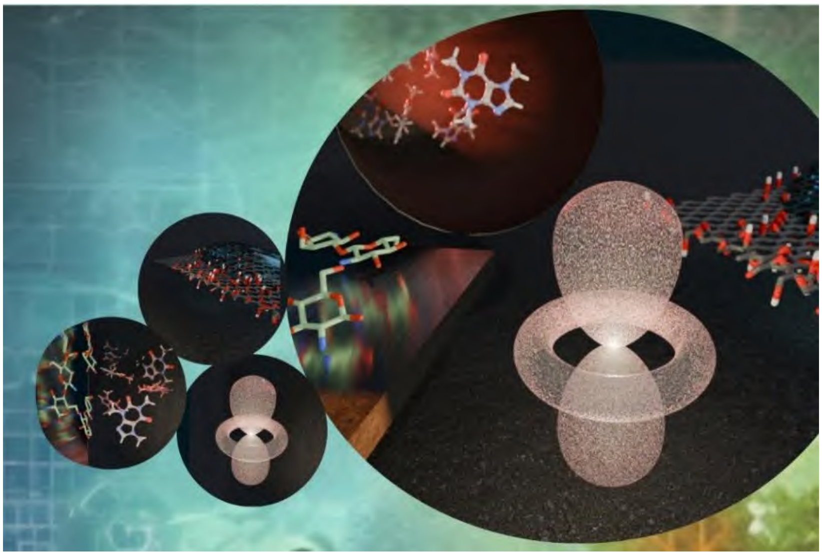
Volume 12



- AI in Natural Sciences / Industrial Aspects
- Earth & Environmental Sciences
- ICT, Mathematics & Statistics
- Life Sciences
- Physical Sciences
- Science Education

PROCEEDINGS

7th and 8th November 2025



Cover Image: *Chemical Science, being the central science, is truly interdisciplinary, covering a wide spectrum of areas — from biochemistry, electrochemistry, natural products, organometallic chemistry, quantum mechanics and photochemistry to advanced conceptual aspects together with applications such as astrochemistry, chemical biology, chemo-informatics, computational chemistry, energy production, green chemistry, mathematical chemistry, nanotechnology, supramolecular chemistry and toxic-informatics. The cover design symbolises key areas represented by the degree programmes of the Board of Study in Chemical Sciences, namely Analytical Chemistry, Industrial Chemistry and Nanoscience & Nanotechnology.*

Cover Design: Dr R.J.K.U. Ranatunga and Mr R.N. Pilapitiya

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Message from the Vice-Chancellor
RESCON 2025

It is with great pride and anticipation that I extend my warmest greetings to all participants of RESCON 2025-the 12th Annual Research Congress of the Postgraduate Institute of Science (PGIS), University of Peradeniya-scheduled for the 7th and 8th of November 2025.

PGIS stands as Sri Lanka's leading national institute for postgraduate education in the sciences. For over two decades, it has cultivated a thriving academic environment where rigorous scientific inquiry meets national relevance and global standards. With its multidisciplinary approach and close linkage to the University of Peradeniya's strong research ecosystem, PGIS continues to play a vital role in expanding the frontiers of scientific knowledge and addressing critical issues facing the country and the world.

The theme of this year's congress-*"Synergy in Science: Uniting Disciplines for a Better Tomorrow"*-aptly captures the institute's vision. In an era defined by complexity and interconnected challenges, interdisciplinary collaboration is essential for innovation, resilience, and impact. I am pleased to note that RESCON 2025 will showcase 238 research presentations spanning a wide spectrum of fields-from artificial intelligence and environmental sciences to physical sciences, life sciences, mathematics, ICT, and science education.

This congress is not merely an academic event; it is a vibrant forum where young scholars, experienced researchers, and industry partners come together to exchange ideas, forge collaborations, and envision solutions for national development and global advancement.

I commend the Director of PGIS, the academic and organising committees, and every postgraduate researcher and research student contributing to this effort. I am confident that the outcomes of RESCON 2025 will further elevate the standing of PGIS and the University of Peradeniya as centres of excellence in postgraduate research.

I wish all participants an intellectually enriching and inspiring experience.

Prof. Terrence Madhujith
Vice-Chancellor
University of Peradeniya

Message from the Director
RESCON 2025

It is with great pleasure that I welcome you to RESCON 2025, the annual research congress of the Postgraduate Institute of Science (PGIS), University of Peradeniya, to be held on 7–8 November 2025. Guided by the theme *"Synergy in Science: Uniting Disciplines for a Better Tomorrow,"* this event highlights the importance of interdisciplinary collaboration in addressing national and global challenges. With participation from over 400 postgraduate researchers and scientists, RESCON 2025 provides a dynamic platform for innovation, knowledge exchange, and partnerships among academia, industry, and policymakers.

Since its establishment in 1996, the PGIS has become a national centre of excellence, advancing postgraduate education and scientific research across diverse disciplines. Affiliated with the University of Peradeniya, PGIS remains committed to academic excellence, innovation, and national relevance. The PGIS Research Congress (RESCON), launched in 2014, continues to serve as a platform for postgraduate scholars to present their work and engage in multidisciplinary collaboration. The 12^{th} RESCON 2025 proudly continues this tradition of research excellence. In preparation for the congress, several Pre-Conference Workshops led by renowned international and local experts addressed key topics such as neuroplasticity, academic challenges, bioanalytical applications, clean energy, and technology-driven crop breeding—broadening the perspectives and skills of our postgraduate community.

This year's congress features 215 oral and 21 poster presentations across Artificial Intelligence, Earth and Environmental Sciences, Computing, Mathematics and Statistics, Life Sciences, Science Education, and Physical Sciences. We are honoured to welcome Prof. Jayantha Gunaratne (A*STAR, Singapore) as *Chief Guest*; Prof. Claudio Verani (University of Windsor, Canada) and Prof. Veranja Karunaratne (ESOFT University) as *Keynote Speakers*; and Dr. Dushanthi Dissanayake (University of Peradeniya) as *Plenary Speaker*. Their presence adds great value and prestige to RESCON 2025.

I extend my sincere appreciation to Prof. Manawadevi Ganehenege (Congress Chair), Dr. Gajaba Ellepola (Secretary), Prof. Namal Priyantha (Editor-in-Chief), the Editorial Committee, reviewers, and the RESCON Organizing Team, for their exceptional efforts and dedication. Your commitment has been instrumental to the success of RESCON 2025.

May RESCON 2025 continue to inspire and unite the scientific community in generating knowledge and innovations that meaningfully contribute to sustainable national development and global progress.

Prof. Nanda Balasooriya
Director, Postgraduate Institute of Science
University of Peradeniya

Message from the Congress Chairperson
RESCON 2025

It is with great pleasure and honour that I welcome you to RESCON 2025, the Annual Research Congress of the Postgraduate Institute of Science (PGIS), University of Peradeniya, organized by the Board of Study in Chemical Sciences. As the flagship research congress of PGIS, RESCON brings together postgraduate researchers, academics, scientists, and professionals from Sri Lanka and beyond to share knowledge, foster collaboration, and explore new frontiers in science. Now in its 12th consecutive year, it continues to serve as a vital platform for advancing research, innovation, and interdisciplinary exchange across diverse scientific disciplines. The theme of RESCON 2025, "Synergy in Science: Uniting Disciplines for a Better Tomorrow," emphasizes the importance of interdisciplinary collaboration in addressing global challenges and developing transformative solutions for society. We are honoured that Prof. Matthew Allen, Chair, Department of Chemistry, Wayne State University, USA, has endorsed this year's congress. Held on November 7th and 8th, 2025, the event features nearly 238 presentations across six key themes: AI in Natural Sciences and Industrial Aspects; Earth and Environmental Sciences; ICT, Mathematics and Statistics; Life Sciences; Science Education; and Physical Sciences. These contributions reflect the diversity and strength of research undertaken at universities, research institutes, and industries—both locally and internationally. In preparation for the main event, five pre-conference workshops conducted by eminent international experts provided valuable insights into cutting-edge topics: Intermittent Fasting and Brain Health (Prof. Thiruma Arumugam, Australia); Navigating Academic Challenges (Prof. Ajith Karunaratne, USA); Graduate Studies and SOP Writing (Prof. Susan Lunte, Dr. Binodh De Silva, and Dr. Gamini Dharmasena, USA); Clean Energy Trends and Opportunities for Higher Studies in Europe (Prof. Upul K. G. Wijayantha, UK); and Transforming Crop Breeding through Technology and Adaptive Strategies (Dr. Miceal Francki, Australia). We are privileged to have Prof. Jayantha Gunaratne (A*STAR and National University of Singapore) as Chief Guest, and to welcome Keynote Speakers Prof. Claudio Verani (University of Windsor, Canada) and Prof. Veranja Karunaratne (University of Peradeniya; ESOFT University; SLTC; SLINTEC Academy), along with Dr. Dushanthi Dissanayake (University of Texas at Dallas, USA) as Plenary Speaker. This congress is the outcome of dedicated teamwork. I extend my sincere appreciation to Prof. Nanda Balasooriya, Director of PGIS, for his unwavering support; Dr. Gajaba Ellepola for his outstanding secretarial work; Prof. Namal Priyantha for editorial guidance and fundraising coordination; and to all conveners, associate editors, subcommittees, reviewers, session chairs, PGIS staff, and the Young Researchers' Forum for their contributions. Special thanks also go to Dr. Manjula Wijesinghe, Mr. Rusith Pilapitiya, Ms. Samadhi Rajasinghe, and Mr. Isira Rathnayake for their excellent technical support in managing the editorial process and CMT system.

On behalf of the Organizing Committee, I wish all participants a stimulating and inspiring congress. May RESCON 2025 continue to be a beacon of collaboration, discovery, and scientific excellence.

Prof. Manawadevi Y. U. Ganehenege
Chairperson, PGIS RESCON 2025 & Board of Study in Chemical Sciences

Message from the Editor-in-Chief
RESCON 2025

I am pleased to deliver a message to mark the second 12th annual Research Congress of the Postgraduate Institute of Science (PGIS RESCON 2025), University of Peradeniya. Having recognized the importance of dissemination of outcomes of novel research, the PGIS initiated RESCON in the year 2024, and continued as an annual event. RESCON is the most important research event of the PGIS.

In addition to the five themes that were recognized earlier: namely, Earth and Environmental Sciences; ICT, Mathematics and Statistics; Life Sciences; Physical Sciences; and Science Education; the organising committee, having recognized the importance of artificial intelligence (AI) and extension of basic research toward industrial applications, another theme ‘AI in Natural Sciences and Industrial Aspects was added. About 275 abstracts were received, all of which were subjected to double-blind review. Each abstract was reviewed by two reviewers, who represented the subject discipline of the abstract. After about 10% rejections and a few withdrawals, about 240 abstracts, having satisfied the required quality, novelty and innovativeness, were selected for oral/poster presentations to be delivered in the technical sessions of RESCON 2025, scheduled to be held on the 7th and 8th of November 2025.

I appreciate the Associate Editors, Theme Coordinators, Editorial Assistants, and the members of the Young Researchers’ Forum who immensely contributed throughout the entire editorial process – from the time of calling abstracts until the compilation of the Proceedings – which took several months of hard work.

I am certain that RESCON 2025 provides an effective platform for both presenters and participants to share/learn research findings and share ideas. I wish RESCON 2025 a great success!

Prof. Namal Priyantha
Editor-in-Chief, PGIS RESCON 2025

Chief Guest
Prof. Jayantha Gunaratne

Professor Jayantha Gunaratne is a world-renowned leader in biomedical research with nearly three decades of pioneering contributions in the domain and talent development. He completed his first-rate training at the Scripps Institution of University of California San Diego, USA as a postdoctoral research scholar, upon his Doctor of Science degrees from the Tokyo Institute of Technology and B.Sc. (Special) in Chemistry from the University of Peradeniya.

As Senior Principal Investigator and Deputy Division Director of Cell & Molecular Therapy Division at the Institute of Molecular and Cell Biology (IMCB), A*STAR, Singapore, Professor Gunaratne leads a multidisciplinary translational research program that has delivered breakthrough innovations. His impact is attested by over a hundred publications, multiple patents and inventions, and a strong record of industry/pharma-aligned collaborations.

He is also a Professor (Adj) at the School of Medicine, National University of Singapore, and was a founding Adjunct Faculty at the Imperial College London-Nanyang Technological University Joint Medical School and a faculty member at Ruhuna University Medical Faculty, contributing significantly to medical education. Professor Gunaratne's career reflects a lifelong commitment to advancing science, translating discoveries into impactful innovations, and nurturing the next generation of scientific leaders.

Speech Summary

“From Daltons to Hundred Thousand Daltons: A Transformative Scientific Odyssey Across Scales of Life”

My scientific journey began on this very land, where my fascination with molecules first took root through the study of chemistry and natural product research, decoding nature’s small wonders at the Dalton scale. This curiosity deepened during my Ph.D. in Japan, where I ventured into the intricate world of biomolecules and advanced bioanalytical chemistry through the study of complex carbohydrates. The voyage then carried me across the Pacific, from East to West, to UC San Diego, where molecular biology and animal physiology converged in my exploration of fertilization, the essence of life. These experiences collectively shaped a holistic perspective on life’s molecular orchestration, bridging chemistry, biology, biochemistry and physiology. Returning from the Western Pacific waves to the Eastern Island ways, in Singapore I surf the dynamic behaviour of proteins that choreograph human phenotypes and whose glitches give rise to diseases. By harnessing Nobel Prize–winning mass spectrometry technologies, my biomedical research team explores the proteome’s hidden complexity to translate molecular insight into pathways from disease to cure and toward the restoration of health. This talk reflects a beautiful, rustic, and transformative scientific odyssey - rooted in gratitude to the Eden that nurtured it: the University of Peradeniya, the soil that shaped both my science and spirit.

Keynote Speaker
Prof. Veranja Karunaratne

Professor Veranja Karunaratne is a distinguished Sri Lankan chemist and academic, holding a B.Sc. (First Class) from the University of Colombo and a Ph.D. in Synthetic Organic Chemistry from the University of British Columbia, Canada. A Professor Emeritus at the University of Peradeniya, he has held key leadership roles, including Vice Chancellor of ESOFT University, SLTC, and SLINTEC Academy, as well as Chairman of NASTEC and the National Intellectual Property Advisory Commission. An elected Fellow of the National Academy of Sciences, Sri Lanka, and the Royal Society of Chemistry (UK), he has 17 international patents, 192 publications, and an h-index of 43, while mentoring 24 Ph.D. and 14 M.Phil. students. His accolades include the French Order of Academic Palms (2012), NSF awards, and the Presidential Award for Scientific Publication (2001-2017), cementing his legacy as a pioneer in Sri Lankan science and innovation.

Keynote Speech Summary - "Research & Development in Sri Lanka, the road not taken"

Research and Development requires substantial investment of financial resources and since Independence Sri Lanka has underinvested in this area. Both Government and the Private Sector investment in R & D is low compared to many countries, which stifles the development of new technologies and innovations. While Sri Lanka's Education System is good compared to many developing countries, there is a big disconnect between academic institutions and industry needs. This gap has led to lack of practical skills and innovation focused learning leading to graduates who are less able to contribute to R & D. Those highly skilled professionals tend to migrate to countries with better living conditions and working opportunities at an alarming rate, thus depriving the country of a talent pool required to develop R & D. In Sri Lanka, complicated regulations and bureaucratic inefficiencies can stifle innovation. Startups and research initiatives often face significant challenges in traversing these hurdles, which can discourage investment and development.

Sri Lanka has faced various economic challenges, including inflation and external debt pressures, which can divert attention and resources away from long-term R&D efforts. Short-term economic challenges often take precedence over investment in R & D. Innovation often thrives on collaboration between universities, research institutions, and the private sector. In Sri Lanka, there may be limited collaboration, reducing the potential for applied research and practical innovation. The small size of Sri Lanka's market may limit the potential for commercialization of new products and technologies, which can discourage private sector investment in R & D. Insufficient infrastructure, including technological and laboratory facilities, can hinder R&D activities. Without the right tools and environment, researchers might struggle to produce meaningful results. An exception in this regard is the formation Sri Lanka Institute of Nanotechnology (SLINTEC) as a public private partnership in 2008. Addressing these issues needs a concerted effort, where the creation of a collaborative, win-win ecosystem between the Government and the Private Sector that encourages innovation and supports R & D initiatives is required.

Keynote Speaker
Prof. Claudio Verani

Claudio Verani is the Dean of the Faculty of Science at the University of Windsor in Canada, where he is advancing a vision for science education built on critical thinking, problem-solving research, hands-on experience, and workforce readiness. He previously spent 22 years at Wayne State University in the United States as a Professor of Chemistry, conducting research in molecular electronics, renewable fuels, environmental science, and drug development. He continues his research activity in molecular electronics and environmental science at Windsor.

From 2017 to 2024, Verani served as Associate Dean in the College of Liberal Arts and Sciences, overseeing research, infrastructure, museums, special projects, and the COVID Task Force, while liaising with university leadership in research and facilities.

He earned his B.Sc. and M.Sc. in Bioinorganic Chemistry from UFSC in Brazil, his Ph.D. from the Max Planck Institute and Ruhr Universität in Germany and completed postdoctoral training at Johns Hopkins University in the United States.

Keynote Speech Summary - "Synergies for a Brave New World - A Concerted Effort to Build a Positive Future"

In Synergies for a Brave New World, Prof. Claudio Verani explores the evolving intersection of science, technology, and education through a thought-provoking parallel with Aldous Huxley's book Brave New World. Rather than dwelling on dystopian outcomes, Verani reframes the cautionary themes of the 1932 novel as a catalyst for optimism, highlighting how society can harness emerging opportunities to build a more equitable, sustainable, and human-centered future.

His talk emphasizes the urgency of reimagining education as a collaborative ecosystem, where schools, educators, and students work in synergy to anticipate technological shifts and cultivate the adaptive skills required for the workforce of tomorrow. Verani advocates for a proactive, interdisciplinary approach that not only equips learners with technical competencies but also fosters ethical awareness, critical thinking, and resilience.

By bridging literary reflection with scientific foresight, Verani invites his audience to consider how intentional partnerships across disciplines and institutions can unlock untapped potential, thus laying the groundwork for a future that can be innovative, inclusive and deeply attuned to the needs of both present and future generations.

Plenary Speaker
Dr. Dushanthi Dissanayake

Dr. Dissanayake is a synthetic organic chemist and dedicated educator with over eight years of full-time teaching experience at undergraduate levels. She is skilled in organic synthesis, polymer synthesis, characterization techniques and working in a clean room environment.

Dr. Dissanayake has a passion for student-centered learning and consistently brought complex chemical concepts to life through engaging instruction and direct mentorship. Her teaching philosophy emphasizes clarity, creativity and connection ensuring that every learner feels empowered to reach their full potential.

In recent years, Dr. Dissanayake has developed a growing interest in the intersection of education and technology, particularly the transformative potential of artificial intelligence in teaching and learning.

Speech Summary

"Teaching in the era of AI - Active learning as a way forward"

The rise of AI marks a transformative moment in education. With AI now capable of delivering information, explanations, and personalized feedback instantly, teaching can no longer revolve around content delivery alone. Instead, the teaching role becomes even more challenging and complex. Rather than being replaced, educators are repositioned as designers of meaningful and engaging learning experiences.

Active learning is the most effective learning method to integrate AI in education. Rather than discouraging the use of AI, educators should guide students in using it critically and creatively. Strategies such as critiquing AI-generated responses, comparing solution pathways, and collaboratively crafting better prompts turn AI into a learning partner rather than a shortcut.

The educator's goal is not to control or compete with AI but to elevate learning so that AI becomes a tool for deeper thought, collaboration, and curiosity. Active learning strategies empower students to move beyond passively accepting AI-generated responses and instead engage critically, reflect deeply, and extend their thinking beyond what AI presents.

List of Abstracts

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Theme 2 - Earth and Environmental Sciences

Theme 3 - ICT, Mathematics and Statistics

Theme 4 - Life Sciences

Theme 5 - Physical Sciences

Theme 6 - Science Education

AI in Natural Sciences / Industrial Aspects

RESCON 2025 AINI 01

IMPROVING CLINICALLY RELEVANT BACTERIAL SPECIES IDENTIFICATION: A COMPUTATIONAL APPROACH USING KONSTANZ INFORMATION MINER (KNIME) PLATFORM

R.M.D.R. Senarathna[1]* and W.R.P. Wijesinghe[2]

[1]*Department of Medical Laboratory Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka.*
*ahs19mls025@ahs.pdn.ac.lk

Determining clinically important bacterial species remains a significant challenge for clinical microbiology laboratories with limited access to advanced diagnostic tools, where delays or misidentifications can compromise patient outcomes and contribute to inappropriate antibiotic use. The purpose of this research was to create a computational system through KNIME that enhanced bacterial species determination by integrating CLSI standard procedures with protocols from Cowan and Steel's Manual. The research value stems from offering a cost-friendly diagnostic enhancement strategy which improves efficiency throughout regular microbiology testing facilities. This research aimed to conduct a systematic analysis of existing identification problems, develop and optimise computational models, evaluate diagnostic effectiveness and resource needs, and validate model performance using hospital-recorded datasets. In this research, two workflows were designed on KNIME. The broad-spectrum workflow was designed to identify 445 species, encompassing rare, common, and less common species. The narrow-spectrum workflow focused on identifying 145 species, primarily common and less common species. The workflow's user interface was developed to enable user-friendly interaction with the KNIME based bacterial identification system. The system interface allows users to input clinical information such as sample type, gram stain results, culture characteristics, and biochemical test results. The system processes these inputs and generates the most possible bacteria species and antibiotics as output. System validation occurred through testing 200 clinical specimens derived from the Teaching Hospital, Peradeniya. The bacterial identification model reached outstanding performance levels with 99.8% accuracy and 98.5% recall, but 94.6% precision and 99.3% specificity alongside an F1 score of 96.5%. The antibiotic selection component performed at a moderate accuracy of 78.0%. Testing confirmed the reliability of the developed computational workflow, which provided bacterial identification services alongside antibiotic selection capabilities. The research demonstrates how combining traditional microbiological procedures with computational systems creates improved diagnostic pipelines to enhance clinical diagnosis while benefiting resource-constrained healthcare settings.

Keywords: Bacterial species identification, Clinical microbiology**,** Computational workflow**,** Diagnostic efficiency, KNIME

RESCON 2025 AINI 02

A STUDY ON THE IMPACT OF PSYCHOLOGICAL DISTRESS AND PERSONALITY TRAITS ON SMARTPHONE ADDICTION AMONG YOUNG ADULTS IN SRI LANKA USING MACHINE LEARNING

V. Vasanthakumar*, Dheelaka Weerasinghe and Sumedha Kulasekara

Department of Data Science, National Institute of Business Management, Sri Lanka.
viduvk.official@gmail.com

In today's digital society, reliance on smartphones has escalated to the point where it poses significant risk to mental well-being, particularly among young adults. This study explores how psychological distress and personality traits influence patterns of smartphone addiction in Sri Lanka, focusing on individuals aged between 18 and 35 years. The objective was twofold: to identify the relationship between mental health factors and addictive behaviours; and to evaluate the usefulness of machine learning techniques for early risk detection. A cohort of 300 participants was surveyed using three validated instruments: the Ten-Item Personality Inventory (TIPI), the Smartphone Addiction Scale - Short Version (SAS-SV), and the Depression Anxiety Stress Scales (DASS-21). Data preparation included cleaning, normalisation, and feature engineering prior to model development. Several supervised algorithms were trained, including logistic regression, decision tree, support vector machine (SVM), random forest, XGBoost, and feedforward neural networks. Performance was evaluated through accuracy, recall, precision, F1-score, and area under the curve (AUC). Among the tested models, XGBoost demonstrated the strongest predictive capability, with an AUC of 0.99. Psychological outcomes revealed that addicted participants exhibited notably higher levels of stress and anxiety-dysphoria. Personality analysis further indicated heightened neuroticism, coupled with lower conscientiousness and diminished emotional stability, among the addicted group. These findings confirm that addictive smartphone use is strongly linked to both psychological distress and unfavourable personality characteristics. The study underscores the advantage of combining psychological assessment with machine learning to recognise vulnerable individuals at an early stage. Practical implications extend to mental health practitioners, educators, and policymakers, who may use these insights to design targeted strategies aimed at mitigating smartphone addiction and enhancing digital well-being among young adults.

Keywords: Addiction, Machine learning, Mental health, Personality traits, Smartphone

RESCON 2025 AINI 03

IN SILICO IDENTIFICATION OF PHYTOCHEMICALS WITH ANTI-LEPTOSPIRAL ACTIVITY USING COMPUTER-AIDED DRUG DESIGN (CADD)

A.H.A.U. Amaradasa[1], L.R.L.S. Kumari[2] and W.R.P. Wijesinghe[1,2]*

[1]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka.*
*priyangaw@sci.pdn.ac.lk

Leptospirosis, one of the most common zoonotic diseases in the world, caused by pathogenic *Leptospira* spp., remains a significant public health concern due to diagnostic and therapeutic challenges. However, there are limited therapeutic options. Therefore, this study aimed to identify potential phytochemicals with anti-leptospiral properties against pathogenic *Leptospira*. In this study, 2260 phytochemicals were screened against 15 FDA-approved antibiotics that were administered for the treatment of leptospirosis. Quantitative Structure-Activity Relationship (QSAR), a computational modeling-based technique that determines the structural similarities between chemical compounds, was used to predict active compounds against *Leptospira*. The structures of compounds were obtained from the ChEMBL database in SMILES format, and converted into RDKit molecule fingerprint with MACCS fingerprints using the KNIME (Konstanz Information Miner) analytics platform. Machine learning models, Random Forest (RF), Artificial Neural Network (ANN), and Support Vector Machine (SVM) were executed with 20-fold cross-validation to predict potential drug candidates. The bioavailability of the predicted compounds was determined by the drug likeliness test. The ANN model has been able to predict six phytochemicals, which complied with drug-likeness parameters while the RF and SVM models have not predicted any compounds. The prediction accuracies of the RF, ANN and SVM models were determined to be 99.74%, 99.48% and 99.35%, respectively. The predicted phytochemicals were ixorapeptide II (Compound A), conessine (Compound B), thiophene (Compound C), methyl 8-hydroxy-3-methyl-4-[(E)-3-methyl-4-oxobut-2-enyl]-7-oxo-1,4-dihydronaphthalene-4a-carboxylate (Compound D), pyrrolidinedithiocarbamate (Compound E) and oleanolic acid glutaryl hemiester (Compound F). Compound B and Compound E were already known to have certain levels of antibacterial activity against various other bacteria. Compound D, Compound E, and Compound F are synthetic derivatives of plant-based compounds. While laboratory and clinical validation is required to determine the activity of these compounds, this study demonstrates the importance of computational techniques for screening and identifying potential drug candidates from large datasets in a cost and time-efficient manner.

Keywords: CADD, KNIME, Leptospirosis, Machine learning, Phytochemicals

RESCON 2025 AINI 04

DETECTION OF NOVEL GENETIC DETERMINANTS OF ANTIMICROBIAL RESISTANCE IN *Staphylococcus aureus* THROUGH PAN-GENOME AND RESISTOME ANALYSIS

S. Branavan[1,2], S.P. Abeysundara[2,3] and W.R.P. Wijesinghe[1,2]*

[1]*Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[3]*Department of Statistics and Computer Science, University of Peradeniya, Peradeniya, Sri Lanka.*
*priyangaw@sci.pdn.ac.lk

Antimicrobial resistance (AMR) has become a significant global health concern, particularly with methicillin-resistant *Staphylococcus aureus* (MRSA), which has a complex genomic basis and evolving resistance mechanisms. Although genes such as *mecA* and *mecR1* are well known contributors, previous research has not fully identified the genes associated with AMR, particularly those linked to mobile genetic elements. This study aimed to uncover such novel genes to improve AMR management strategies. We retrieved and assembled 91 publicly available *S. aureus* genomes representing Asian human and livestock hosts, which were originally sequenced using Oxford Nanopore technology, and supplemented these with 56 laboratory-validated MRSA and methicillin-susceptible *S. aureus* genomes from the BV-BRC database. Genomes were annotated and sequence typed with Prokka and MLST (v. 2.22.0) tools, respectively, and antibiotic-resistant genes and virulence genes were detected using ABRicate (v. 1.0.1) against CARD, ResFinder, and VFDB databases. Pan-genome analysis (Roary v. 3.13.0), mobile genetic element identification (plasmidFinder, ISEScan v. 1.7.2.3), Fisher's exact test, and the statistical association test, were performed to evaluate the correlations between genotype and phenotype. All analyses were executed on Galaxy and Google Colab platforms. Among the 334 MRSA-specific genes identified, *mecR1* (resistance) and *essC, esxB, sdrE* and *fnbB* (virulence) exhibited significant association with resistant phenotype ($p < 0.001$). Two novel MGE-associated transposases (LEHPCDPB_00452, OKANCEOL_00333) were detected, suggesting a potential for horizontal gene transfer. From the several sequence types detected through MLST, only ST_8 showed a statistically significant association with methicillin resistance ($p < 0.01$). In conclusion, this research revealed critical genetic determinants for methicillin resistance and virulence in *S. aureus*, providing a promising framework for AMR surveillance and the discovery of novel therapeutic targets. This study highlights the value of integrating next-generation sequencing with laboratory validation in exploring AMR mechanisms. The future work will focus on enhancing the sample size to further refine and strengthen the results.

Financial assistance from the URC Multidisciplinary Research Grant 2024 (Grant No. 449) is acknowledged.

Keywords: Antibiotic-resistant genes, MLST, MRSA, *Staphylococcus aureus*, Virulence genes

RESCON 2025 AINI 05

MACHINE LEARNING DRIVEN IN SILICO SCREENING IN THE KNIME PLATFORM AND MOLECULAR DOCKING TO IDENTIFY PHYTOCHEMICALS WITH ALK INHIBITORY ACTIVITY

P.T. Dilshan[1], L.R.L.S. Kumari[2] and W.R.P. Wijesinghe[2]*

[1]Department of Molecular Biology and Biotechnology, University of Peradeniya, Peradeniya, Sri Lanka.
[2]Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka.
*priyangaw@sci.pdn.ac.lk

ALK^+ (Anaplastic lymphoma kinase) lung cancer, a subtype of non-small cell lung cancer, occurs due to aberrant activation of the ALK gene, commonly due to its fusion with other genes. Despite the presence of approved drugs against ALK, emerging resistance necessitates the discovery of safer and effective alternatives. Traditional drug discovery is a time-consuming and resource-intensive process. Consequently, this study aimed to identify potential ALK inhibitors from phytochemicals based on quantitative structure-activity relationship via Machine learning (ML) in the KNIME platform, followed by assessment of drug-likeness, molecular docking, and toxicity predictions. Using a modified TeachOpenCADD workflow, three ML models, namely Random Forest, Artificial Neural Network and Support Vector Machine, were trained to predict phytochemicals exhibiting structural similarity to known ALK inhibitors. Subsequently, the oral drug-likeness of predicted molecules was assessed via Lipinski's rule of five. Filtered compounds were subjected to molecular docking analysis using PYRX software employing the ALK kinase domain (PDB ID: 2XP2) as the macromolecule. Finally, toxicity prediction was performed using ProTox-3.0. ML models predicted ten phytochemicals with potential ALK inhibitory activity, achieving over 97% accuracy. All candidate molecules complied with three or more of Lipinski's criteria for drug likeness. Molecular docking revealed nine molecules with binding affinity less than the inclusive binding affinity threshold of -5 kcal mol^{-1} and six molecules exhibited a lower binding affinity than the stringent threshold of -7 kcal mol^{-1}. Based on toxicity predictions, out of six, only four phytochemicals, namely, Luteolin, Mearnsetin, Lichochalcone D, and Murrayaquinone A, exhibited lower toxicity than the positive control, Crizotinib. Myricetin and Fisetin, with strong binding affinities, are worth exploring despite their toxicity, provided that the effective dose can be achieved within the therapeutic window. These findings emphasised the importance of phytochemicals as promising candidates for the development of next-generation inhibitors for ALK-positive lung cancers despite emerging resistance.

Keywords: CADD, Lipinski's rule of five, Lung cancer, PYRX, Tyrosine kinase inhibitors

RESCON 2025 AINI 06

PREDICTIVE COLOR ASSESSMENT OF PRE HEAT-TREATED GEUDA USING RAMAN SPECTROSCOPIC ANALYSIS

N.N. Dandeniya[1]*, T.L.M.D. Fonseka[2], H.H.E. Jayaweera[2], S. Illangasinghe[3], S. Koodeswaran[4] and D. Weerasinghe[4]

[1]GemIntel, Ratnapura, Sri Lanka.
[2]Department of Physics, University of Colombo, Sri Lanka.
[3] Gem & Jewellery Research & Training Institute, Ratnapura, Sri Lanka.
[4]National Institute of Business Management (NIBM), Sri Lanka.
** nimendradandeniya@gmail.com*

The gemstone industry faces significant challenges in predicting the final color outcome of heat-treated Geuda stones (low-grade corundum), leading to substantial financial risks due to subjective visual grading methods. This study presents a breakthrough solution using advanced machine learning techniques applied to pre-treatment spectroscopic data from 140 Geuda stones with varying internal characteristics. Our proprietary analytical framework successfully addresses the challenges of limited sample sizes and data complexity in gemological applications. The developed predictive model demonstrates exceptional performance, achieving 98.5% accuracy in predicting final colour grades using only pre-treatment spectroscopic signatures, with precision, recall, and F1 scores all exceeding 98%. Results were benchmarked against traditional GIA colour grading. Comparative analysis highlights that, while inexperienced graders and at times even experienced gemologists cannot consistently predict the correct heat-treatment outcomes, the proposed model provides reliable and objective predictions, directly addressing this long-standing industry challenge. Beyond prediction, this research provides new insights into spectroscopic signatures associated with colour development, identifying key features that correlate with successful blue sapphire formation. The practical implications are substantial: gemstone traders and processors can now make informed decisions about which Geuda stones to heat treat, significantly reducing financial risk and maximizing value recovery. This objective assessment tool eliminates guesswork in traditional evaluation, providing the industry with a scientific foundation for commercial decision-making whilst maintaining the precision required for high-value applications.

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Keywords: Colour Prediction, Geuda, Heat Treatment, Machine Learning, Raman Spectroscopy

RESCON 2025 AINI 07

IMPACT OF PURIFICATION PROCESSES ON ISOTOPIC AND TRACE ELEMENT SIGNATURES IN BOTTLED WATER IN SRI LANKA

W.M.G.S. Wijesooriya[1,2]*, H.M.T.G.A. Pitawala[2,3], N. Priyantha[2,4], E.A.N.V. Edirisinghe[1], M.D. Kalpage[1] and K.S.G.S. Priyadarshanee[1]

[1]*Sri Lanka Atomic Energy Board, Wellampitiya, Sri Lanka.*
[2]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[3]*Department of Geology, University of Peradeniya, Peradeniya, Sri Lanka.*
[4]*Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.*
*ganganiw55@gmail.com

Bottled water is a rapidly growing global commodity, raising concerns regarding source authenticity and safety. Unlike natural mineral water, which undergoes only filtration, bottled drinking water is commonly treated through reverse osmosis, distillation, ozonation, or filtration. To reduce the cost, manufacturers adopt inexpensive purification techniques, while misleading the water source to demand their products. Stable isotopic signatures are important tools for source authentication. This study investigates how purification techniques affect the isotopic integrity ($\delta^{18}O$ and $\delta^{2}H$) and trace elemental concentrations in bottled water, with implications for source verification and safety. Water samples from twelve brands and from the relevant sources were analysed for stable isotope ($\delta^{18}O$, $\delta^{2}H$) and trace element (Cd, Cr, Cu, Pb, Mn, Ni, Se, Zn and As) composition, using liquid water isotope analyser and inductively coupled plasma-mass spectrometer. Isotopic measurements were quadruplicated, and trace element measurements were triplicated. Statistical differences in isotopic measurements were assessed using Welch's *t*-test at 95% confidence level. The $\delta^{18}O$ and $\delta^{2}H$ isotopic compositions of bottled water deviated by 1 – 15‰ and 0 – 16‰, respectively, from their source waters. Significant isotopic shifts ($p < 0.05$) were observed in eight brands for $\delta^{18}O$ and six brands for $\delta^{2}H$, indicating that the purification processes induced significant alterations in isotopic signatures. All source water samples complied with WHO guidelines for trace elements, except one with elevated Se, which was reduced to acceptable levels (< 10 ppb) after processing. Notably, one product sample contained Pb exceeding the WHO limit of 5 ppb, likely due to post-treatment contamination. The findings indicate that purification processes can substantially alter isotopic signatures, complicating efforts to trace water origins, while generally enhancing trace element safety. However, improper handling may introduce contaminants, underscoring the need for strict quality assurance. Robust statistical models incorporating broader spatiotemporal data could help account for isotopic shifts and improve source verification of bottled water.

Keywords: Bottled water, Isotopes, Purification, Source water, Trace elements

RESCON 2025 AINI 75

PRETRAINED DEEP LEARNING MODELS FOR MULTICLASS CLASSIFICATION OF HIP REGION FRACTURES IN X-RAY IMAGING

M. Kanthasamy[1], L. Karunakaran[2], V. Abishethvarman[1]*, S. Prasanth[3] and B.T.G.S. Kumara[1,4]

[1]*Department of Computing & Information Systems, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka.*
[2]*Department of Physical Science & Technology, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka.*
[3]*Faculty of Engineering and Applied Science, Memorial University of Newfoundland, Canada.*
*abishethvarman@gmail.com

Hip region fractures, including pelvic, femoral neck, intertrochanteric and subtrochanteric fractures, are critical medical conditions, especially when diagnosed early. These fractures impair mobility, increase the risk of complications, and cause additional issues. Early diagnosis using X-ray imaging is vital for effective treatment. Recent advances in computer vision, particularly the use of pre-trained models, have revolutionised fracture detection by combining various models to improve classification accuracy and stability. This research developed and evaluated pretrained deep learning methods for multiclass classification of hip fractures on X-ray images. The dataset consists of 1000 X-ray images from Sri Lankan hospitals (2022-2023), categorised into five types: non-fracture, femoral neck, intertrochanteric, subtrochanteric, and combined fractures. Preprocessing and data augmentation techniques were used to increase dataset diversity. The data was split into 70:15:15 for training validation, and testing to evaluate performance. The pre-trained model architectures include ResNet-101, ResNet-50, EfficientNetB0, and EfficientNetV2, with ResNet-10 being trained at different levels with parameterised training. ResNet101 achieved the highest test accuracy of 0.8000, followed by ResNet-50 (0.7786), EfficientNetB0 (0.7286), and EfficientNetV2 (0.7500). These pre-trained models significantly enhance multiclass hip fracture classification, yielding more accurate results compared to customised vision models trained from scratch. This approach has potential clinical applications, aiding early and reliable diagnosis. Furthermore, it can be used to differentiate the components of the hip region individually, utilizing sophisticated data augmentation techniques that help in classification. This research proves that pre-trained models can be effective in biomedical applications rather than building and training them from scratch.

Keywords: Hip region fracture, Multiclass fracture classification, Pretrained deep learning models, Vision models, X-ray images

Earth & Environmental Sciences

RESCON 2025 EES 01

VALORISATION OF BANANA PSEUDOSTEM (BPS) WASTE FOR DEFLUORIDATION OF DRINKING WATER

J. De Silva, P.G.A.P.T. Piyumanthi, B.D.I.M. Batugedara and S.A.M.A.I.K. Senanayake*

Department of Zoology, University of Sri Jayewardenepura, Nugegoda, Sri Lanka.
*indunil@sci.sjp.ac.lk

Dental and skeletal fluorosis are prevalent in the dry zone of Sri Lanka, among people who utilise drinking water with high fluoride levels. This study investigated the possibility of banana pseudostem (BPS) derived fibres and cellulose to remove fluoride in drinking water. BPS fibres and cellulose were extracted through sequential mechanical and acid hydrolysis methods, respectively. They were characterised using; scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), and physicochemical analysis. Fluoride removal efficiency was studied following batch adsorption experiments using SPADNS spectrophotometric method. The extraction yields of BPS fibres and cellulose resulted in 5% and 3%, respectively. SEM images confirmed successful extraction and fibrous morphology, which aligned with macrofibrils in BPS fibers (width ≈ 87 µm) and aggregated rod-like structures in microcrystalline cellulose (10 – 25 µm width). FTIR spectra highlighted hydroxyl, alkene and ether, as functional groups essential for fluoride binding. XRD confirmed the semi-crystalline nature of cellulose I allomorph, supporting structural integrity during adsorption. Physicochemical analysis emphasised the adsorptive dominance of BPS fibres; higher water holding capacity (16.96±0.02 g g^{-1}), higher swelling capacity (5.00±0.02 mL g^{-1}) and lower moisture content (13.16±0.08%) compared to those of cellulose. Adsorption optimisation identified 0.4 g adsorbent dosage, 0.5 mg L^{-1} fluoride concentration, pH 2 and 10, and 90 min contact time as the ideal conditions. However, 1.5 mg L^{-1} fluoride concentration and pH 7 were used, in accordance with WHO guidelines and to depict typical fluoride levels and pH in groundwater (7.2 – 8.2) of Sri Lanka. Under these optimised conditions, BPS fibres achieved a removal efficiency of 63.19±0.03%, outperforming cellulose (35.81±0.07%). Post-adsorption SEM-EDX analysis confirmed the fluoride adsorption by the detection of fluorine (F) peaks. According to the results, BPS fibre is highlighted as a promising defluoridation biomaterial by serving as a blueprint for future development of bio-waste-based adsorbents for sustainable water purification.

Keywords: Banana pseudostem, BPS cellulose, BPS fibres, Defluorination, Waste valorisation

RESCON 2025 EES 02

DEVELOPMENT OF AN ECO-FRIENDLY LANTANA-BASED BIOADSORBENT FOR EFFECTIVE ALUMINIUM REMOVAL FROM INDUSTRIAL WASTEWATER

M.D.C. Sadushani[1], T.N. Dharmapriya[1], R.M.M.K. Karunathilaka[2], A.M.S.R. Abeysinghe[3] and N. Priyantha[4]*

[1]Department of Environmental Technology, University of Colombo, Colombo, Sri Lanka.
[2]Research and Development Unit, Faculty of Medicine, University of Peradeniya, Peradeniya, Sri Lanka.
[3]Department of Environmental and Industrial Sciences, University of Peradeniya, Peradeniya, Sri Lanka.
[4]Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.
*namal.priyantha@yahoo.com

Aluminium (Al) contamination in industrial wastewater, especially under acidic conditions, poses environmental and health risks. Conventional treatments such as chemical precipitation produce hazardous sludge. This study explores the use of invasive plant *Lantana camara* as a low-cost biosorbent for Al removal. Three approaches were applied to leaves and stems of *L. camara* as raw material, chemical surface modification, and thermal conversion to biochar. In a typical experiment, adsorbent (1.00 g) was added to 50.0 mL of 100 mg L^{-1} Al solution, shaken for 1.0 h at 150 rpm at room temperature, and analysed through atomic absorption spectroscopy. As the raw biosorbent exhibits insignificant Al removal, it is necessary to modify it for efficiency improvement. Alkaline treatment of raw biosorbent with 0.1 mol L^{-1} NaOH achieves a removal efficiency of 71.2% for leaves, and 36.0% for stems, while acidic treatment with 0.5 mol L^{-1} HNO_3 results in 61.2% and 23.6% removal for leaves and stems, respectively. Sequential acid–base treatment (0.2 mol L^{-1} NaOH followed by 0.5 mol L^{-1} HNO_3) shows maximum efficiencies of 90.4% and 93.1% for leaves and stems, respectively. Furthermore, thermal conversion of leaves into biochar showed Al removal efficiencies of 90.5%, 90.7%, 91.4%, and 92.0% at pyrolysis temperatures of 250 °C, 300 °C, 350 °C and 600 °C, respectively. Dosage optimisation reveals that even 0.10 g of leaf biochar achieves 80.6% Al removal, increasing progressively to 87.1%, 95.6%, 96.6%, 97.3%, and 99.1% at dosages of 0.25, 0.50, 0.75,1.00, and 2.00 g, respectively. Al removal increases from 73.0% at 3 min to 81.1% at 50 min with only slight improvements at 60 (83.8%) and 90 min (86.0%), making 50 min the optimal shaking time. Thermal treatment outperforms chemical modification in adsorption, structure, and sustainability. X-ray fluorescence spectroscopy shows high native Ca and K, enabling effective ion exchange. Utilising *L. camara* provides a sustainable solution for Al removal while aiding in invasive species control, ecological balance, and resource recovery.

Keywords: Aluminium removal, Biochar, Chemical modification, Invasive plant, *Lantana camara*

RESCON 2025 EES 03

SRI LANKAN LATERITE – AN ADSORBENT FOR TETRACYCLINE IN AQUEOUS MEDIA

U.S.T. Sachintha[1], I.M. Wijekoon[2] and N.H. Koralegedara[1]*

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

Antibiotics and their residues are considered as emerging contaminants, as their accumulation in the environment causes antibiotic resistance among microorganisms. Hence, accumulation, prevention, and immediate removal of antibiotics are essential. Laterite (LT), a naturally occurring iron-rich soil, is a well-known adsorbent for many environmental contaminants. However, its application in antibiotic adsorption is limited. Hence, this study investigates the adsorption potential of raw LT in removing tetracycline (TC), a widely used antibiotic that is frequently detected in aquatic environments. Batch adsorption experiments were conducted to assess the TC removal potential of LT under different conditions. TC solutions of known concentrations (1, 4, 17, 50, 72 mg L^{-1}) were thoroughly mixed with LT over specified contact times (5, 10, 30, 60, 120, 180, 240 min) and analysed for TC concentrations using a UV spectrophotometer (at λ_{max}= 352.1 nm). The effects of pH (3, 4, 5, 7, 10), adsorbent dosage (5, 10, 15, 20 g L^{-1}), and the soil organic matter (OM) were investigated. Optimum removal was observed at pH 5 − 7 with 10 g L^{-1} adsorbent dosage, and in the absence of OM. The low adsorption observed at both acidic (pH < 5) and alkaline pH (pH > 7) is attributed to electrostatic repulsion between LT and TC due to their similar surface charges (pH_{zpc} of LT = 5.8 and pKa of TC is 3.3, 7.7, and 9.7). As TC exists in its zwitterionic form at pH 3.3 − 7.7, the maximum adsorption is observed at pH 5 − 7. TC Adsorption data followed the Langmuir isotherm model (R^2 = 0.9981), indicating monolayer adsorption on a homogeneous surface. Kinetics data aligned the best with the pseudo-first-order model, suggesting that an electrostatic attraction-initiated interaction between LT and TC. Furthermore, Fourier transform infrared spectroscopic analysis confirmed the complexation between TC and Fe and Al groups of LT by changes in relevant peak positions and intensities, indicating electrostatic attraction followed by hydrogen bonding and metal-ligand coordination. These findings highlight the potential of laterite as a sustainable, low-cost, and eco-friendly adsorbent for TC removal in contaminated water systems.

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Keywords: Adsorption, Antibiotic, Fe-rich soil, Remediation, Tetracycline

RESCON 2025 EES 04

ENVIRONMENTAL IMPACT OF INHALATIONAL AGENTS USED IN OPERATING THEATRES IN SRI LANKA: A RETROSPECTIVE MULTI-CENTRE AUDIT

S.U.D. Samarasinghe[1]*, A.B. Abeysundara[1], A. Samarasinghe[2], D.G.H. Warnasuriya[1] and P. Munasinghe[1]

[1]*Department of Anesthesiology and Critical Care, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*National Hospital, Kandy, Sri Lanka.*
*senani.samarasinghe@med.pdn.ac.lk

Inhalational anesthetic agents, particularly isoflurane and sevoflurane, are potent greenhouse gases that contribute to healthcare-related environmental pollution, especially in settings that lack proper scavenging systems. Despite global awareness, there is a scarcity of data on the environmental impact of anesthetic practices in low-resource settings, such as in Sri Lanka, highlighting a critical research gap. A retrospective audit assessed 315 theatre sessions, conducted over one month at National Hospital-Kandy, Teaching Hospital-Peradeniya and Dental Hospital-Peradeniya. Data were collected on volatile agent usage, surgery duration, fresh gas flow rates, and the availability and functionality of anesthetic gas scavenging systems (AGSS), using anesthesia theatre records maintained manually by doctors. Agent usage and CO_2 equivalent (CO_2e) emissions were calculated using established equations to determine the volatile agent consumption and CO_2 equivalent. AGSS were unavailable in 204 sessions (64.8%), AGSS were present but not connected in 56 (17.8%), and AGSS were present merely venting gases into the external environment without proper degradation in 24 sessions (7.6%). Only 31 sessions (9.8%) used a properly functioning AGSS. The mean minimal alveolar concentration (MAC) fraction of agent consumption was 1.03%. Out of the total MAC fractions, the mean MAC fraction of isoflurane is 1.02% while sevoflurane is 1.13%. A total of 3519.5 mL of volatile agent fluid was used, but only 368.0 mL (10.50%) was effectively scavenged. More than 89% was released directly to the environment. Total emissions during the study period of one month amounted to 35.713 kg CO_2e, isoflurane contributing 34.738 kg CO_2e and sevoflurane 0.975 kg CO_2e. Additionally, 16.5% of sessions used N_2O/O_2 mixtures, compounding the environmental burden. The audit reflects major deficiencies in AGSS implementation in Sri Lankan operating theatres, resulting in significant environmental and occupational risks. Urgent interventions, including infrastructure improvement, staff education and adoption of low-flow or total intravenous anesthesia techniques, are needed to promote sustainable anesthetic practices.

Keywords: Anesthetic pollution, Environmental hazard, Inhalational agents, Scavenging systems, Volatile gases

RESCON 2025 EES 05

ALTITUDE-DRIVEN VARIATIONS IN AIRBORNE BACTERIAL COMMUNITIES: A COMPARATIVE STUDY FROM PIDURUTHALAGALA AND COLOMBO, SRI LANKA

H.M.S.A.T. Gunathilaka[1], **C. Dissanayake**[1], **E. Gunasekaran**[1], **C. Thotawatthage**[1,2] **and D.N. Magana-Arachchi**[1]*

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka.*
[2]*Department of Physical Sciences, Rajarata University of Sri Lanka, Mihintale, Sri Lanka.*
*dhammika.ma@nifs.ac.lk

Understanding the diversity and distribution of airborne bacteria is a critical concern. This study examined the differences in airborne bacteria at two varying altitudes in Sri Lanka: Piduruthalagala Mountain (PT) and Lotus Tower (LT). Eight samples were collected on filter papers from each location using an Envirotech APM 550 fine particulate air sampler. After 30 minutes of sample collection, the filter papers were cut into fine pieces and shaken in 8 mL of distilled water at 100 rpm for 2 h. After centrifugation, the filtrate was cultured on Luria-Bertani (LB) culture media. Bacterial DNA was extracted using Boom's method. Sample preparation was conducted, followed by 16S Metagenomic Sequencing Library Preparation targeting the 16S V3-V4 region. The DNA of 45 culturable isolates were extracted, comprising 25 from PT and 20 from LT. The PCR amplicons and metagenomic samples were sequenced per the manufacturer's instructions at Macrogen Inc., South Korea. The isolates exhibited taxonomic diversity, comprising 46 species from the Gammaproteobacteria, Betaproteobacteria, and Firmicutes phyla. 16S rRNA amplicon metagenome sequencing identified 80 bacterial species, including 21 phyla, 20 classes, 17 orders, 12 families, and 22 genera. Pseudomonadota was the most dominant phylum, followed by Firmicutes. Cyanobacteria were present at all sites; LT showed a higher abundance (0.48%) than PT (0.16%), likely due to its proximity to Beira Lake and the sea. The genera *Brevundimonas, Fenollaria, Prevotella, Peptoni, Enterococcus,* and *Corynebacterium* were exclusively found at high-elevation sites. The average Simpson index for the LT site was 0.6645 for bottom samples and 0.7733 for top samples. At the PB site, it was 0.8333 for the top, and 0.7307 for the bottom samples. Overall, the samples collected from higher altitudes exhibited greater alpha diversity. The viable microbes originating from high altitudes shape microbial dynamics in lower elevations. This research offers a framework for analyzing airborne microbial communities on both local and regional scales.

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Keywords: Airborne microorganism, Air samples, High altitudes, 16S rRNA amplicon sequencing, Microbial diversity

RESCON 2025 EES 06

Panicum maximum- DERIVED CELLULOSE NANOPARTICLES INCORPORATED MEMBRANE FOR TARGETED CO_2 CAPTURE IN AIR PURIFICATION

A.H.M.Y. Nilmani[1], J.M.S.G.B. Navarathne[1], N. Priyantha[1,2] and M.B. Wijesinghe[1,2]*

[1]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.*
*manjulaw@sci.pdn.ac.lk

Air pollution poses a profound threat to the environment, imperiling human health, ecosystems, biodiversity, and exacerbating climate change. Carbon dioxide (CO_2), released through industrial processes, burning fossil fuels and deforestation, stands out as the most significant contributor to atmospheric degradation. This study presents the development of an advanced, sustainable cellulose nanoparticle (CNP) based membrane engineered for effective CO_2 removal from contaminated air. CNPs were isolated from *Panicum maximum* through a chemical treatment followed by delignification, bleaching and acid hydrolysis. The scanning electron microscopy, granulometry and X-ray diffraction confirm the formation of CNPs with diameters less than 100 nm. These CNPs were subsequently integrated into cotton fabric substrates in the presence of polyvinyl alcohol (PVA) as the binding agent. These modified cotton fabrics (MCFs) were tested with untreated bare cotton fabrics (BCFs) serving as controls. A custom-built experimental system comprising calibrated CO_2 and pressure sensors, a controlled CO_2 injection unit, and test chambers was employed to evaluate the filtration efficacy of the membranes. Initial trials at ambient CO_2 concentrations (~430 ppm) demonstrated a substantial reduction of 90 ppm (decrease to 340 ppm) with MCFs, whereas BCFs showed no change. Pressure fluctuations mirrored CO_2 removal patterns, confirming membrane performance. Further tests at elevated CO_2 levels (2,000 and 5,000 ppm) revealed concentration-dependent removal efficiency. Although absolute reduction was less pronounced at higher concentrations, MCFs still achieved meaningful CO_2 capture, particularly at lower CO_2 loadings. These findings validate the potential of CNP-coated cotton membranes as scalable filtration media for CO_2 mitigation. Future work will focus on optimising fabrication parameters such as nanoparticle loading, PVA concentration, membrane thickness and functionalisation, to further enhance the CO_2 filtration capacity and operational robustness for practical air purification applications.

Keywords: Cellulose nanoparticles (CNPs), CO_2 filtration membrane, *Panicum maximum,* Sustainable air purification

RESCON 2025 EES 07

PRELIMINARY STUDY ON IMPACT OF HERD SIZE ON ANTIPREDATOR VIGILANCE OF SPOTTED DEER (*Axis axis*) AT WILPATTU NATIONAL PARK, SRI LANKA

S.M.D. Suriyabandara[1]* and C.S. Wijesundara[2]

[1]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Zoology, University of Peradeniya, Peradeniya, Sri Lanka.*
*darshanasuriyabandara1998@gmail.com

Several studies across the globe have shown that predators control prey animals not only by direct killing, but also by creating a landscape of fear, the spatial variation in a prey animal's perception of predation risk. Various animals show different strategies to offset the perception of predation risk in landscape of fear. Herding is also one method used by different animals, such as ungulates. This aspect is essential in managing predator and prey species within protected areas. In the present study, how the vigilance behavior of spotted deer (*Axis axis*) changes with respect to the herd size was examined. The study was conducted in May and June 2025, in Wilpattu National Park, Sri Lanka. Twenty focal animals of *Axis axis* were sampled during this study (male-6, female-14). Vigilance behavior of one animal was studied between 2 – 5 min. The number of animals in the herd of the focal animal and the proportion of time spent by the focal animal on antipredator vigilance behavior, *i.e.*, raised head posture above the horizontal line with its ears in an upright position were recorded. A Pearson correlation test was conducted to assess the relationship between the herd size and vigilance behavior. Mean herd size observed was 8.66±2.18 individuals per herd. According to the results, there is a strong negative correlation between *Axis axis* herd size and antipredator vigilance (Pearson correlation = –0.499, $p = 0.025$). This shows that the herd size has a strong impact on vigilance behavior of axis deer and when the herd size increases axis deer becomes less vigilant. These findings suggest that *Axis axis* exhibit reduced antipredator fear responses when occurring in large herds. Therefore, it can be identified that large herds support *Axis axis* to offset the fear towards predators and increase the proportion time spent on fitness enhancing activities such as foraging.

Financial assistance from Postgraduate Institute of Science, University of Peradeniya (Grant No. PGIS/2024/03) is acknowledged.

Keywords: Antipredator vigilance, Focal animal sampling, Herding, Predation, Ungulates

RESCON 2025 EES 08

EVALUATING THE CATCH EFFICIENCY OF YELLOWFIN TUNA (*Thunnus albacares*) IN SRI LANKA'S LONGLINE FISHERIES ACROSS WESTERN AND EASTERN WATERS OF THE INDIAN OCEAN

K.D.V.N. Wijenayake[1]*, S.S.K. Haputhantri[2] and T.R.I. Gamage[3]

[1]*Department of Fisheries and Marine Science, Ocean University of Sri Lanka, Colombo, Sri Lanka.*
[2]*The National Aquatic Resources Research and Development Agency, Colombo, Sri Lanka.*
*VishadiFMS2019021@student.ocu.ac.lk

The study was conducted to evaluate the efficiency of capturing yellowfin tuna (*Thunnus albacares*) using live, dead, and artificial lures in longline fishery in Sri Lanka. Data were collected from fishing operations conducted in the coastal waters of the Western and Eastern regions of Sri Lanka within the Indian Ocean. Primary data were obtained through structured interviews with longline fishermen from 150 commercial vessels operating at five major landing sites (Dikkowita, Negombo, Tangalle, Nilwella, and Kottegoda) during the period from September to December 2024. Catch per unit effort (CPUE) was calculated and analysed using the Kruskal-Wallis test. Significant differences in CPUE were observed among bait types for both the number of fish caught and total weight (p = 0.001). Dead bait demonstrated the highest catch efficiency (0.513±0.376 individuals per 100 hooks; 0.221±0.160 kg per hook), followed closely by artificial lures (0.506±0.394 individuals per 100 hooks; 0.210±0.184 kg per hook), while live bait recorded the lowest efficiency (0.429±0.429 individuals per 100 hooks; 0.176±0.205 kg per hook). No statistically significant difference in CPUE ($p > 0.05$) was observed between the Western and Eastern regions of the Indian Ocean; however, dead bait showed slightly higher efficiency in the Western region. Although live bait showed the highest median CPUE values, its use was constrained by high costs, storage challenges, and limited availability. Artificial lures were identified as a competitive and cost-effective alternative, offering a sustainable option to reduce dependence on natural baitfish. Variations in regional factors such as prey availability, water clarity, and predator behavior were also considered to have influenced bait performance and catch efficiency.

Keywords: Artificial lures, Catch efficiency, Catch per unit effort, Longline fishery, Yellowfin tuna

RESCON 2025 EES 09

IDENTIFICATION AND PREVALENCE OF *Dinurus euthynni* INFECTING *Auxis thazard* (FRIGATE TUNA) FROM SOUTHERN AND NORTHEASTERN MARINE WATERS OF SRI LANKA

T.R.I. Gamage[1]*, R.P.V.J. Rajapakse[2], K.D.V.N. Wijenayake[1] and N.M.T. Anupama[2]

[1]*Department of Fisheries and Marine Science, The Ocean University of Sri Lanka, Nugegoda, Sri Lanka.*
[2]*Department of Veterinary Pathobiology, University of Peradeniya, Peradeniya, Sri Lanka.*
*ruvishan1001@gmail.com.

Auxis thazard (Frigate tuna) is an economically important tuna species found in Sri Lankan coastal waters. Endoparasite infections can cause inflammation, congestion, and hemorrhage in vital organs such as the stomach, liver, and intestines of fish. The digenean fauna of this species is still inadequately documented. The aim of this study was to identify the digenean parasitic trematode, *Dinurus euthynni,* parasitising Frigate tuna and compare its prevalence in northeast coast (Trincomalee) and southern coast (Galle) of Sri Lanka. A total of 50 specimens, 25 each from Galle and Trincomalee, were dissected. Parasites were extracted from their stomach, cleaned with 0.9% saline water, and preserved in 70% aqueous ethanol solution. Morphological identification was based on characteristics including a dorsoventrally flattened, narrow, elongate body with rounded anterior and posterior ends, a short fore body and well-developed ecsoma longer than the body, and with irregular tegument covered with prominent plications. The oral and ventral suckers were well-developed, muscular and transversely oval. Phylogenetic analysis was conducted using the second internal transcribed spacer (ITS2) and cytochrome c oxidase subunit 1 (COX1) gene regions. The identified local sequence was 100% similar to the sequence identified from Rio de Janeiro, Brazil, bearing accession no. OP458340.1. The parasites measured between 4479 – 14562 µm and the length of ecsoma ranged between 2107 – 8141 µm. A total of 79 specimens of *D. euthynni* were recorded across both sites. The prevalence was higher in Galle (52%) compared to Trincomalee (28%). The mean abundance was 2.5±0.7 in Galle and 0.6±0.2 in Trincomalee. According to the Mann-Whitney U test, there was a significant difference in parasite abundance between sites (p = 0.032). This study reports the identification of *D. euthynni* and marks the first attempt to study its infection in Sri Lankan marine food fish.

Keywords: *Dinurus euthynni,* Endoparasite, Frigate tuna, Trematodes

RESCON 2025 EES 10

ENVIRONMENTAL GRADIENTS AND FUNCTIONAL RESILIENCE: A COMPARATIVE STUDY OF REEF FISH COMMUNITIES IN PASIKUDA AND POLHENA BACK-REEFS

C.I.R. Weerakoon[1], G. Ellepola[2], M.P. Gunawardena[1], S. Mathangadheerage[3]* and J. Bandara[4]

[1]Faculty of Science, Horizon Campus, Malabe, Sri Lanka.
[2]Department of Zoology, University of Peradeniya, Peradeniya Sri Lanka.
[3]Sustainability, Risk & Compliance, Walkers Tours (Ltd.), Colombo, Sri Lanka.
[4]Faculty of Marine Sciences and Fisheries Technology, University of Ruhuna, Matara, Sri Lanka.
*sudheera007@yahoo.com

Coral back-reef ecosystems are biodiversity hotspots that are critical to sustain key ecological processes; yet they are increasingly vulnerable to climatic and anthropogenic stressors. This study examined reef fish communities in two shallow back-reef ecosystems in Sri Lanka: Pasikuda (East Coast, sheltered, northeast monsoon influenced) and Polhena (South Coast, wave exposed, southwest monsoon influenced), to assess how environmental gradients influence community composition, functional traits, and ecological resilience. Underwater visual census data was collected from 20 stratified plots in each site. Species abundance and environmental parameters were analysed using multivariate ordinations (NMDS, CCA), functional diversity metrics (FRic, FDis, FR; based on feeding behavior across 12 dietary guilds), and Boosted Regression Trees (BRTs). Indicator species analysis was employed to identify habitat-specific assemblages. Despite higher taxonomic richness and abundance in Pasikuda, both sites exhibited similar evenness and low dominance. Community composition diverged along distinct environmental axes: pH and depth were key structuring factors in Pasikuda, whereas salinity and depth were key in Polhena. Functional richness peaked in isolated plots but showed contrasting spatial patterns. Pasikuda showed variable FRic linked to environmental fluctuations, while Polhena maintained stable but lower FRic. FDis revealed broad trait use in Pasikuda verses more clustered train use in Polhena. Functional redundancy, a proxy for ecological insurance, was greater in deeper Polhena plots, whereas Pasikuda's resilience stemmed from broad trait dispersion. BRT models confirmed site-specific ecological thresholds: pH (~37%) was most important in Pasikuda, while salinity (~49%) and depth (~37%) were key drivers in Polhena. Indicator species further supported these contrasting resilience strategies, showing trait overlap in Polhena vs. niche differentiation in Pasikuda. These findings demonstrate that even under similar monsoonal regimes, back-reef ecosystems may adopt distinct resilience mechanisms. Integrating environmental data with machine learning offers a powerful diagnostic framework for adaptive reef conservation. However, limited sampling warrants caution and further study to capture dynamic reef responses under climate pressure.

Financial assistance from Maalu Maalu Resort & Spa (Thema Collection) is acknowledged.

Keywords: Computational ecology, Environmental gradients, Functional diversity, Reef fish assemblages, Resilience mechanisms

RESCON 2025 EES 11

GEOCHEMICAL AND MINERALOGICAL PROPERTIES OF GEOPHAGIC SOILS CONSUMED BY PURPLE-FACED LANGURS (*Semnopithecus vetulus*) IN THE KALUDIYAPOKUNA FOREST RESERVE, SRI LANKA

R.M.C.D. Jayaweera[1], R. Chandrajith[2]* and R. Vandercone[3]

[1]*Department of Environmental and Industrial Sciences, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Geology, University of Peradeniya, Peradeniya, Sri Lanka.*
[3]*Department of Zoology, University of Peradeniya, Peradeniya, Sri Lanka.*
*rohanac@sci.pdn.ac.lk

Geophagy is the deliberate consumption of earth materials observed in many animals, possibly for nutritional supplements and self-medication. The purple-faced langur (*Semnopithecus vetulus*), a critically endangered colobine monkey, is endemic to Sri Lanka. The present study assessed the soil's self-medication and nutritional roles by comparing the texture, mineralogical, and geochemical characteristics of the geophagic and nongeophagic soils consumed by purple-faced langurs in the Kaludiyapokuna Forest Reserve (KFR), Sri Lanka. Such a study is crucial to furthering the understanding of their ecological requirements. Soil samples were taken from seven termite mounds utilised by langurs in the KFR. Non-geophagic soils from the same site were also collected as controls. The soil physical characteristics, including pH, electrical conductivity, major and trace elements (Na, K, Mg, P, Mn, Fe, Cu, and Zn), and soil organic matter content, were determined for both consumed and control samples using standard analytical techniques. Textural and mineralogical analyses were also carried out to identify their differences. Geochemical analysis showed no statistically significant difference between the consumed and control soils ($p \leq 0.05$). However, there was a significant difference in soil iron content ($p \leq 0.009$) and particle size distribution (sand; $p \leq 0.048$, silt; $p \leq 0.004$, clay; $p \leq 0.035$) between the consumed and control samples. Clay minerals, such as illite, montmorillonite and kaolinite, were identified in consumed soils. Based on these findings, supplementation of iron intake and/or self-medication appear to be the most likely explanation for geophagy in *Semnopithecus vetulus* in the KFR.

Keywords: Geophagy, Nutrient supplement, Purple-faced langur, *Semnopithecus vetulus*

RESCON 2025 EES 12

AVIFAUNAL DIVERSITY AND ABUNDANCE IN RELATION TO ELEVATION AND LAND USE PATTERN OF RAWAN OYA, KANDY, SRI LANKA

B.T.S.T. Fernando* and R. L. Jayaratne

Department of Biological Sciences, Rajarata University of Sri Lanka, Mihintale, Sri Lanka.
*saumyafdo99@gmail.com

Riparian ecosystems are complex ecological landscapes that sustain diverse avifaunal communities by providing a range of resources. However, only limited studies are available in Sri Lanka on avifaunal diversity in relation to elevation gradients and land use patterns. This study investigated the avifaunal diversity and abundance within the Rawan Oya riparian zone, Kandy, Sri Lanka from June 2024 to January 2025. The riparian zone varies in elevation from 450 m (Polgolla Urban Town) to 1500 m (Hunasgiriya Mountains). Surveys were conducted at three sites, namely, Angammana (788 m elevation), Rahas Ella (565 m elevation) and Polgolla (457 m elevation), representing diverse land-use types, including natural forest patches, home gardens, paddy fields, and a dam area (near Polgolla). Direct observations were made using line transect (200 m long and 50 m wide) and point count methods. A total of 2530 birds representing 112 species and 51 families were recorded, including 85 resident (76%), 9 migrant (8%) and 18 endemic (16%) species. Conservation status assessments revealed 2 vulnerable species (2%), 8 near threatened species (7%) and 102 least concern species (91%). Thirty-two species were common to all three sites, while 24 species were unique to Angammana, 10 to Rahas Ella and 14 to Polgolla. Bray-Curtis similarity analysis revealed greater similarity between Angammana and Polgolla (0.6310) than between Angammana and Rahas Ella (0.4314), suggesting a marginal effect of elevation on avifaunal composition. A chi-square test of independence revealed that the distribution of feeding guilds varied across sites, indicating that land use patterns strongly influenced the availability of resources and hence the bird community structure. Additionally, mixed-species flocking was also observed. These findings highlight that the land use patterns, rather than elevation, shape avifaunal diversity and abundance in Rawan Oya riparian zone.

Keywords: Avifauna, Elevation gradient, Land use pattern, Rawan Oya, Riparian zone

RESCON 2025 EES 13

THE FORAGING AND SOCIAL DYNAMICS OF CROWS IN CHILAW: AN INSIGHT FOR URBAN CROW MANAGEMENT

M.A.S.P. Dissanayake* **and V.A.K. Fernando**

Department of Zoology and Environment Sciences, University of Colombo, Colombo, Sri Lanka.
*prasannasujeewa98@gmail.com

Two crow species are found in Sri Lanka: *Corvus splendens* (House Crow) and *C. macrorhynchos* (Large-billed Crow). They are considered nuisance and pests on some occasions despite beneficial ecological roles. Understanding their foraging and social dynamics is crucial for sustainable management of crows in urban environments, where garbage exacerbates the issue. This study, conducted in Chilaw, assessed both crow species together, focusing on habitat preferences, factors influencing abundance, and public perceptions shaped by urban sanitation. The study sites were classified as urban and suburban with five sampling locations each (U1 to U5 and SU1 to SU5). Observations such as the frequency of feeding, procurement of waste, and vigilance, were carried out during two daily sessions: morning (07:00 – 09:00) and evening (16:00 – 18:00) for 10 days between March and May 2025 through fixed-point counts using a binocular and naked eye. The highest average crow abundance (390±154 individuals/day) among all 10 locations was recorded in Fishery Harbour (U3), which can be attributed to the easy availability of fish waste. Among both urban and suburban locations, crow abundance was notably higher in the evening (U – 203±91 and SU – 164±46 individuals/day) compared to the morning (U – 128±37 and SU – 106±24 individuals/day), though not statistically significant ($p > 0.05$). Crow abundance varied significantly across urban ($F_{(4, 20)} = 8.72$, $p < 0.01$) and suburban locations ($F_{(4, 20)} = 3.41$, $p < 0.05$). U3 recorded the highest vigilance frequency (572 individuals/day) among the locations. The highest level of vigilance was displayed on transmission lines (1022 individuals/day) when all habitats were considered together. Considering the crow diet, the highest proportion comprised processed food (67%), and the most abundant type of procured waste by crows was animal products (25%). Habitat usage by the crows was determined using the Habitat Preference Index, with the highest preference (0.45) exhibited at U3. A perfect positive correlation ($r^2 = 1$, $p < 0.05$) between vigilance and feeding was observed at all urban sites except at the railway station (U4). Of the 20 community members surveyed focusing on public experience with crow-related behaviors along with urban environmental factors, 45% found crows troublesome, and 40% acted by driving away crows and cleaning food scraps frequently. A significant correlation between crow-related disturbances and garbage accumulation levels was evident ($r^2 = 0.526$, $p < 0.05$). The study emphasizes the need to limit the access of crows to fish waste and prevent garbage accumulation to prevent increased crow gatherings by evening via responsible waste disposal and integrated urban planning.

Keywords: Community perception, Habitat preference, Urban crow management, Vigilance, Waste management

RESCON 2025 EES 14

OXALIC ACID-MODIFIED ROCK PHOSPHATE AS A SUSTAINABLE PHOSPHORUS FERTILIZER: ENHANCEMENT OF PHOSPHORUS SOLUBILITY AND CONTROLLED RELEASE BEHAVIOR

S. Dabare and I. Munaweera*

Department of Chemistry, University of Sri Jayewardenepura, Nugegoda, Sri Lanka.
*imalka@sjp.ac.lk

Eppawala Rock Phosphate (ERP), is a locally available but sparingly soluble phosphate source in Sri Lanka. It has limited applications in neutral to alkaline soils due to its low solubility. While organic acid treatments, such as with oxalic acid, have been explored to improve phosphorus release, the combined effect of oxalic acid treatment with mechanochemical grinding on ERP solubility remains underexplored, marking a key research gap. This study investigated the modification of ERP by varying ERP: oxalic acid (OA) ratio (0.2:1.0 to 1.2:1.0), with a focus on enhancing phosphorus availability through mechanochemical grinding, a process that promotes solid-state reactions of ERP and oxalic acid. The objective was to assess the phosphorus, iron, and aluminium releasing ability of the modified ERP (OA-ERP) in both aqueous and soil systems, comparing it with unmodified ERP and triple superphosphate (TSP) as controls. The OA-ERP at a 1.2:1.0 ratio released 99.9% of its phosphorus, exceeding TSP's 82.9% release. Investigation of kinetics revealed a zero-order release pattern for OA-ERP (1.2:1.0), indicating a surface-controlled release mechanism. OA-ERP (0.9:1.0) followed pseudo-first order kinetics, indicating diffusion-limited release. Iron release was highest in OA-ERP (1.2:1.0) (19.99 mg g^{-1}), compared to TSP (0.58 mg g^{-1}), facilitated by oxalate-induced surface activation and complexation. The release of Al was minimal and stabilised over time due to strong oxalate complexation. In soil, TSP released phosphorus quickly, showing a rapid spike early on, but its cumulative release remained relatively low over time, reaching only about 13.6% of the applied phosphorus by the 50th day. In contrast, OA-ERP treatments demonstrated more sustained phosphorus release with OA-ERP (1:1) and OA-ERP (1.2:1.0) treatments releasing 22.3% and 28.8%, respectively. These findings demonstrate that mechanochemical grinding combined with oxalic acid treatment significantly enhances ERP's fertilizer potential, positioning OA-ERP as a controlled-release, eco-friendly alternative for improving phosphorus use efficiency in sustainable agriculture.

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Keywords: Eppawala rock phosphate, Oxalic acid, Phosphorus availability, Soil incubation, Sustainable fertilizer

RESCON 2025 EES 15

CHARACTERISATION OF CARBONATED AND SERPENTINISED ULTRAMAFIC BODIES IN SOUTHERN SRI LANKA: IMPLICATIONS FOR MULTI-STAGE GEOLOGICAL EVOLUTION

K.T.P. Jayaweera[1,2]*, P.L. Dharmapriya[1], R. Chandrajith[1], S.P.K. Malaviarachchi[1], A. Pitawala[1], S. Karunatillake[3] and K. Sajeev[4]

[1]*Department of Geology, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[3]*Department of Geology and Geophysics, Louisiana State University, Baton Rouge, USA.*
[4]*Centre for Earth Sciences, Indian Institute of Science, Bangalore, India.*
*s18067@sci.pdn.ac.lk

Three serpentinite occurrences in southern Sri Lanka, Ginigalpelessa, Ussangoda, and Indikolapelessa, located along the boundary between the Vijayan and Highland Complexes, have the potential to preserve records of multi-stage fluid-rock interactions, which may be expressed through diverse mineral assemblages and textural relationships at meso- to micro-scales. Field observations prominently revealed crosscutting chert veins at Ginigalpelessa and magnesite networks in all three locations that delineate serpentinisation processes associated with subsequent carbonation and silicification. Field and petrographic studies, combined with electron probe microanalysis (EPMA) and X-ray diffraction (XRD), were employed to characterised mineral phases and reconstruct the alteration history of these serpentinite bodies. According to XRD analyses, Ginigalpelessa contains both antigorite and chrysotile with minor lizardite, while in Ussangoda and Indikolapelessa, the coexistence of both antigorite and chrysotile polymorphs are accompanied by enhanced goethite, indicative of oxidative weathering. The associated mineral assemblages include talc, brucite, magnetite, forsterite, enstatite, hematite, maghemite, spinel, lizardite, chlorite, and goethite, reflecting progressive alteration of an ultramafic protolith under dynamically evolving fluid regimes. Mesh-textured pseudomorphs after forsteritic olivine (Fo_{96-98}) preserve primary igneous textures, while disseminated chromium spinel (Cr# 61-86), exhibits holly-leaf morphologies and compositional zoning, indicative of oxidative serpentinisation. At Indikolapelessa, crosscutting carbonate veins predominantly composed of magnesite, with minor dolomite and quartz, representing post-serpentinisation carbonation under CO_2-rich conditions. The preservation of relict forsterite-enstatite assemblages suggests incomplete serpentinisation, while the systematic occurrence of magnetite reflects Fe^{2+} oxidation during the alteration. Systematic crosscutting relationships between magnesite-rich carbonate veins and serpentinised zones establish a coherent paragenetic sequence, recording multiple hydrothermal episodes across all the study sites. This integrated, multi-locality analysis elucidates the complex interplay of serpentinisation, carbonation, and silicification processes, providing critical insight into fluid evolution within ultramafic systems and constraining the timing and nature of multi-stage alteration pathways in Sri Lankan serpentinites.

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Keywords: Antigorite, Magnesite, Multi-stage, Serpentinisation

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INVESTIGATING CRYSTAL CHARACTERISTICS OF VEIN GRAPHITE FOR INDUSTRIAL APPLICATIONS, VALUE ADDITION AND LOW-CARBON DEVELOPMENT

G.M.S.S. Gunawardhana[1,2], P.G.K.D. Palandagama[1,2], S.P.K. Malaviarachchi[1,3]*, L. Zhao[4] and J. Gunatilake[1,3]

[1]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Bogala Graphite Lanka PLC., Aruggammana, Sri Lanka.*
[3]*Department of Geology, University of Peradeniya, Peradeniya, Sri Lanka.*
[4]*Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing, China.*
*malavi@sci.pdn.ac.lk

Sri Lanka's vein graphite, renowned for its exceptional purity (95 – 99.99% carbon), represents a globally significant yet underutilised mineral resource. A critical research gap exists in understanding how different graphite morphological varieties found in Sri Lanka correlate with specific industrial uses. This lack of clarity limits efficient resource utilisation and product development for high-value markets, including emerging eco-friendly technologies. The primary objective of this study was to evaluate how different crystal structures and quantities of vein graphite influence specific industrial applications to enhance value addition and contribute to low-carbon development, while investigating the feasibility of integrating renewable energy into production, which will effectively reduce the carbon footprint of graphite operations. Initial site investigations were conducted, and samples were collected from major graphite mines in Sri Lanka, including Bogala, Kahatagaha, and Ragedara, and some minor mines in Boralugoda and Agalawatta. Sample characteristics, morphologies of graphite crystals in different graphite sites, host rock, and mineralogy analyses were done for the samples collected. The main host rock types were identified as biotite gneisses, garnet-biotite gneisses, charnockitic-gneiss, marble, and charnockitic-sillimanite-gneiss, with main impurities being quartz, pyrite, mica, feldspar, and garnet. Preliminary results indicate that the carbon percentage of the four graphite types varies by mine, suggesting it may be influenced by the original fluid characteristics that form the veins. Therefore, characteristics of the four types of vein graphite and their formation mechanisms will be studied further with isotopic and geochemical analyses. It is also aimed to identify optimal graphite types and quantities for specific applications, promoting low-carbon development and suggesting sustainable mining and processing techniques that reduce carbon emissions, waste generation, while focusing on renewable energy integration. The findings will provide policy recommendations to modernise the graphite industry, aligning it with global sustainability trends and enhancing its economic and strategic value.

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Keywords: Graphite types, Sri Lankan vein graphite, Sustainable development, Value addition.

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ESTIMATION OF SOIL ORGANIC CARBON AND ITS INFLUENCE ON NUTRIENT DYNAMICS IN SHIFTING CULTIVATION WITHIN THE KATUPOTHA TANK CASCADE SYSTEM, SRI LANKA

W.D.U. Premarathna[1,2], **G.A.D. Perera**[3], **S.B. Karunaratne**[4] **and R.R. Ratnayake**[1*]

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka.*
[2]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[3]*Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka.*
[4]*CSIRO Agriculture and Food, Butler Laboratory, Black Mountain, Acton, Australia.*
*renuka.ra@nifs.ac.lk

Shifting cultivation, one of Sri Lanka's oldest agricultural practices, has been important in sustaining communities since ancient times. Frequent removal of natural vegetation for cultivation often leads to the deterioration of native plant species and soil. Understanding the interactions between soil total organic carbon (TOC) and essential nutrients is vital for sustainable land management, especially in sensitive dry zone ecosystems. This study aimed to assess the relationship between TOC and some available soil macronutrients (nitrate, phosphate, and ammonium) in fallow forests after shifting cultivation at the Katupotha tank cascade system (KTCS), Mihintale, Sri Lanka. Composite soil samples were formed by pooling three samples from each of 16 random locations at two depths: surface (0 – 15 cm) and sub-surface (15 – 30 cm). Soil pH, electrical conductivity (EC), bulk density, TOC, and available macronutrients were analysed using standard protocols. In the surface soil, TOC ranged from 0.42 – 1.31% (mean 0.94%), and phosphate, nitrate, and ammonium ranged from 0.21 – 13.01, 0.29 – 26.07, and 7.52 – 57.14 $\mu g\ g^{-1}$, respectively (means: 4.20, 11.47, 23.97 $\mu g\ g^{-1}$). In the subsurface, TOC ranged from 0.24 – 1.27% (mean 0.76%), with phosphate, nitrate, and ammonium ranging from 0.01 – 3.99, 1.47 – 16.08, and 5.33 – 39.83 $\mu g\ g^{-1}$, respectively (means: 1.01, 6.66, 21.46 $\mu g\ g^{-1}$). Paired *t*-tests showed significant depth-wise differences in TOC ($p = 0.019$), nitrate ($p = 0.037$), and phosphate ($p = 0.009$), indicating depth-dependent variation in nutrient distribution. Pearson correlation analysis revealed a moderate positive correlation between TOC and nitrate at both depths ($r = 0.50$, $p = 0.06$ for 0 – 15 cm; $r = 0.51$, $p = 0.05$ for 15 – 30 cm), and a significant correlation was found for TOC and phosphate at the surface ($r = 0.54$, $p = 0.04$). The high levels of TOC, nitrate, and phosphate in young fallow forest soils suggest frequent cultivation and the deliberate addition of these nutrients by farmers, indicating a shift away from the sustainable nutrient management practices of traditional farming systems toward high-input, sedentary agriculture.

Keywords: Carbon sequestration, Macronutrient availability, Shifting cultivation, Soil health, Sustainable land management

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Not Presented at RESCON 2025

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GEOGRAPHIC AUTHENTICATION OF CEYLON TEA BASED ON THE TRACE ELEMENT AND STABLE ISOTOPE FINGERPRINTS

K.M. Binduhewa[1]*, B.A.T. Amalka[1], S.M.N.K. Tilakarathne[1], D.C.K. Dissanayake[1], K.G.N. Piyasena[2], M.A.B. Ranatunga[2], R. Chandrajith[3] and L.S.K. Hettiarachchi[2]

[1]*Sri Lanka Atomic Energy Board, Wellampitiya, Sri Lanka.*
[2]*Tea Research Institute of Sri Lanka, Talawakelle, Sri Lanka.*
[3]*Department of Geology, University of Peradeniya, Peradeniya, Sri Lanka.*
*kasunmbinduhewa@gmail.com

Tea (*Camellia sinensis*) is the most commercially important agricultural export in Sri Lanka. Ceylon tea is renowned for its unique taste, rich golden colour, and fresh aroma. However, it is one of the most common targets for food counterfeiting, which poses a significant risk to consumers due to its increasing popularity and widespread consumption. This study aims to investigate whether a chemometric model based on stable isotope ratios and trace elements can differentiate Ceylon tea from teas of other major tea-exporting countries. A total of 298 orthodox black tea samples: 12 from China, 20 from India, 16 from Vietnam, 16 from Kenya, and 234 from Sri Lanka, representing all the seven tea growing regions were collected. The stable isotope composition ($\delta^{13}C$, $\delta^{15}N$, $\delta^{2}H$, and $\delta^{18}O$) and the concentrations of 18 trace elements (Al, As, Ba, Be, Cd, Co, Cr, Cu, Fe, Ga, K, Mg, Mn, Ni, Rb, Sr, V and Zn) were determined using isotope ratio mass spectrometry (IRMS) and inductively coupled plasma mass spectrometry (ICP-MS), respectively. Unsupervised principal component analysis was followed by supervised orthogonal partial least square discriminant analysis (OPLS-DA) to differentiate Ceylon tea from other tea. While an overlap between Sri Lankan and Indian tea was observed, the OPLS-DA score plot demonstrated good overall separation of Ceylon tea from others, supported by strong R^2 and Q^2 values (0.816 and 0.789, respectively). Eight variables ($\delta^{2}H$, $\delta^{18}O$, $\delta^{13}C$, Rb, As, Sr, Cr, and Co) were identified as significant indicators, and these findings are consistent with existing studies. External validation using a test dataset of 156 samples yielded a perfect classification accuracy of 100%. This study demonstrates that the use of stable isotope ratios and trace element profiles along with chemometric techniques, provides a robust and reliable approach to differentiate Ceylon tea from others.

Keywords: Ceylon tea, Chemometric model, Geographic authentication, Stable isotope ratio, Trace elements

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SYNERGISTIC EFFECTS OF ATMOSPHERIC LEAD DEPOSITION AND CLIMATE CHANGE FACTORS ON UPPER MONTANE FOREST DIEBACK IN SRI LANKA

A.A. Pandigama[1] and M.B. Wijesinghe[1,2]*

[1]*Department of Environmental and Industrial Sciences, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.*
*manjulaw@sci.pdn.ac.lk

Reported since 1978, Upper Montane Rain Forests (UMRFs) in Sri Lanka have been threatened due to a high degree of forest dieback. This study examined the effects of atmospheric lead (Pb) deposition and rainfall variability, representing climate change factors on UMRF dieback. Nine study sites were selected across Horton Plains National Park, Pidurutalagala Conservation Forest, and Knuckles Conservation Forest, representing dieback-affected and relatively healthy areas. Vegetation health trends were assessed using Enhanced Vegetation Index (EVI) imagery processed with a Python-based image segmentation programme to quantify the unhealthy vegetation percentage. To minimise Pb interference from soil, 27 epiphytic *Thuidiaceae* moss samples were collected methodically from the nine study sites, digested, and analysed via inductively coupled plasma-mass spectrometry as bioindicators of atmospheric Pb deposition. Lead concentrations in moss samples were compared between healthy and unhealthy sites. Monthly rainfall data (2017 – 2024) were incorporated into correlation analyses with vegetation health data. An overall positive trend in forest regeneration from 2017 to 2024 was observed in 88.9% of sites. Concentrations of Pb in moss samples did not show a clear relationship with vegetation health within sites. However, a significant difference ($p < 0.001$) in Pb concentrations was found between the eastern and western slopes of the central highlands, suggesting a possibility for atmospheric deposition and transboundary pollution. Importantly, 77.8% of sites exhibited a moderately strong to strong negative correlation between rainfall and unhealthy vegetation, with stronger effects at higher elevations (*e.g.*, Great Western Mountain, Pearson correlation coefficient = -0.84). Across dieback-affected sites, the mean unhealthy vegetation percentage (EVI < 0.2) was 51.19±8.98%, with the highest at the Great Western Mountain summit (64.29±9.73%). In 2020, unhealthy vegetation peaked with a mean of 57.06±12.31%. It is concluded that rainfall variability, representing climate stress, has a more significant relationship with UMRF dieback than atmospheric Pb deposition.

Keywords: Forest dieback, Climate change, Lead deposition, Moss bioindicator, Heavy metal pollution

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APPLICATION OF POMEGRANATE PEEL IN REMOVING HARDNESS

N.F. Samama* **and S. Devaisy**

Department of Bio-Science, University of Vavuniya, Vavuniya, Sri Lanka.
*fsamama1999@gmail.com

Reverse osmosis (RO) is highly effective in removing hardness from drinking water. However, excessive water wastage as RO brine, removal of beneficial elements and high energy consumption are challenges that need to be addressed. This study investigated the use of fruit peel-based biosorbents as a sustainable and cost-effective alternative for the reduction of groundwater hardness. Groundwater samples with an initial total hardness of 650±20 mg L^{-1} were collected from a dug well at the University of Vavuniya. Five different fruit peels; beetroot, lemon, orange, banana, and pomegranate, were tested in both raw and phosphoric acid-treated forms for their hardness removal potential. Preliminary data identified phosphoric acid-treated pomegranate peel as the most effective biosorbent with the dose of 2.0 g L^{-1} at 360 min contact time. Batch adsorption experiments were carried out using different biosorbent doses (0.1 – 10 g L^{-1}) and contact times (15 – 1440 min). The phosphoric acid-treated pomegranate peel achieved a maximum hardness removal of 73% at an optimum dose of 8.0 g L^{-1} at 240 min contact time. The adsorption data closely followed Freundlich adsorption isotherm ($R^2 = 0.82$) and the pseudo-second order kinetics model ($R^2 = 0.92$), suggesting a chemisorption mechanism with the maximum adsorption capacity of 200 mg g^{-1}. Column studies supported these findings, with breakthrough curves fitting well with the Yoon-Nelson and Thomas models at different flow rates (0.33, 3.00, and 6.00 mL min^{-1}). However, a slight deviation was noted at higher flow rates. The results demonstrate the effectiveness of phosphoric acid-activated pomegranate peel as a low-cost, eco-friendly biosorbent for hardness removal, as phosphoric acid treatment enhances porosity and introduces surface functional groups that improve ion exchange characteristics and adsorption capacity. This approach offers a sustainable alternative for rural water treatment systems and promotes the 'waste to resource' concept by utilising agricultural waste materials.

Keywords: Adsorption, Biosorbents, Groundwater, Hardness removal, Pomegranate peel

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MANGO *(Mangifera indica)* LEAF-DERIVED BIOSORBENT FOR EFFECTIVE TURBIDITY REMOVAL FROM RUBBER PROCESSING WASTEWATER

H.A.S.N. Hettiarachchi[1], A.S. Welagedara[2], H.G.T.P. Samarawickrama[2] and S. Devaisy[1]*

[1]*Department of Bioscience, University of Vavuniya, Vavuniya, Sri Lanka.*
[2]*Environment Management Department, Board of Investment of Sri Lanka, World Trade Centre, Colombo, Sri Lanka.*
*sukanyahdev@vau.ac.lk

Natural rubber (NR) production generates a substantial volume of wastewater characterised by high turbidity (~70 NTU) and chemical oxygen demand (COD) levels of 400 ppm. These values exceed the permissible discharge limits set by the Central Environmental Authority, posing a significant environmental challenge. Current wastewater treatment methods employed by the rubber industry are often energy-intensive, costly, and insufficient in ensuring long-term environmental safety. Therefore, this study aims to develop a sustainable and eco-friendly alternative using biosorbents derived from *Mangifera indica* (mango) leaves. The mango leaf-based biosorbent (MLBS) prepared through drying (100 °C for 4 h), grinding, and sieving of mango leaves (particle size: 1 mm – 2.5 mm), was evaluated through batch adsorption experiments. The results revealed a remarkable reduction in turbidity by 90% and a 38% decrease in COD under optimised conditions (shaking speed: 120 rpm, temperature: 25 °C, initial and final pH ~8.5 and ~6.8). Isotherm and kinetics studies indicated that the optimum dosage and optimal contact time for effective adsorption were 3.0 g L^{-1} and 30 min, respectively. However, the use of a 2.0 g L^{-1} dosage was more cost-effective (two replicates were used). Furthermore, the adsorption kinetics were best described by the pseudo-first order model, which yielded the highest coefficient of determination (turbidity: R^2 = 0.9471, COD: R^2 = 0.7599). This suggests that the biosorption process is predominantly governed by a physical adsorption mechanism rather than chemical bonding. These findings highlight the potential of MLBS as a low-cost, biodegradable, and effective solution for the treatment of rubber industry effluents. The approach not only contributes to pollution reduction but also supports the circular economy by utilising agricultural waste. Future studies should focus on enhancing the adsorptive capacity of MLBS through chemical modification and incorporation of the biosorbent as filling materials in columns and constructed wetlands.

Keywords: Mango leaves, Turbidity, Rubber, Biosorbent, Wastewater

RESCON 2025 EES 24

REVERSE OSMOSIS TREATMENT AND ENVIRONMENTAL RISK IN A CKDu HOTSPOT: A CASE STUDY FROM WILGAMUWA, SRI LANKA

I.U.B. Athauda[1]*, L.M.K. Weligamage[1], B. Rathnayake[1], C. Jayaweera[1], N.D. Mahalekam[1], R. Chandrajith[1], P. Vlahos[2], S. Anand[3], N. Nanayakkara[4] and S. Hewapathiranage[5]

[1]*Department of Geology, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Marine Sciences, University of Connecticut, Storrs, USA.*
[3]*Division of Nephrology, School of Medicine, Stanford University, Stanford, USA.*
[4]*Centre for Research, National Hospital, Kandy, Sri Lanka.*
[5]*Nephrology and Kidney Transplant Unit, National Hospital, Kandy, Sri Lanka.*
*isharaathauda94@gmail.com

Chronic Kidney Disease of uncertain etiology (CKDu) is a major public health concern in Sri Lanka, particularly in the dry zone. The most widely supported hypothesis associates CKDu with drinking-water quality, with hydrogeochemical factors. Although reverse osmosis (RO) treatment plants have been installed to improve water quality in affected regions, they produce highly concentrated effluents that are often discharged untreated, posing ecological risks. This study evaluated key geochemical parameters in source water, treated (filtered) water, and effluent water from selected RO plants (n = 10) in Wilgamuwa, a high CKDu-prevalent area. Most source water samples were moderate to very hard, with total hardness (TH) ranging from 80 – 340 mg L^{-1}. The mean total alkalinity (TA) was 196 mg L^{-1}, which is close to the maximum permissible limit specified by the Sri Lanka Standards (SLS). Two source water samples exceeded the fluoride guideline of 1.0 mg L^{-1}. The average ion removal rates from source water across the RO treatment plants were 88% (Mg^{2+}), 77% (Ca^{2+}), 64% (K^+), 34% (Na^+), 79% (F^-), 84% (Cl^-), and 95% (SO_4^{2-}). The filtered water showed TA of (3 – 7 mg L^{-1}) and TH of (4 – 36 mg L^{-1}). Ion concentrations in filtered water samples were: Ca^{2+} (3 – 9 mg L^{-1}), Mg^{2+} (< 2 mg L^{-1}), Na^+(3 – 14 mg L^{-1}), K^+ (< 5 mg L^{-1}), F^- (1 mg L^{-1}), Cl^- (8 mg L^{-1}), and SO_4^{2-} (< 2 mg L^{-1}). In contrast, effluent water showed considerable variability, with TA ranging from 115 – 708 mg L^{-1} and TH from 96 – 720 mg L^{-1}. Electrical conductivity and total dissolved solids in the effluent ranged from 444 – 1776 µS cm^{-1} and 284 – 1243 mg L^{-1}, respectively. Effluent ion concentrations were: Ca^{2+} (19 – 80 mg L^{-1}), Mg^{2+} (2 – 34 mg L^{-1}), Na^+ (10 – 149 mg L^{-1}), K^+ (1 – 5 mg L^{-1}), F^- (< 3 mg L^{-1}), Cl^- (4 – 250 mg L^{-1}), and SO_4^{2-} (9 – 104 mg L^{-1}). This highly concentrated RO effluent is often discharged directly into agricultural land or nearby waterways, raising concern about soil salinisation and water quality degradation. These findings emphasise the need for effective RO effluent treatment, using methods such as chemical precipitation or electrodialysis, before environmental release. Future research should assess trace metals in RO effluents to evaluate their roles in contamination of surface and groundwater, and bioaccumulation in aquatic food webs.

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Keywords: Bioaccumulation, Chronic kidney disease of uncertain etiology, Reverse osmosis

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DEVELOPMENT OF BIOMASS BOILER ASH-BASED ADSORBENT FOR TEXTILE DYE REMOVAL

M.J. Chiranga[1], I.C. Jayasinghe[1], R.M.M.K. Karunathilaka[2], T.N. Dharmapriya[1] and N. Priyantha[3]*

[1]*Department of Environmental Technology, University of Colombo, Colombo, Sri Lanka.*
[2]*Research and Development Unit, Faculty of Medicine, University of Peradeniya, Peradeniya, Sri Lanka.*
[3]*Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.*
*namalpriyantha@sci.pdn.ac.lk

The textile industry releases dye-contaminated effluents that pollute water and generate biomass boiler ash as solid waste, both of which demand sustainable management. This study investigated the use of biomass boiler ash generated from a rubber wood-fired boiler at an apparel factory in Colombo, Sri Lanka, as a low-cost adsorbent to remove Asahifix Red XP-3BF (Reactive Red 194 dye or AR dye), both sourced from the same factory. Two types of biomass boiler ash: Boiler Bed Ash (BBA) and Wet Bottom Ash (WBA), were collected, oven-dried, sieved, and tested for dye adsorption potential. Preliminary tests revealed that BBA achieved a higher removal efficiency (63.06%) of the AR dye compared to WBA (32.32%). Therefore, subsequent studies were performed using BBA. The effects of adsorbent dosage, shaking time, settling time, and dye concentration were evaluated under controlled laboratory conditions with 10 mg L^{-1} initial dye concentration at an ambient temperature. Results indicated that the highest AR dye removal of 98.2% is achieved at 10 g L^{-1} adsorbent dosage. However, 4.0 g L^{-1} dosage, showing 54.3% was selected as the optimum dosage to compromise the adsorbent load for large effluent volumes, thereby balancing sustainable performance and material economy. Further, the optimal shaking and settling times were identified as 60 min and 20 min, respectively. Dye removal decreased with the increase in the initial dye concentration, from 82.1% at 5 mg L^{-1} to 13.2% at 50 mg L^{-1}. X-ray fluorescence analysis of fresh and spent BBA adsorbent revealed the emergence of 12% potassium in the spent material, confirming successful adsorption of AR dye. Adsorption behavior fitted to the Langmuir isotherm model (R^2 = 0.9681), indicating monolayer adsorption on a homogeneous surface with a maximum adsorption capacity (Q_{max}) of 1.72 mg g^{-1}. Separation factor (R_{L}) values ranging from 0.018 to 0.155 confirmed that the process was favorable. The study demonstrates a circular economy and sustainable practice through utilising waste from the same source, ensuring a cost-effective, eco-friendly, and reliable treatment approach.

Keywords: Adsorption isotherms, Biomass boiler ash, Circular economy, Textile dye removal, Wastewater treatment

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DEVELOPMENT OF A RAINWATER QUALITY INDEX USING PRECIPITATION OF SELECTED LOCATIONS IN KANDY DISTRICT

K.N.K. Kankanamge[1] and N. Priyantha[2]*

[1]*Department of Environmental and Industrial Sciences, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.*
*namalpriyantha@sci.pdn.ac.lk

With rising demand and an unreliable municipal supply, Kandy (Sri Lanka) is experiencing increasing water security challenges. In response, rainwater harvesting is gaining importance as a supplementary source of freshwater, particularly in areas where access to treated water is limited. Although the rainwater quality is influenced by urbanisation and industrialisation, not much attention has been paid in determining comprehensive rainwater quality indices despite their importance. Therefore, this study focuses on determining the physicochemical characteristics of rainwater collected from three strategically selected locations within the Kandy area, comprising two suburban areas and one urban area, which is highly contaminated by vehicular emissions and industrial activities in the surrounding areas, to formulate a rainwater quality index (RQI). Weekly samples were collected over a period of 30 weeks in 2024. The samples were analysed for key water quality parameters, namely, pH, electrical conductivity, total hardness, and three selected anions: NO_3^-, SO_4^{2-} and Cl^-, which are predominant anions present in the atmospheric precipitation around this area because of cultivation activities, vehicular emissions, water treatment plants, and dumping sites. The simple rank sum method, enabling the integration of multiple variables into a single, interpretable value, was used in this exercise. The RQI is given by,

$$\mathrm{RQI} = \Sigma W_i Q_i$$

where W_i represents the relative weight of parameters, and Q_i is the quality rating of each of the parameters. The RQI is determined as $\Sigma W_i Q_i$ which has a range of 1 to 100, where 100 is the worst quality. The results revealed that the rainwater quality of the study sites ranged from 15.2 to 100.0. Seasonal variation was also observed, with a slight decline in water quality during the early monsoon period, because the dry season showed the higher air pollutant level across the sampling area. These findings underscore the spatial and temporal variability of rainwater quality in Kandy and demonstrate the usefulness of the RQI formulated as a practical tool for water quality assessment.

Keywords: Bulk deposition, Kandy, Rainwater quality index, Urbanisation

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MULTIVARIATE ANALYSIS ON HYDROGEOCHEMICAL EVOLUTION OF GROUNDWATER IN A GEOLOGICALLY CONTROLLED AQUIFER SYSTEM

S.H.U. Hansani[1]*, R. Weerasooriya[1] and P.L. Dharmapriya[2]

[1]*Centre for Water Quality Research, National Institute of Fundamental Studies, Kandy, Sri Lanka.*
[2]*Department of Geology, University of Peradeniya, Peradeniya, Sri Lanka.*
*uthpala.he@nifs.ac.lk

This study investigated hydrogeochemical evolution in the Netiyagama area, located in the North Central Province of Sri Lanka. A total of 120 water samples were analysed alongside silicate rock analysis to characterise water-rock interactions. Mineralogical studies and principal component analysis identified 16 ions (Na^+, K^+, Ca^{2+}, Mg^{2+}, Cl^-, SO_4^{2-}, HCO_3^-, CO_3^{2-}, Si^{4+}, Sr^{2+}, Fe^{3+}, Mn^{2+}, Al^{3+}, Zn^{2+}, Cu^{2+}, Co^{2+}) that would contribute to groundwater chemistry. They were used in a hierarchical cluster analysis (HCA) to identify water clusters linked to geological conditions of the area dominated by granitic gneiss, hornblende biotite gneiss and charnockitic gneiss. The HCA delineated 7 clusters, which revealed distinct chemical signatures correlated with lithological heterogeneity and spatial distribution of fractures. The hydrogeochemical evolutionary trends indicate a progression of water chemistry. Initially reverse ion exchange dominates in recharge zones, where Na^+ substitutes for Ca^{2+} and Mg^{2+} in aquifer materials, resulting in water enriched with Ca^{2+} and Mg^{2+} ions as indicated by negative chloro-alkaline indices and elevated Ca^{2+}/Na^+ ratios (~1.7). The recharge zone groundwater between major fold axes exemplifies this stage of evolution, characterised by mixed $CaNaHCO_3$ water exhibiting minimal chemical variability, indicative of fresh recharge water. As groundwater moves towards discharge areas, prolonged residence time and interaction with diverse lithologies lead to the depletion of exchangeable sodium with the aquifer materials. Additional processes, such as the dissolution of secondary calcite, release Ca^{2+} and HCO_3^- ions, prompting a shift toward normal ion exchange, where Ca^{2+} and Mg^{2+} are exchanged for Na^+, or mixed ion exchange environments, as indicated by variations in Ca/Na ratios (0.5 – 1.0). These geochemical transformations coincide with an increase in mineralisation parameters such as salinity, nitrate concentration, and the presence of heavy metals, particularly under anthropogenic influences (*e.g.* fertilisers) in the most evolved groundwater clusters. The clustering results highlight a distinct shift from bicarbonate-rich recharge waters to chloride-dominated discharge waters, reflecting increased water-rock interactions. The findings reveal critical aquifer geochemical processes, vital for sustainable groundwater management in geologically complex areas.

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Keywords: Multivariate analysis, Equilibrium reactions, Groundwater evolution, Dry zone

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DEVELOPMENT OF A LOW-COST GOLD NANOPARTICLE-MODIFIED CARBON FIBRE MICROELECTRODE FOR SENSITIVE DETECTION OF TOXIC ARSENIC(III)

D.M.L.R. Dissanayake[1], H.P.G. Nawaruwan[3], A.R. Ushani[4] and M.B. Wijesinghe[1,2]*

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.
[2]Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.
[3]Department of Physics, University of Peradeniya, Peradeniya, Sri Lanka.
[4]Department of Environmental and Industrial Sciences, University of Peradeniya, Peradeniya, Sri Lanka.
*manjulaw@sci.pdn.ac.lk

Arsenic is one of the most toxic elements naturally found on Earth and is introduced into the environment through anthropogenic activities. Among its various forms, inorganic arsenic, particularly As(III), is considered the most toxic. Developing field-portable techniques for measuring arsenic in water and food is crucial in safeguarding human and animal health. Electroanalytical techniques are well-suited for this purpose, offering miniaturisation and lower cost compared to methods such as atomic absorption and emission spectroscopic methods. Modified macroelectrodes incorporating gold nanoparticles and voltammetry have shown promise in quantifying As(III) in aqueous media. However, their lengthy deposition steps limit real-world applications. To address this limitation, a carbon microelectrode, which is commercially available, ranging from \$100 to \$150, has been fabricated using an inexpensive home-built setup at one-quarter the cost of commercial electrodes. The instrumental setup developed consisted of a nichrome wire, a variable power supply and a vacuum system, enabling the fabrication of microelectrodes by sealing carbon fibre within a glass capillary. The potential applied for sealing the electrode and the sealing time were optimised to obtain a well-sealed electrode. A home-built polishing system was used to expose the electrode surface, cutting with the grit papers (1000, 2000 and 3000) and followed by polishing with alumina powder. The fabricated electrode was characterised using cyclic voltammetry, showing a limiting current of 6.45 nA. Gold nanoparticles were electrodeposited onto the microelectrode within the potential range of –0.5 V to 1.5 V. The number of deposition cycles was optimised to 15, yielding the highest reducible current for As(III). Anodic stripping voltammetry was then employed to construct a calibration curve, giving an R^2 value of 0.96 under optimised conditions of –0.5 V stripping potential and 5 min deposition time. Under these conditions, a detection limit of 10 nM was achieved.

Keywords: Arsenic detection, As(III) toxicity, Carbon fibre microelectrode, Electrochemical sensing, Gold nanoparticle

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GREEN BIOSORPTION APPROACH FOR HEXAVALENT CHROMIUM REMOVAL USING WATER HYACINTH POWDER: KINETICS AND ISOTHERMS

A.P.N.H.D. Amarasinghe and N. Priyantha*

Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.
*namalpriyantha@sci.pdn.ac.lk

Hexavalent chromium [Cr(VI)] contamination in water sources poses a significant threat to environment and human health, necessitating efficient and sustainable remediation strategies. Among available methods, adsorption is widely recognised for its simplicity and efficacy, with biosorbents offering a promising eco-friendly and cost-effective alternative to synthetic materials. This study investigated the potential of powdered *Eichhornia crassipes* (water hyacinth), a highly invasive aquatic plant, as a natural biosorbent for the removal of Cr(VI) from synthetic aqueous solutions. The biosorbent was prepared by drying the entire plant at 60 °C and grinding it to a particle size of 300–500 µm, which was identified as optimal for effective adsorption. Key operational parameters, namely, biosorbent dosage, contact time and solution pH, were systematically optimized. The maximum removal efficiency of > 95% and the highest adsorption capacity of 12.40 mg g^{-1} were achieved for 10 mg L^{-1} Cr(VI) solution at 1.50 g dosage, 90 min shaking time and 30 min settling time. The process remains effective at solution pH values above 5.5, eliminating the need for pH adjustment and thus enhancing field applicability. Adsorption kinetics follows the pseudo-first-order model, indicating predominantly physisorption, accompanied by specific interactions with dichromate ions. Fourier-transform infrared spectroscopy reveals the involvement of –OH, C–O–C, and C=O functional groups in Cr(VI) binding, supported by characteristic spectral shifts. X-ray fluorescence spectroscopy confirms Cr uptake, while scanning electron microscopy indicates significant surface morphological changes after adsorption of Cr. Isotherm modeling shows the best fit with the Sips model, suggesting heterogeneous adsorption behavior encompassing both monolayer and multilayer characteristics. These results demonstrate that *E. crassipes* powder is a highly efficient, low-cost, and environmentally sustainable biosorbent for Cr(VI) remediation, offering strong potential for practical application in wastewater treatment systems.

Keywords: Adsorption, Chromium, *Eichhornia crassipes,* Remediation

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CARBON STOCK ANALYSIS OF SEAGRASSES (*Enhalus* sp., *Cymodocea* sp., and *Halophila* sp.) IN PUTTALAM LAGOON, SRI LANKA

R.M.K.S. Rathnayaka[1]* and C.S. Munasinghe[2]

[1]*Department of Environmental and Industrial Sciences, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Zoology, University of Peradeniya, Peradeniya, Sri Lanka.*
*kaveeshya2019@gmail.com

Seagrass ecosystems are considered as one of the most threatened coastal ecosystems, which provide numerous ecological benefits including acting as a carbon sink by storing considerable amounts of organic carbon as blue carbon in their biomass and sediments. In Sri Lanka, studies conducted on carbon stocks in seagrass ecosystems are extremely rare. This study aimed to assess the biomass and quantify the organic carbon stock in aboveground and belowground living biomass of three seagrass species in Puttalam Lagoon. *Enhalus* sp., *Cymodocea* sp., and *Halophila* sp. were collected from Sinna Arichchal and Palakudawa with six repetitions at each station, and the organic carbon content were determined using PerkinElmer® 2400 Series II CHNS/O elemental analyzer. Total biomass of seagrass species followed the order; *Enhalus* sp. > *Cymodocea* sp. > *Halophila* sp. The total organic carbon stored in the biomass was significantly different ($p < 0.05$) among selected seagrass species. *Enhalus* sp. had the highest organic carbon storage of 1.342±0.196 Mg C ha^{-1} in their biomass, while the seagrass *Halophila* sp. had the lowest organic carbon content of 0.156±0.012 Mg C ha^{-1}. The organic carbon stock in biomass of *Cymodocea* sp. was 0.373±0.118 Mg C ha^{-1}. In addition, the organic carbon stored in belowground biomass of each seagrass species was significantly greater ($p < 0.05$) than the organic carbon in their aboveground biomass with *Enhalus* sp. having the highest organic carbon in their belowground biomass of 1.082±0.167 Mg C ha^{-1}. This study revealed that seagrass species with larger structural sizes can store more organic carbon in their biomass, with a positive correlation ($r = 0.99$, $p < 0.001$) between biomass and organic carbon content strengthening this relationship. This suggests that the implementation of conservation and restoration practices are required to improve seagrass ecosystems as nature-based solutions to mitigate climate change.

Keywords: Aboveground biomass, Belowground biomass, Blue carbon, Organic carbon, Seagrasses

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COMPARATIVE EVALUATION OF THE FUNCTIONAL PROPERTIES OF COGON GRASS (*Imperata cylindrica*) FIBRE IN BIODEGRADABLE PACKAGING

K.K.M.G. Kavindya and K.G.P.N. Bandara*

Department of Food Science & Technology, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka.
*pramod@appsc.sab.ac.lk

With the growing environmental concerns of plastic packaging, the development of biodegradable packaging has gained widespread attention as a sustainable alternative to conventional, non-biodegradable packaging. Agricultural byproducts and abundant plant biomass serve as valuable sources of natural fibres for such applications. This study investigated the potential of cogon grass leaf fibre (CGLF) in developing biodegradable packaging due to its strong binding ability and reinforcement characteristics. Functional and structural properties of CGLF films were evaluated in comparison to a control composed of sugarcane bagasse (*Saccharum officinarum*) fibre (SBF) and rice straw fibre (*Oryza sativa*) (RSF) in 1:1 ratio (w/w), against three formulations developed by incorporating SBF:RSF:CGLF ratios (w/w) of 1:1:1 (S1), 1:2:1 (S2), and 1:3:2 (S3), respectively. Fibre extraction was done via alkaline treatment. Physical and mechanical properties, such as biodegradability, moisture content (MC), water vapor transmission rate (WVTR), water solubility (WS), hardness and foldability, of the above material were assessed, and data were analysed by one-way ANOVA using MINITAB 19.0 software at 0.05 significance level. Properties were further validated using Fourier transform infrared spectroscopy (FTIR) to confirm the presence of functional groups and interactions. The results demonstrated that incorporation of the highest CGLF percentage; in S3 formulation, significantly improved its overall performance across almost all the parameters determined. It possessed a significantly high biodegradability (63.63±9.09%), potentially facilitating the eco-friendly disposal. It exhibited the lowest MC (6.07±0.15%), potentially preserving structural integrity even in the humid conditions. The WVTR was also at its lowest in S3 (4.71±0.59%), highlighting enhanced water barrier properties. Notably, S3 exhibited zero water solubility as well. Moreover, it showed the highest hardness (1343.70±172.30 g), signifying increased resistance to physical and mechanical stress. Furthermore, S3 exhibited the highest foldability, a crucial attribute for packaging requires to be shaped during the usage. The FTIR spectroscopic analysis further confirmed enhanced structural bonding in S3, including strong intermolecular hydrogen bonding and the presence of major functional groups such as carbonyl (C=O) and hydroxyl (–OH), indicating a well-balanced composition of cellulose and hemicellulose with reduced lignin content. These interactions enhanced surface uniformity and mechanical integrity of S3 formulation. Hence, CGLF offers significant potential as an eco-friendly, functional component for improving the quality and sustainability of biodegradable packaging.

Keywords: Biodegradable, Cogon grass, Fibre packaging, FTIR analysis, Sustainability

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ETHNOBOTANICAL SURVEY OF MEDICINAL PLANTS IN NAGAR KOVIL, JAFFNA DISTRICT: A SIDDHA MEDICINE PERSPECTIVE

V. Gumuthagini*, T. Sharsaayin, N. Navaluxmy and S. Viviyan

Department of Gunapadam, University of Jaffna, Kaithady, Sri Lanka.
*gumuthaginiv@gmail.com

Indigenous systems of medicine including Siddha medicine, are deeply reliant on medicinal plant diversity. This study was conducted in Nagar Kovil, Jaffna, situated within a dry ecological zone. It was hypothesised in this study that the unique interplay of dry-zone ecology and enduring cultural practices have fostered a significant reservoir of medicinally important plant species. A systematic ecological survey was conducted using 20 randomised belt transects (500 m^2 each), across three major habitat types: dry forest, wetland and agricultural lands. All medicinal plant species were identified and data on abundance, growth form, perenniality and ecological status were recorded. Quantitative data were analysed using descriptive statistics. The study identified 92 medicinal plant species from 84 genera and 42 families. The most species-rich family was Fabaceae (9 species; 9.78%), followed by Asteraceae and Euphorbiaceae (5 each; 5.43%). Herbs were the most abundant growth form (31 species; 33.70%), followed by shrubs (26.09%), trees (18.48%) and climbers (11.96%). The majority were perennial (54%). Leaves were the most utilised plant part (44.57%), followed by roots (34.78%) and flowers (26.09%). Therapeutically, most species were used for gastrointestinal (32.20%) and dermatological (29.66%) disorders, followed by respiratory ailments (19.49%). This foundational ecological inventory confirms Nagar Kovil as a significant reservoir of medicinal plants. The findings have critical implications: for conservation policy, they provide a basis to advocate for designating a protected medicinal plant zone; for public health, they highlight a resource for pharmacological research and potential integration of traditional medicine; and for ecological science, they contribute baseline data on dry-zone flora to biodiversity databases. A key limitation was the focus on ecological metrics; subsequent studies should integrate ethnobotanical interviews. This work underscores the urgent need for *in-situ* conservation strategies to ensure sustainability of these resources for cultural preservation, scientific discovery and community well-being.

Keywords: Conservation, Dry-Zone ecology, Ethnobotany, Medicinal plants, Siddha medicine

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SOIL SEED BANKS IN DIFFERENT LAND COVER TYPES IN HANTANA, SRI LANKA: INDICATORS OF FOREST REGENERATION POTENTIAL

D.T.W. Samarakoon[1], H.M.S.P. Madawala[1], H.T.K. Abeysundara[2], E.H.C.M. Eeriyawala[1] and A.M.T.A. Gunaratne[1]*

[1]Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka.
[2]Department of Statistics and Computer Science, University of Peradeniya, Peradeniya, Sri Lanka.
*thilanka.gunaratne@sci.pdn.ac.lk

Hantana Mountain Range (HMR) has undergone various anthropogenic disturbances over time, leading to a landscape mosaic of unrestored, partially restored, and fully restored ecosystems. In this study, the soil seed banks across six land cover types in the HMR were examined to assess their regeneration potential under different stages of natural regeneration. This included an open grassland (OG > 30 yr), a grassland where forest restoration was initiated recently (RF – 1 yr), a grassland where forest restoration was initiated 30 years ago (RF – 30 yr), a *Pinus* plantation (PS > 30 yr), a *Pinus* plantation enriched with broadleaved plant species (EP – 20 yr), and a naturally regenerated secondary forest (SF > 30 yr). Four 10 × 10 m^2 plots were established in each land cover type, and three randomly selected 1 × 1 m^2 quadrats from each plot were used for seed bank sampling. Wet and dry season samples were placed in trays inside a glasshouse and monitored for four months. The seedling densities of woody species did not differ significantly among these sites (p_{wet} = 0.616, p_{dry} = 0.899). The highest seedling densities of woody species were recorded in RF – 30 yr during both seasons (Wet = 165.2 seedlings m^{-2}, Dry = 89.3 seedlings m^{-2}). A significant difference in seedling densities of non-woody species between sites was recorded during the wet season (p_{wet} = 0.000). PS > 30 yr recorded the highest seedling densities of non-woody species (Wet = 548.0 seedlings m^{-2}, Dry = 285.7 seedlings m^{-2}). Except SF > 30 yr and RF – 30 yr, other sites recorded a significant difference between seedling densities of woody and non–woody species ($p_{OG>30\ yr}$ = 0.008, $p_{RF\text{-}1\ yr}$ = 0.034, $p_{PS>30\ yr}$ = 0.000, $p_{EP\text{-}20\ yr}$ = 0.002). The invasive species *Clidemia hirta* was present in all sites (Wet 0 – 83%, Dry 53 – 96%). These results indicate that different restoration strategies shape the composition and regeneration potential of seed banks over time, thus contributing differently to the natural regeneration process.

Keywords: Hantana, Forest restoration, Land cover types, Regeneration, Soil seed bank

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ASSESSMENT OF MAJOR ANION CONCENTRATIONS IN A STORED DRINKING WATER SAMPLE

N. Mudannayake[1]*, S.H.U. Hansani[1], P. Wijekoon[2] and R. Weerasooriya[1]

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka.*
[2]*Department of Statistics & Computer Science, University of Peradeniya, Peradeniya, Sri Lanka.*
*nalesha63@gmail.com

Determination of the fluctuation of concentration of anions of a drinking water sample during storage is a crucial aspect in attaining reliable water quality monitoring. Water samples collected from a well in Natiyagama, Sri Lanka, during September to December 2023, were used for this research due to the availability of other geological and hydrologic data, which were crucial in assessing analytical data fluctuations upon storage. Well log data showed three aquifer layers: a shallow zone below 10 m MSL, an intermediate fractured zone between 10 – 80 MSL, and a deeper confined zone below 80 m MSL. Each has distinct water chemistry, however, mixing between them due to multi-depth extraction alters their individual characteristics, making it difficult to isolate the chemistry of individual layers. The analysis was performed weekly for seventeen weeks through high-performance liquid chromatography-ion chromatography (HPLC-IC). The sample was filtered before analysis through a 0.45 µm filter unit into a glass vial. The sample was stored at 4 °C between weekly analyses. The highest concentration fluctuation was shown in nitrate (NO_3^-) ions (52.65 – 117.86 ppm), and the least concentration fluctuation was evident in sulphate (SO_4^{2-}) ions (43.02 – 56.27 ppm), while chloride (Cl^-) ions (22.82 – 24.42 ppm) showed intermediate concentration fluctuations. The possible reasons for a notably high fluctuation of NO_3^- ion concentrations could be the intensification by anthropogenic activities due to the presence of microbes that metabolise nitrate or related compounds even at refrigerated temperatures. Chloride ions are generally more chemically stable at refrigerated conditions, maintaining a stable fluctuation. The chemical stability of SO_4^{2-} ions could be a possible influence in showing the least concentration fluctuation under the given storage conditions. The results revealed that the spike in the increase of all three anions was seen in the ninth week of analysis. To increase the statistical significance further, advanced statistical procedures, such as the paired *t*-test, are recommended with increased sample data points.

Keywords: Drinking water, Refrigeration, Sulphate, Nitrate, Chloride

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EVALUATION OF THE FIELD USABILITY OF A NOVEL CENTRIFUGAL MICROFLUIDIC DEVICE COMPARED TO CONVENTIONAL METHODS FOR DETERMINATION OF CHEMICAL OXYGEN DEMAND

H.M.S.N. Deegala[1]*, Z. Wu[1,2,3], B.V.N. Sewwandi[1], K.M.N.K.B. Kuruppu[1], A.C.A. Jayasundera[4] and R. Weerasooriya[1]

[1]*Centre for Water Quality Research, National Institute of Fundamental Studies, Kandy, Sri Lanka, Joint Research and Demonstration Centre for Water Technology, Peradeniya, Sri Lanka.*
[2]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[3]*Wuhan Newfibre Optics Electron Co., Ltd, Wuhan, China.*
[4]*School of Science and Agriculture, Missouri Valley College, Marshall, United States of America.*
*shashinideegala@gmail.com

Chemical oxygen demand (COD) is a crucial parameter used in evaluating water quality. It measures the chemically oxidisable organic matter in water. Both conventional COD analysing methods, the open reflux titrimetric method and the closed reflux spectrophotometric method, are time-consuming, bulky, laborious, and not suitable for immediate decision-making, which is a requirement in environmental analysis. To the best of our knowledge, for the first time, portable equipment which holds two centrifugal microfluidic chips (CMCs) was developed for *in situ* COD measurement. CMCs were fabricated from poly(methyl methacrylate) (PMMA) and poly(ethylene terephthalate) (PET). The portable equipment automates digestion, centrifugal control, and real-time data transmission. Field COD analysis avoids the need for sample preservation, minimises errors from transport and storage, and enables quick environmental assessments. This study focused on evaluating the field usability of the novel device through a survey. A questionnaire was prepared to evaluate the portability, throughput, cost efficiency, ability to perform various processes, miniaturisation, ease of use, energy efficiency, and durability of both conventional and microfluidic devices. Responses were gathered by distributing the questionnaire among 30 participants, which included researchers, graduate students, lab technicians, research assistants, and engineers. As advised in the questionnaire, participants rated each parameter on a 0 – 10 scale, where 0 was worst and 10 best. A paired t-test was performed on all responses, and $p < 0.0001$ for all parameters confirmed that the novel microfluidic device outperformed conventional analysis. The most significant differences were in miniaturisation and programmability, where microfluidic devices averaged 9 compared to 3 for traditional analysis. Performance gaps greater than 5 were observed in portability, usability, and energy efficiency. For durability, conventional analysis scored 6, while microfluidic devices achieved 9. These results highlighted the overall advantage of the microfluidic method, mainly in terms of adaptability, integration, and operational efficiency. The higher scores in all categories showed that the novel device is effective for field testing.

Keywords: Centrifugal microfluidic chips, Chemical oxygen demand, *in-situ* analysis

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CALIBRATION OF A NO_2 SENSOR USING A CUSTOM-BUILT SETUP AND MONITORING NO_2 LEVELS AT GALAHA JUNCTION

J.M.S.G.B. Navarathne[1], **M.B. Wijesinghe**[2]* **and A. Bandara**[2]

[1]*Department of Environmental and Industrial Sciences, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.*
*manjulaw@sci.pdn.ac.lk

An average human inhales approximately 10000 liters of air per day, making air quality a matter of critical importance. Regular monitoring of air quality is essential; however, traditional gas sampling and quantification methods, such as gas chromatography, meet challenges due to their complexity and cost. Moreover, integrated commercial gas sensing systems are often expensive. This study employed commercially available gas sensors, calibrated using a custom-built portable setup, to monitor air pollution. Calibration was conducted by introducing five different gas concentrations, ranging from 0.10 ppm to 3.00 ppm, into an airtight chamber that contains the NO_2 gas sensor (MICS 6814), using a closed system. Sensor output was recorded via an Arduino Uno board. To establish the calibration curve, the sensor response was plotted against the concentration of gas. The sensor's response to NO_2 concentration followed a polynomial relationship with a high correlation coefficient of 0.9958. The sensor contains a tin dioxide layer, which withdraws electrons when oxidising gases are adsorbed to its surface. The polynomial response occurs because the material reaches its adsorption capacity as the gas concentration increases, limiting its sensing response. The results at Galaha junction using this portable setup indicated a significant threefold increase in NO_2 concentration compared to data recorded in 2020. The primary source of pollution is vehicles, which increase significantly during traffic hours. Lower concentrations were observed during periods of low traffic density, between 3:00 and 4:00 p.m., averaging 0.15 ppm, while peak levels occurred between 5:00 and 6:00 p.m., averaging 0.45 ppm. During periods of heavy traffic, NO_2 levels reach up to 0.75 ppm, almost six times higher than the permissible limit. In conclusion, NO_2 concentrations at Galaha Junction consistently exceed acceptable thresholds, highlighting the urgent need for effective air quality management in the region.

Keywords: Air pollution, Arduino, Sensor calibration

RESCON 2025 EES 78

DETERMINATION OF HEAVY METALS IN SKIPJACK TUNA (*Katsuwonus pelamis*) SAMPLED FROM DIFFERENT FISHING AREAS OF SRI LANKA

M.K. Madushani[1]* and M.B. Wijesinghe[2]

[1]*Department of Environmental and Industrial Sciences, University of Peradeniya, Peradeniya, Sri Lanka*
[2]*Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.*
*madushanimag@gmail.com

The skipjack tuna (*Katsuwonus pelamis*) is a highly nutritious marine fish species that contributes substantially to the daily fish catch in Sri Lanka; however, its safety may be compromised by heavy metal contamination resulting from marine pollution. In this study, 30 skipjack tuna samples (three from each site) were collected from ten Sri Lankan coastal locations (Beruwala, Galle, Modara, Moratuwa, Negombo, Panadura, Sarakkuwa, Trincomalee, Uswetakeyyawa, and Wadduwa), mainly in areas affected by the X-Press Pearl disaster. The edible flesh of the samples was dried and digested using a well-established acid digestion procedure reported in the literature, employing concentrated HNO_3 and 50% H_2O_2. Initially, three samples, each from Sarakkuwa, Negombo and Panadura, were analysed using inductively coupled plasma mass spectrometry (ICP-MS) for Cr, Hg, Cd, Pb, and As. The mean concentrations (±SD) were: Cr 0.625 (±0.478) mg kg^{-1}, Hg 0.064 (±0.034) mg kg^{-1}, Cd 0.041 (±0.017) mg kg^{-1}, Pb 0.353 (±0.352) mg kg^{-1}, and As 1.850 (±1.553) mg kg^{-1}. Based on these preliminary findings, further analyses were conducted for Pb and As in all 30 samples, as their concentrations exceeded the permissible limits (Pb = 0.2 mg kg^{-1}; As = 0.5 mg kg^{-1}). The highest concentrations were observed in samples from Sarakkuwa, with As 3.831 (± 0.381) mg kg^{-1} and Pb 0.595 (±0.120) mg kg^{-1}, while statistical analysis indicated that Pb concentrations in Sarakkuwa samples were significantly higher than the maximum permissible level (p = 0.008). The lowest Pb concentration was recorded in Modara samples (0.026±0.046 mg kg^{-1}), whereas the lowest As concentration was found in Panadura samples (0.490±0.053 mg kg^{-1}). Overall, samples from Sarakkuwa exhibited the highest Pb and As levels among all sampling sites, which may be attributed to their proximity to the X-Press Pearl disaster site.

Keywords: ICP-MS, Permissible levels, Sri Lanka, Wet digestion, Xpress Pearl.

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ANALYSIS OF AMBIENT AIR POLLUTION LEVELS AND TRENDS IN SELECTED URBAN AREAS IN SRI LANKA, FROM 2020 JANUARY TO 2023 JUNE

D.T.A.S.P. Dissanayake

Institute of Human Resource Advancement, University of Colombo, Colombo, Sri Lanka.
sdissanayake008@gmail.com

Ambient air pollution has become a global issue due to its negative effect on human health and environmental sustainability. This study analyses ambient air pollution levels and trends in Colombo (Battaramulla) and Kandy, Sri Lanka, from January 2020 to June 2023, focusing on major pollutants: particulate matter ($PM_{2.5}$, PM_{10}), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO), and ozone (O_3). The main objectives were to study temporal trends in air pollutants, conduct a comparative analysis of ambient air pollutants and meteorological factors in both cities, and study the relationship between selected meteorological factors and ambient air pollutants. Hence, secondary data (hourly) on ambient air pollutants and meteorological data (temperature, relative humidity, solar radiation, and barometric pressure) were obtained from air quality monitoring stations (AQMS) over 30 months and analysed using SPSS software package. Results showed significant monthly, yearly, and seasonal variations in ambient air pollutant concentrations. Considering the years of study, the highest levels of ambient air pollution in Colombo were observed from November to February, while Kandy experienced its peak pollution from May to November. The highest monthly averages of CO (657.5 $\mu g\ L^{-1}$), O_3 (22.3 $\mu g\ L^{-1}$), SO_2 (8.6 $\mu g\ L^{-1}$), $PM_{2.5}$ (28.9 $\mu g\ m^{-3}$), PM_{10} (45.3 $\mu g\ m^{-3}$), and NO_2 (20.4 $\mu g\ L^{-1}$) concentrations in Colombo were recorded during northeast monsoon, and contrasting patterns were observed in Kandy. The lowest monthly averages for ambient pollutant levels in Colombo; CO (566.8 $\mu g\ L^{-1}$), SO_2 (6.0 $\mu g\ L^{-1}$), $PM_{2.5}$ (23.9 $\mu g\ m^{-3}$), and NO_2 (15.6 $\mu g\ L^{-1}$) were recorded in southwest monsoon period. Results from 2020 – 2023 indicated $PM_{2.5}$, PM_{10}, NO_2, SO_2, and O_3 levels were steadily increasing while the CO levels were decreasing in Colombo. These pollutants are below their air quality standards except for fine particles ($PM_{2.5}$), which are above the WHO guidelines (15 $\mu g\ m^{-3}$). Statistical analysis showed that in Colombo, ambient temperature and relative humidity (p = 0.004) turn out to be the most important meteorological parameters affecting air pollutants, while in Kandy, ambient temperature (p = 0.004) and barometric pressure (p = 0.002) have a high effect on ambient air pollutants. The results highlight the importance of meteorological factors in shaping ambient air quality and provide evidence to develop location-specific ambient air pollution control strategies.

Keywords: Air pollution, Meteorological factors, Seasonal trends, Sri Lanka, Urban areas

ICT, Mathematics & Statistics

RESCON 2025 CMS 01

A ROBUST APPROACH TO RECONSTRUCT OCULAR ABERRATIONS FROM MEASUREMENTS WITH NOISE

M.P.D.S. Lakshmi[1]*, S.P.D.S.S.K. Karunarathna[1] and T.M.M. De Silva[2]

[1]*Department of Mathematical Sciences, Wayamba University of Sri Lanka, Kuliyapitiya, Sri Lanka.*
[2]*Department of Mathematics, University of Kelaniya, Kelaniya, Sri Lanka.*
*saroja@wyb.ac.lk

Precise measurement of ocular aberrations is crucial for effective vision corrections, such as laser refractive surgeries and customised contact lenses. In clinical practice, multiple wavefront measurements are taken from each patient to enhance accuracy. However, these repeated measurements introduce significant variability due to pupil size fluctuations, aberrometer misalignments, and accommodation of the eye's optical system. Previous studies have primarily investigated this variability through changes in Zernike coefficients (ZCs). In this study, the variability of ZCs was explored by incorporating measurement noise into the raw local slope data recorded from the Shack-Hartmann aberrometer, rather than focusing solely on output coefficients. Synthetic data representing various eye conditions, including astigmatism, myopia, keratoconus, and keratoplasty were used, with normally distributed random noise $(\mu = 0, \sigma^2 = 1)$ added to simulate real-world measurement variations. Spatial smoothing was applied to the noisy data using Tikhonov regularisation, and optimal smoothing parameter was computed through the generalised cross-validation method to produce a representative wavefront. The results of this study are presented via Signal-to-Noise (S/N) ratios for individual ZCs, comparing the performance of least squares and spatial smoothing approaches. It was observed that spatial smoothing consistently yields significantly lower S/N ratios $(< 2\ dB)$, indicating the high capability to detect noise variability through spatial approach. In contrast, the least square approach yields higher S/N ratios $(> 10\ dB)$, indicating its limited capacity to manage measurement variability. This work offers new insights on taking the effects of measurement variability in ocular wavefront analysis. These findings lead us to conclude that spatial smoothing not only improves the reliability of Zernike coefficients' estimation but also has direct implications for clinical practice, enabling ophthalmologists to make better-informed decisions in customized vision correction procedures including laser refractive surgeries and tailoring contact lens designs. This approach can lead to more accurate diagnoses and better customisation of corrective procedure, ultimately improving patient outcomes in vision care.

Keywords: Signal-to-Noise ratio, Spatial smoothing, Variability, Zernike coefficients

RESCON 2025 CMS 02

COMPARISON OF THE FLOW CHARACTERISTICS OF GOLD AND GRAPHENE NANOPARTICLES IN A STENOSED ARTERY USING OPTIMAL HOMOTOPY ANALYSIS METHOD

A.M.H.I. Attanayake[1]*, **W.H.D.T. Karunarathna**[2] **and M.T.M. Dewasurendra**[1]

[1]*Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Mathematical Sciences, Wayamba University of Sri Lanka, Kuliyapitiya, Sri Lanka.*
*harshikaattanayake@gmail.com

This study examines the flow characteristics of human blood containing gold and graphene nanoparticles through stenosed arteries. The primary objective is to compare the effects of these nanoparticles on the velocity and temperature profiles of blood flow. The governing boundary layer equations, along with suitable boundary conditions that describe the physical phenomena, are transformed into a dimensionless form using similarity transformations. The resulting nonlinear ordinary differential equations are then solved using the Optimal Homotopy Analysis Method (OHAM), a robust analytical technique based on topological concepts, which involves the construction of linear operators, initial approximations, and deformation equations. Numerical simulations are performed using the Mathematica package BVPH 2.0, developed by Liao. In 2021, Sarwar and Hussain analyzed only the flow characteristics of gold blood nanofluid under stenotic artery using MATLAB software numerically. This work is an extension of the above study performed by comparing flow characteristics of human blood with both gold and graphene nanoparticles present separately under stenosed artery. The analysis explores the impact of key physical parameters, including the Prandtl number, nanoparticle volume fraction, and the blood flow parameter. The results demonstrate the convergence of OHAM, producing higher-order approximations with minimal residual errors. These findings offer valuable insights into the thermophysical behavior of nanoparticle-enhanced blood flow and hold significant potential for biomedical applications, particularly in the diagnosis and treatment of atherosclerosis.

Keywords: Gold nanoparticles, Graphene nanoparticles, Optimal Homotopy Analysis Method, Similarity transformations, Stenosed artery

RESCON 2025 CMS 03

INTRODUCING THE METHOD OF DIRECTLY DEFINING THE INVERSE MAPPING (MDDiM) FOR CONVECTION-DIFFUSION EQUATIONS: A NOVEL SEMI-ANALYTICAL METHOD

B.S.K. De Silva[1]* and M.T.M. Dewasurendra[2]

[1]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka.*
*sahankalana95@gmail.com

The main aim of this paper is to introduce a semi-analytical method, known as the Method of Directly Defining the inverse Mapping (MDDiM), for obtaining approximate solutions to the convection-diffusion (CD) equation. This novel method is applied for the first time to convection-diffusion problems. This equation is a parabolic partial differential equation that describes the movement of physical quantities such as heat, particles, or energy within a system, due to the combined effects of convection and diffusion. Traditionally perturbation and asymptotic techniques have been widely used to obtain analytical approximations for nonlinear problems. However, due to the strong nonlinearity, perturbation and asymptotic approximations often fail. The Homotopy Analysis Method (HAM) was introduced by Shijun Liao in 1992 to solve highly nonlinear problems. HAM does not depend on physical parameters and ensures a convergent series solution. Moreover, it provides great flexibility in the selection of base functions, initial guesses, and linear operators. However, it still requires calculating the linear operator to find unknown functions. In scientific computing, a substantial amount of time is required to calculate the inverse operator for the differential equation. To overcome this obstacle, the MDDiM was introduced by Liao in 2016, allowing the inverse linear mapping to be directly selected. Finally, a numerical example is given to illustrate the accuracy and stability of this method. MDDiM is compared with the Optimal Homotopy Analysis Method (OHAM), HAM, and the Homotopy Perturbation Method (HPM). The results show that MDDiM is more accurate than the others. It is shown by the comparison of the approximate and exact solutions that the proposed method is highly effective and computationally efficient.

Keywords: Convection-diffusion equation, Homotopy Analysis Method, Method of Directly Defining Inverse Mapping, Nonlinear partial differential equations, Semi-analytical methods

RESCON 2025 CMS 04

A MODEL CRYPTOGRAPHIC SCHEME BASED ON RADIO ARITHMETIC MEAN LABELING OF EVEN CYCLE GRAPHS

G.H.S.N. Weerasinghe[1]* and A.A.I. Perera[2]

[1]*Department of Physical Science, Rajarata University of Sri Lanka, Mihintale, Sri Lanka.*
[2]*Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka.*
*nethmini1026@gmail.com

Graph labeling is the assignment of integers, typically non-negative, to the vertices or edges of a graph according to specified rules. Such labelings can support applications in areas like communication networks, coding theory, and encryption. Among these, Radio Arithmetic Mean (RAM) labeling extends classical radio labeling by replacing the difference of vertex labels with their average. Formally, it requires: $\lceil([f(u) + f(v)]) / (2)\rceil \geq diam(G) + 1 - d(u, v)$, where $d(u, v)$ is the distance between any two vertices u and v, and $diam(G)$ is the graph diameter. The Radio Mean Number (RMN) of a labeled graph is the largest integer assigned to any vertex under a valid RAM labeling. In this study, a polyalphabetic encryption scheme based on RAM labeling of even cycle graphs was developed, combining with parity checking to determine block order. The plaintext is divided into blocks based on RAM labeling, which creates a structured and unpredictable organization. Within each block, a keyword determines how characters are substituted. A parity rule then decides whether the block is processed in normal or reversed order, adding complexity. Each character is encrypted using the block's parity combined with a column shift taken from the RMN. This approach ensures that even identical characters are encrypted differently, which helps hide patterns in the plaintext. Decryption is straightforward and only requires three shared elements: the labeled graph, the keyword, and the parity string. This framework demonstrates how combinatorial graph structures enhance encryption security and flexibility. Future research may look into other graph families and labeling methods to improve the approach.

Keywords: Cryptography, Decryption, Encryption, Even cycles, Radio Arithmetic Mean Labeling

RESCON 2025 CMS 05

STUDY OF THE BEHAVIOUR OF ANGLE STRUCTURES IN ALEXANDROV SPACES WITH LOWER CURVATURE BOUNDS

T.A.B. Malith* and N.P.W.B.V.K. Senanayake

Department of Mathematics, University of Kelaniya, Kelaniya, Sri Lanka.
*mr.bimsara@gmail.com

Alexandrov spaces with Curvature Bounded Below (CBB) constitute a core category of metric spaces extending the concepts of Riemannian geometry to provide a natural framework for studying comparison geometry, first introduced by A.D. Alexandrov in the 1950s. This study investigated the behaviour of angles formed in such spaces based on the fact that geodesics do not have branch points and aimed to explore and formalise the angular relationships in CBB spaces, which are central to understanding both local and global geometric structures. Firstly, a natural angle between two geodesics of Alexandrov spaces with CBB was defined by a constant k $(Curv(X) \geq k)$. Next, three lemmas were established. They are Lemma on Angle Sub-additivity, Lemma on Angle Linearity, and Lemma on Limit Angle, which depict the properties of angles in these spaces. Specifically, these properties describe how angles behave at geodesic limits, how they satisfy sub-additive inequalities at a point and how they exhibit linearity along geodesics. Together, they contribute to a clearer geometric intuition of angle behaviour in these settings and establish structural constraints valuable in theoretical explorations. The proofs are presented in a structured and accessible manner, making them suitable for readers with diverse mathematical backgrounds.

Keywords: Alexandrov spaces, Angle behaviour, Curvature Bounded Below, Geodesics

RESCON 2025 CMS 06

TWO TYPES OF BI-FUZZY OPEN SETS IN BI-FUZZY TOPOLOGICAL SPACES AND THEIR PROPERTIES

M. Arunmaran* and P. Piriyalucksan

Department of Mathematics and Statistics, University of Jaffna, Jaffna, Sri Lanka.
*marunmaran03@gmail.com

The idea of fuzzy topological spaces was initially proposed by Chang in 1968, inspired by Zadeh's discovery of fuzzy sets. In his work, the fundamental concepts of classical topology were examined to create a new theory of fuzzy topology integrating fuzzy sets. More recently, the notion of bi-fuzzy topological spaces has emerged. This study aimed to explore two novel types of open sets within bi-fuzzy topological spaces, namely, bi-fuzzy (m,n)-α_n-open sets and bi-fuzzy (m,n)-β_n-open, and elucidate some properties associated with these open sets. For a non-empty set X, a fuzzy topology is a family τ of fuzzy subsets in X satisfying the following conditions: 0_X , $1_X \in \tau$; finite intersection of members of τ is a member of τ; and the arbitrary union of members of τ is a member of τ. The pair (X,τ) is called a fuzzy topological space. Also, the elements of τ are called fuzzy open sets. Moreover, we call the triple (X,τ_m,τ_n) as the bi-fuzzy topological space, where τ_m and τ_n are two fuzzy topologies defined in a non-empty set X. Let (X,τ_m,τ_n) be a bi-fuzzy topological space, and A be a fuzzy set. Then the set A is called bi-fuzzy open if $A \in \tau_m \cap \tau_n$; bi-fuzzy-(m,n)-preopen, if $A \leq int_m\big(cl_n(A)\big)$; bi-fuzzy-$(m,n)$-semi-open, if $A \leq cl_m\big(int_n(A)\big)$; bi-fuzzy-$(m,n)$-$\alpha_n$-open, if $A \leq int_n(cl_m(int_n(A)))$; bi-fuzzy-$(m,n)$-$\beta_n$-open, if $A \leq cl_n(int_m(cl_n(A)))$. In this study, firstly, it was demonstrated that a bi-fuzzy-(m,n)-α_n-open set is distinct from a bi-fuzzy-(m,n)-α_m-open set. Subsequently, we established that the union of two bi-fuzzy-(m,n)-α_n-open sets is a bi-fuzzy-(m,n)-α_n-open set. However, the intersection of two bi-fuzzy-(m,n)-α_n-open sets does not yield a bi-fuzzy-(m,n)-α_n-open set. Furthermore, we illustrated that every bi-fuzzy open set is a bi-fuzzy-(m,n)-α_n-open. Also, every bi-fuzzy-(m,n)-α_n-open set is bi-fuzzy-(m,n)-semi-open. However, the converse of these results is not true. Next, we showed that the union of two bi-fuzzy-(m,n)-β_n-open sets is a bi-fuzzy-(m,n)-β_n-open set. However, the intersection of two bi-fuzzy-(m,n)-β_n-open sets need not be a bi-fuzzy-(m,n)-β_n-open set. It is established that every bi-fuzzy open set is a bi-fuzzy-(m,n)-β_n-open. Finally, we showed that every bi-fuzzy-(m,n)-preopen set is bi-fuzzy-(m,n)-β_n-open. In this study, within a bi-fuzzy topological framework, two new types of open sets were introduced, namely bi-fuzzy-(m,n)-$\alpha_n$open set and bi-fuzzy-(m,n)-β_n-open sets. Also, the relationships between the union and intersection of these fuzzy sets were explained. Moreover, the connections between these two sets and the following categories were explored: bi-fuzzy-(m,n)-preopen sets, bi-fuzzy-(m,n)-semi-open sets and bi-fuzzy open sets.

Keywords: Bi-fuzzy (m,n)-α_n-open sets, Bi-fuzzy (m,n)-β_n-open sets, Bi-fuzzy (m,n)-preopen sets, Bi-fuzzy (m,n)-semi-open sets, Bi-fuzzy topological spaces

RESCON 2025 CMS 07

JACOBI ELLIPTIC FUNCTIONS FROM THE PERSPECTIVE OF QUADRATIC DIFFERENTIALS

P.G.P. Kumara[1,2]*and K.M.N.M. Chathuranga[2]

[1]*Department of Computing & Information Systems, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka.*
[2]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
*prasad@foc.sab.ac.lk

Trigonometric functions are defined using the circle and are periodic with a single period along the real line. When the circle is replaced with an ellipse, a new class of functions can be introduced. By extending the independent variable to complex numbers, doubly periodic functions known as elliptic functions can be obtained. These have two distinct periods and are defined on the complex plane. Due to their doubly periodic nature, elliptic functions repeat their values over a fundamental parallelogram. In other words, their domain can be considered as a torus. Jacobi's elliptic functions $pq(u, m)$ are a generalisation related to ellipses. When the parameter m is 0 or 1, the functions reduce to non-elliptic forms. Although several types of elliptic functions have been comprehensively investigated, there has been a notable absence of studies on the quadratic differentials of elliptic functions. A quadratic differential refers to a meromorphic differential form of degree two defined on a Riemann surface, and they play a significant role in visualising geometric aspects of meromorphic functions. Geometrically, a quadratic differential induces a field of trajectories on its domain, whose behavior provides insight into the location and nature of the zeros and poles of the associated meromorphic function. This study examines the trajectory structure of Jacobi elliptic sn function within their fundamental rectangle and on the torus, using Python for visualisation. In this study, we discuss the quadratic differential form of autonomous systems and verify that the Phase Portrait of solutions to an autonomous system with two variables coincides with the trajectory structure of the corresponding quadratic differential. Finally, we represent the Jacobi sn function as an autonomous system with two variables and confirm that the trajectory structure of solutions to these autonomous systems aligns with the trajectory structure of the Jacobi sn function, along with its respective fundamental parallelogram.

Keywords: Autonomous Systems, Jacobi Elliptic Functions, Meromorphic Differential, Quadratic Differentials, Trajectory structure

RESCON 2025 CMS 08

BI-LEVEL LINEAR PROGRAMMING MODEL FOR UDAWALAWE WATER RESERVOIR MANAGEMENT

R.A.K.T. Madusha* and D.M. Samarathunga

Department of Mathematics, University of Ruhuna, Matara, Sri Lanka.
*tharakak772@gmail.com

Bi-level programming is an effective mathematical framework to address hierarchical decision making problems commonly encountered in real-world applications. This study develops a bi-level linear programming model to optimise the management of the Udawalawe water reservoir system, which plays a crucial role in ensuring reliable water supply for agriculture. No previous studies have addressed bi-level programming model for Udawalawa water reservoir management in Sri Lanka. Hence this study fills an important research gap. The model captures the interaction between two levels of decision makers: central authority and agricultural users (farmers). At the upper level, the water management authority or government aims to determine the optimal schedule for monthly water releases and reservoir storage over a one-year planning horizon. These decisions are made with the objective of managing limited water resources efficiently while meeting agricultural demands. At the lower level, farmers respond to the water release policies by deciding the area to cultivate for different types of crops, purposing to maximize their profit. These decisions are subject to constraints related to water availability in each month, crop-specific water requirements and yield targets. To solve this hierarchical model, the bi-level problem is reformulated into a single level optimisation problem using the Karush-Kuhn-Tucker (KKT) conditions, allowing for the use of conventional non-linear programming solvers. Real-world data, including inflow rates of the Udawalawe reservoir, crop water requirements, and economic parameters are used to validate the model. Data were sourced from the Mahaweli Authority. The results provide an optimal monthly water release strategy and a land allocation plan for crop cultivation that satisfies both upper and lower-level objectives. This research highlights the potential of bi-level optimisation techniques in water resource planning. The proposed model offers a systematic and computationally efficient approach that supports better coordination between government and farmers. It enables improved reservoir operation, increased water use efficiency and enhanced agricultural productivity under limited resource conditions.

Keywords: Bi-level programming, Karush-Kuhn-Tucker (KKT) condition, Optimisation, Single-level reformulation, Water reservoir management

RESCON 2025 CMS 09

APPLYING THE MODIFIED FIREFLY ALGORITHM TO SOLVE THE SINGLE-STAGE FIXED CHARGE TRANSPORTATION PROBLEM

E.M.D.B Ekanayake[1]* and W.N.P. Rodrigo[2]

[1]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka.*
*dananjayaekanayake96@gmail.com

Transportation problems are a fundamental class of optimization problems in operational research, aimed at determining the most cost-effective way to distribute goods from multiple sources to multiple destinations. These problems are widely applied in supply chain management, logistics, and distribution planning. Among the various types of transportation problems, this research investigated the Fixed Charge Transportation Problem (FCTP) focusing on single-stage FCTP where goods are transported directly from production to consumers without intermediate stages or redistribution centers. The primary considerations are determining which transportation routes to use and how much to ship across them while minimizing the total cost, which consists of both fixed and variable components. In this study, a Modified Firefly Algorithm (MFA) is proposed to address this challenge. Because it has less complexity and is easy to understand, it can also be used for discrete optimisation problems like transportation problems. The standard FA, inspired by the flashing behavior of fireflies, was improved in this study through several problem-specific modifications. The algorithm incorporated adaptive motion rules, refined attraction calculations based on cost functions, and constraint-handling mechanisms to ensure feasibility. The algorithm was implemented in Python and tested on a series of small- to medium-scale problem instances. The accuracy of this algorithm was discussed by comparing the results obtained with other existing heuristic methods. This method has achieved better or equal results compared to existing methods when applied to small- and medium-scale problems. It has also demonstrated efficiency in terms of convergence speed, obtaining accurate results within ten iterations and obtaining accurate results in minimal time. Also, the repeated trials with different numerical examples showed consistent results for the robustness of the algorithm. Accordingly, the modified FA model has shown success for small- and medium-scale numerical problems. It provides not only high-quality solutions but also a flexible basis for future improvements aimed at solving large-scale and multi-stage fixed charge transport problems.

Keywords: Firefly algorithm, Heuristic methods, Near optimum solution, Optimisation, Single-stage fixed charge transportation problem

RESCON 2025 CMS 10

COOPERATIVE HUNTING AND PREY REFUGE IN THE DYNAMICS OF PREDATOR-PREY INTERACTION

W.L.D.P. Tharushika* and T.M.M. De Silva

Department of Mathematics, University of Kelaniya, Kelaniya, Sri Lanka.
*parami9978tharush@gmail.com

Prey refuge and predator cooperation play pivotal roles in shaping predator-prey interactions. In this study, a discrete-time predator-prey model based on Ricker-type dynamics was developed, integrating cooperative hunting behaviour among predators and incorporating the prey refuge effect. Their effects on stability, persistence, and long-term dynamics were analysed. A detailed mathematical analysis identifies fixed points and assesses their stability using Jacobian matrices. To examine the transition to oscillatory dynamics, Neimark-Sacker bifurcation conditions are derived analytically. The analytical findings are subsequently validated through numerical simulations conducted under varying levels of prey refuge and predator cooperation. Ecologically, this bifurcation corresponds to the onset of quasiperiodic oscillations in population densities, reflecting recurrent fluctuations in the abundance of both predators and prey. The results show that the system stabilises at a positive equilibrium in the absence of prey refuge and predator cooperation. In contrast, low prey refuge combined with slight cooperation causes destabilisation and oscillation. Under high refuge conditions, predator persistence requires both strong cooperation and high conversion efficiency. Quantitatively, it is found that, when prey growth is sufficiently large, a predator-free equilibrium emerges and remains stable if the effective predation rate is below a critical threshold. These findings provide novel insight that cooperative hunting can counteract the destabilising effects of prey refuge. They also reveal a threshold mechanism that determines the persistence of predators and ecological balance. This study contributes to the theoretical understanding of predator-prey interaction and provides theoretical insights relevant to biodiversity conservation and the management of predator-prey ecosystems.

Keywords: Discrete-time predator-prey system, Neimark-Sacker bifurcation, Predator cooperation, Prey refuge, Ricker model

RESCON 2025 CMS 11

SYMBOLIC AND ALGORITHMIC INSIGHTS INTO RAINBOW VERTEX ANTIMAGIC COLORING OF WHEEL GRAPHS

D.M.N.U.B. Dasanayake*, **P.G.R.S. Ranasinghe and A.A.I. Perera**

Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka.
*nimeshikabandaradasanayake@gmail.com

This study investigates the Rainbow Vertex Antimagic Coloring (RVAC) - a hybrid of antimagic labeling and vertex coloring of wheel graphs W_n using a combination of symbolic formulas and algorithmic computation. In RVAC, edges are uniquely labeled so that each vertex's color, given by the sum of its incident edges, is distinct while minimising the total number of colors. Formally, for a simple, connected, undirected graph $G = (V, E)$ with a labeling function $f: E(G) \to \{1,2, \dots, |\, E(G)\, |\}$, the weight of a vertex $v \in V(G)$ is defined as $w_f(v) = \sum_{e \in E(V)} f(e)$, where $E(v)$ is the set of edges incident to v. The function f is a vertex antimagic edge labeling if all vertex weights are distinct. A rainbow path is a path whose internal vertices have distinct weights, and the rainbow vertex antimagic connection number $rvac(G)$ is the minimum number of colors needed so that every pair of vertices is connected by a rainbow path. Unlike traditional antimagic labeling or rainbow connections, RVAC explicitly integrates both vertex color distinctness and edge-sum constraints. For wheel graphs W_n, it has been observed that that $rvac(Wn) = 3$ when n is odd and $rvac(Wn) = 2$ when n is even. During analysis, counterexamples arose when applying direct edge labeling, highlighting the limitations of this approach. To address this, a general parity-aware labeling scheme was developed that systematically assigns vertex weights and determines the RVAC directly from these weights, eliminating the need for explicit edge enumeration. A Python-based implementation automates graph construction, applies the labeling formulas, verifies RVAC conditions, and generates visual representations, enabling efficient validation for large n (up to 10^4). This symbolic–algorithmic approach offers a scalable framework for studying RVAC in wheel graphs and other graph families, demonstrating the integration of theoretical reasoning with algorithmic automation for broader mathematical and applied use, with applications in combinatorics, cryptography, and network security.

Financial assistance from Postgraduate Institute of Science, University of Peradeniya (Grant No. PGIS/2024/07) is acknowledged.

Keywords: Computational verification, Graph Labeling, Python algorithm, Rainbow Vertex Antimagic Coloring, Wheel graphs

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A SYMMETRIC CRYPTOGRAPHIC SCHEME USING GRACEFUL LABELING OF ALKANE GRAPHS

S.N.B.M.C.M. Nawarathna*, **D.M.N.U.B. Dasanayake, P.G.R.S. Ranasinghe and A.A.I. Perera**

Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka.
*chathurika.nawarathna@sci.pdn.ac.lk

Cryptography is the study and application of techniques for securing information. Cryptosystems are broadly classified as symmetric, which use the same key for both encryption and decryption, and asymmetric, which use a public-private key pair. The scheme used in this study is based on symmetric ciphers, in which a secret key is exchanged between the sender and the receiver for the encoding and decoding to take place. This proposed scheme is based on the graceful labeling of alkane graphs which are acyclic (tree-like) graphs derived from the chemical structure of saturated hydrocarbons (C_nH_{2n+2}). A graceful labeling assigns distinct integers to vertices so that each edge is labeled by the absolute difference of the numbers on its endpoints, with all edge labels required to be unique. This inherent uniqueness forms the foundation of the cryptosystem. In our scheme, we define a labeling function with parameters tied to the graph structure and then reduce all labels modulo 31 to ensure a consistent and balanced correspondence between vertices and edges. Then map them into a character set comprising the English lowercase alphabet and a few punctuation symbols. The encryption involves dividing the plaintext into four-character blocks, padding with underscores if necessary. Each character in a block is substituted using a column-based shifting mechanism derived from the labeled graph. The decryption inverts this mapping using the same graph structure and parameters, ensuring accurate recovery of the original message. The scheme successfully produced non-repetitive substitution patterns during testing, enabling accurate encryption and decryption and making it a practical option for securing information.

Keywords: Alkane graphs, Cryptography, Graceful labeling, Modulo encoding, Symmetric cipher

RESCON 2025 CMS 13

INVARIANCE OF COARSE Z-SETS UNDER COARSE EMBEDDINGS

P.D.D.A. Chandralal* and A.K. Amarasinghe

Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka.
*dinushaakalanka330@gmail.com

The Z-sets, as subsets of the Hilbert cube Q, are a central concept in infinite-dimensional topology. In this study, we extend the notion of Z-sets from infinite-dimensional topology to large-scale geometry, introducing the concept of Coarse Z-sets. A closed subset $A \subseteq \mathrm{X}$ is called a Z-set of X if for every open cover U of X and every function $f \in C(Q, X)$ there exists a function $g \in C(Q, X \setminus A)$ such that f and g are U-close. We define Coarse Z-sets by analysing the classical definition of Z-sets and examining their behavior under arbitrarily small maps from X into $X \setminus A$, but now in a global, coarse geometric context. Specifically, a subset $A \subseteq \mathrm{X}$ is called Coarse Z-set if there exists a function from X into $X \setminus A$ that is "close" to the identity map in the sense of large-scale geometry. In the current work, we aim to redefine the Coarse Z-sets by using an analog of the Hilbert cube within large-scale geometry. We propose the Banach space l_∞ as the analogue version of the Hilbert cube within large-scale geometry. While investigating this idea, we show that Coarse Z-sets are invariant under coarse embeddings, if X coarsely embeds into Y, then the image of a Coarse Z-set of X under the embedding is a Coarse Z-set of Y. Consequently, the Coarse Z-set of Y can be identified once the Coarse Z-set of X is known. As a result, this demonstrates the connection between Coarse Z-set of a separable space and l_∞ since any separable space X can be coarsely embedded into the Banach space l_∞. Thus, each Coarse Z-set of a separable space X can be mapped into l_∞ due to the universality of l_∞ for separable spaces.

Keywords: Coarse embedding, Hilbert cube, Infinite-dimensional topology, Large-scale geometry, Z-sets

RESCON 2025 CMS 14

MATRIX REPRESENTATION OF DISTINGUISHED VARIETIES ON SYMMETRISED BIDISC

S. Perera* and U.D. Wijesooriya

Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka.
*S19475@sci.pdn.ac.lk

The symmetrisation map $\Pi(z, w) \to (z + w, zw)$ is the map given by $\Pi(z, w) \to (z + w, zw)$ and the symmetrised bidisc, $\mathbb{G}$ is given by $\Pi(\mathbb{D}^2)$, where $\mathbb{D}$ is the open unit disc in $\mathbb{C}$. A non empty set $W \subseteq \mathbb{C}^2$ is called a Distinguished Variety on $\mathbb{G}$ if there exists a polynomial $q(s, p) \in \mathbb{C}[s, p]$ such that $W = \{(s, p) \in \mathbb{G}: q(s, p) = 0\}$ and $Z(q) \subseteq \mathbb{G} \cup b\mathbb{T} \cup \Omega$ where $b\Gamma$ is the image of $\mathbb{T}$ under Π and Ω is the image of $\mathbb{E}$ under Π. It was proven that, any Distinguished Variety on $\mathbb{G}$ can be represented via a square matrix with numerical radius $(\omega(A))$ less than 1. Conversely, given a Distinguished Variety on $\mathbb{G}$ there exists a square matrix A with $\omega(A) \leq 1$ such that $W = \{(s, p) \in \mathbb{G}: \det(A + pA^* - sI) = 0\}$. In this work, we prove that if A_k is a square matrix representing the Distinguished Variety W_k on $\mathbb{G}$ for $k = 1, \dots., n$ then, $\bigoplus_{k=1}^{n} A_k$ represents the Distinguished Variety $W = \bigcup_{k=1}^{n} W_k$ on $\mathbb{G}$. This result would allow us to generate examples for matrices representing Distinguished Varieties on $\mathbb{G}$, specially for reducible Distinguished Varieties, by taking direct sums of the matrices representing its irreducible components.

Keywords: Distinguished variety, Numerical radius, Symmetrised bidisc

RESCON 2025 CMS 15

POLYNOMIALS DEFINING DISTINGUISHED VARIETIES IN A GENERALISED VERSION OF SYMMETRISED BIDISC

J.A.T.D. Jayasingha* **and U.D. Wijesooriya**

Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka.
*s19396@sci.pdn.ac.lk

In this study, we explored the characterisation of algebraic curves known as distinguished varieties that exhibit special boundary behavior of exiting the symmetrised bidisc exclusively through its distinguished boundary. Let $\mathbb{D}$ be the open unit disc, $\mathbb{T}$ be the unit circle, and $\mathbb{E}$ be the $\mathbb{C}\backslash\overline{\mathbb{D}}$ in $\mathbb{C}$. Let $\mathbb{D}^2 = \mathbb{D} \times \mathbb{D}$ be the unit bidisc in $\mathbb{C}^2$. For a polynomial $p(z,w) \in \mathbb{C}[z,w]$ such that its zero set $Z(p) \subseteq \mathbb{D}^2 \cup \mathbb{T}^2 \cup \mathbb{E}^2$, $Z(p) \cap \mathbb{D}^2$ is a distinguished variety in $\mathbb{D}^2$. Let the symmetrisation map $\pi: \mathbb{C}^2 \to \mathbb{C}^2$ be defined by $\pi(z,w) = (z+w, zw)$, and define the symmetrised bidisc $\mathbb{G} = \pi(\mathbb{D}^2)$, the distinguished boundary of $\mathbb{G}$ be $b\Gamma = \pi(\mathbb{T}^2)$, and the exterior of $\mathbb{G}$ be $\Omega = \pi(\mathbb{E}^2)$. For a polynomial $q(s,p) \in \mathbb{C}[s,p]$ such that its zero set $Z(q) \subseteq \mathbb{G} \cup b\Gamma \cup \Omega$, the set $Z(q) \cap \mathbb{G}$ is a distinguished variety in $\mathbb{G}$. It is proven that $W \subset \mathbb{G}$ is a distinguished variety in $\mathbb{G}$ if and only if there exists a distinguished variety V in $\mathbb{D}^2$ such that $W = \pi(V)$. In this study, we partially generalised this result by considering a generalised version of symmetrised bidisc. Considering the map $\tilde{\pi}: \mathbb{C}^2 \to \mathbb{C}^2$ given by $\tilde{\pi}(z,w) = (z+w, z^2+w^2)$, let $\widetilde{\mathbb{G}} = \tilde{\pi}(\mathbb{D}^2)$. By defining a distinguished variety in $\widetilde{\mathbb{G}}$ in a similar fashion, we proved that $\widetilde{W} \subset \widetilde{\mathbb{G}}$ is a distinguished variety in $\widetilde{\mathbb{G}}$ if and only if there exists a distinguished variety V in $\mathbb{D}^2$ such that $\widetilde{W} = \tilde{\pi}(V)$.

Keywords: Distinguished variety, Inner toral polynomials, Symmetrisation map, Symmetrised bidisc

RESCON 2025 CMS 16

USE OF TRIANGULAR DISTRIBUTION AND ANT COLONY OPTIMISATION IN SOLVING MULTI-OBJECTIVE ASSIGNMENT PROBLEMS UNDER UNCERTAINTY

C.P.S. Pathirana[1]* and W.B. Daundasekara[2]

[1]*Department of Mathematics & Philosophy of Engineeing, The Open University of Sri Lanka, Nugegoda, Sri Lanka.*
[2]*Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka.*
*cppat@ou.ac.lk

This study investigates the use of Triangular Distribution (TD) and Ant Colony Optimization Algorithm (ACOA) in solving Multi-Objective Assignment Problems (MOAP) under uncertainty. ACOA is one of the most prominent biologically inspired algorithms to solve optimization problems. Multi - Objective Ant Colony Optimization Algorithm (MOACOA), which is based on the ACOA, is a probabilistic approach for finding the optimal path of the MOAP. In many real-world problems, Assignment Cost (AC) is not deterministic. In fact, it can be observed that AC behaves in an unpredictable manner. Also, depending on the application, AC may not be estimated precisely due to insufficient information related to the application. This study assumes that an AC follows a TD, where AC fluctuates between two estimated values known as optimistic and pessimistic values in a probabilistic manner, where most probable value lies in between. The Monte Carlo simulation technique is used to determine the expected AC. Subsequently, the uncertain assignment problem is reformulated as a deterministic model. The deterministic model is solved separately for each objective using ACOA and subsequently, the positive ideal solution and the negative ideal solution are obtained. In MOAP, a fuzzy exponential membership function (FEMF) is obtained for each objective, according to the different aspiration levels of the decision maker (DM). Then, the FEMF is obtained for each objective and the sum of the FEMF values for each path is determined. This study finds that the change in the shape parameter of the FEMF influences the level of satisfaction for each objective function, and it also finds that all the obtained solutions are reliable with the preference of the DM. If the DM is not satisfied with a specific assignment, alternative assignments can be generated by changing the values of the shape parameter in FEMF as well as by adjusting the aspiration level. The ACOA and TD approaches provide solutions to the MOAP using FEMF under various choices of shape parameters and their corresponding alternative assignments. The findings also describe how different shape parameters affect the objectives and influence convergence to the optimal solution. This in-depth analysis concludes that the proposed technique yields the optimal assignment in accordance with the DM's aspirations.

Keywords: Ant colony optimization algorithm, Assignment problem, Monte Carlo simulation, Triangular distribution, Uncertainty

RESCON 2025 CMS 17

IMPLEMENTATION OF NON-PHARMACEUTICAL INTERVENTIONS TO MINIMISE THE INFECTION DURING THE OUTBREAK OF COVID-19 EPIDEMIC IN SRI LANKA

P. Paramadevan[1]* **and W.B. Daundasekara**[2]

[1]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka.*
*paramadevanp@esn.ac.lk

By accounting for Sri Lanka's limited healthcare resources and economic production in the absence of a vaccine, this study aims to manage an epidemic outbreak while balancing its sanitary and economic effects. The World Health Organization (WHO) proposed to implement certain Non-Pharmaceutical Intervensions (NPIs) to mitigate and investigate the dynamics of the spread of COVID-19. Accordingly, successful use of NPIs, including public health campaigns, washing hands with sanitizers, social distancing, travel bans, public gathering bans, quarantine regulations, and complete lockdowns were enforced to suppress the outbreak in Sri Lanka. In addition to being economically costly, lockdowns cause political instability, societal weariness, and annoyance. NPIs' stringency has, on one hand, reduced the spread of COVID-19, but on the other, it has had a negative impact on both the public and private sectors, which has slowed economic growth and had a significant negative influence on people's mental health. We thoroughly examined the Sri Lankan scenario and proposed an optimisation model that empowers the nation's policymakers to ascertain the severity budget that the nation can afford to reduce the spread of infection. Given the limited health care resources in the nation, this study aims to reduce the number of infections within the several budgetary possibilities. A Mixed Integer Non-Linear Programming epidemic model is developed to determine the optimal sequence of NPIs for each of the 25 districts over varying planning horizon. By linearising quadratic constraints, this Mixed Integer Non-Linear Programming model was later transformed into a Mixed Integer Linear Programming model. Consequently, this Mixed Integer Linear Programming model is transformed into an Integer Linear Programming model by utilising the Decreasing Severity Property of the NPI sequence. For each of the 25 districts, three plans-Plan A, Plan B, and Plan C are taken into consideration. Plan A has no lockdown limitations; however, the total number of lockdown weeks in plan B and consecutive weeks of lockdown in plan C are restricted, and by changing the budget and planning time horizon, the infection levels were obtained. The non-zero binary decision variables in the objective function are identified by solving the developed Mixed Integer Linear Programming model in IBM ILOG Optimisation Studio using the Branch-and-Cut algorithm. The results are analysed and hence determined which NPI sequence should implement for which district during the planning horizon to minimise the infection. Furthermore, the infected number obtained in Plan B is incompatible with the official statistics of the Sri Lankan government.

Keywords: COVID-19, IBM ILOG Optimisation Studio, Mixed Integer Linear Programming, Non-pharmaceutical interventions

RESCON 2025 CMS 18

STUDY OF IMMISCIBLE VISCOUS FINGERING IN POROUS MEDIA USING COMSOL MULTIPHYSICS

M.F. Muhammedh[1], C.W. Sahabandu [2]* and M.T.M. Dewasurendra[1]

[1]*Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Mathematics, The Open University of Sri Lanka, Nugegoda, Sri Lanka.*
*cwsah@ou.ac.lk

This study presents a computational investigation of immiscible viscous fingering in a two-dimensional homogeneous porous medium using COMSOL Multiphysics 5.5. The phenomenon was modeled by injecting a low-viscosity fluid (water-glycerin mixture) into a high-viscosity fluid (crude oil), leading to hydrodynamic instability known as viscous fingering at the fluid interface due to the viscosity contrast between the two fluids. The simulation framework was developed using Darcy's law to describe flow in porous media, coupled with a phase-field method to capture the immiscible fluid interface of the water-glycerin mixture displaces oil in a homogeneous porous medium. The results revealed the dynamic evolution of these structures and provide insight into displacement efficiency and interface morphology in immiscible fluid systems within porous media. The difference in how the water-glycerin mixture and oil move through the medium was characterised by their mobilities, and this difference was described by the log mobility ratio. In this scenario, the water-glycerin mixture flows more easily than the oil, which quantifies how easily one fluid moves in relation to the other. Influence of the variation of the speed of the water-glycerin mixture on the shape and growth of the fingers were also studied. Understanding these effects helps to improve processes such as enhanced oil recovery, where injecting fluid to push out oil is common.

Keywords: COMSOL Multiphysics, Darcy's law, Immiscible viscous fingering, Log mobility ratio, Porous media

RESCON 2025 CMS 19

HOPF ALGEBRA OF LABLED SIMPLE GRAPHS, PERMUTATIONS AND POSETS WITH HOMOMORPHISMS AMONG THOSE

S.M.R.N. Mudalige* and K.M.N.M. Chathuranga

Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka.
*rashinim1999@gmail.com

A Hopf algebra is a compatible bialgebra equipped with an additional map called the antipode map. This study explored the Hopf algebra structures on three fundamental combinatorial objects: Labeled simple graphs ($\mathbb{H}$), Permutations ($\mathbb{S}$), and Posets ($\mathbb{P}$). The main objective was to study three particular Hopf algebra homomorphisms $f: \mathbb{S} \to \mathbb{P}$, $g: \mathbb{S} \to \mathbb{H}$, and $h: \mathbb{P} \to \mathbb{H}$. It is shown that only subsets of labeled simple graphs (those with more than one vertex and at least one edge, as well as the empty graph) and posets arise under these homomorphisms. The composition homomorphism of f and h denoted by $hf: \mathbb{S} \to \mathbb{H}$, behave differently from g. The set of all permutations in ascending order, along with the empty permutation, forms the kernel of *hf*. Similarly, the totally ordered posets and the empty poset constitute the kernel of h. This study contributes to the field by providing insights into how homomorphisms preserve or distort the three combinatorial Hopf algebra structures. The findings not only enhance the understanding of Hopf algebras in combinatorics, but also lay the groundwork for further research in applications in algebraic combinatorics. Future work will focus on developing explicit formulas for the antipodes deepening the understanding of combinatorial structures within the combinatorial Hopf algebraic framework.

Keywords: Combinatorial Hopf algebra, Hopf algebra homomorphisms, Labeled simple graphs, Permutations, Posets

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TOWARDS AN ALGEBRA OF HYPERMATRICES: A HYPERMATRIX REPRESENTATION FOR MULTILINEAR MAPS

S.S.M.A.C. Senevirathne[1]*, A.M.C.U.M. Athapattu[2] and K.M.N.M. Chathuranga[2]

[1]*Department of Mathematics & Statistics, Sri Lanaka Institute of Information Technology, Malabe, Sri Lanka.*
[2]*Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka.*
*aruni.se@sliit.lk

Matrix theory offers a complete and well-understood framework in which linear transformations are represented by matrices, with composition realised through matrix multiplication. However, no such canonical multiplication exists for hypermatrices that extends this structure to the multilinear setting, primarily due to the failure of multilinear maps to be closed under composition. To address this gap partially, the present work introduces a novel multiplication between two hypermatrices with a particular compatibility. The present work establishes a bijective correspondence (modulo choice of ordered bases for each vector space) between multilinear maps $\boldsymbol{f} : \boldsymbol{V_1} \times \boldsymbol{V_2} \times \cdots \times \boldsymbol{V_n} \to \boldsymbol{V_0}$ and hypermatrices $\boldsymbol{\mathcal{A}}$, by developing a multiplication operation between $\boldsymbol{\mathcal{A}}$ and a hypermatrix derived from $\boldsymbol{V_1} \times \boldsymbol{V_2} \times \ldots \times \boldsymbol{V_n}$. Since multilinear maps, in general are not composable, the multiplication introduced does not extend to a general multiplication of hypermatrices. This study provides both explicit computational procedures and theoretical proofs. Beyond partially extending matrix algebra to the multilinear case, this result offers new insights into the structural relationship between hypermatrices and multilinear operators. Moreover, the proposed multiplication has the potential of serving as a foundational operation for a coherent algebraic theory of hypermatrices, analogous in structure and purpose to classical matrix algebra.

Keywords: Canonical multiplication, Hypermatrices, Linear transformation, Multilinear algebra

RESCON 2025 CMS 21

A VARIANT OF RIVEST-SHAMIR-ADLEMAN (RSA) CRYPTOSYSTEM USING GENERALISED CONTINUED FRACTIONS AND CHINESE REMAINDER THEOREM

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

Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka.
*s19434@sci.pdn.ac.lk

Cryptography is essential for securing digital communication by ensuring confidentiality, integrity, and authenticity. Among public-key cryptosystems, Rivest-Shamir-Adleman (RSA) is one of the most widely used. In this study, we present an improved version of RSA by introducing Generalised Continued Fractions (GCF) for constructing encryption exponents and applying the Chinese Remainder Theorem (CRT) with Garner's algorithm for efficient decryption. The main novelty of this work lies in the use of GCF to generate the public exponent. This approach enables the selection of large and irregular exponents that reduce the risk of common weaknesses, such as low-exponent or structured-exponent attacks. While predictable patterns could raise concerns in key generation, their impact is negligible when the exponents produced are sufficiently large and flexible, because security in RSA depends primarily on the hardness of factoring the modulus. To complement this, CRT and Garner's algorithm, which are already established as standard techniques for improving RSA performance, are incorporated to minimise the computational cost of modular exponentiation during decryption. Their role here is to enhance efficiency, while the real contribution is the introduction of GCF for exponent construction. By combining secure exponent design with proven optimisation techniques, the proposed scheme improves decryption performance without reducing cryptographic strength. This research therefore contributes a practical approach that balances efficiency and security. It is especially suitable for lightweight cryptographic applications and secure digital communications, where both computational speed and robust security are essential.

Keywords: Chinese Reminder Theorem, Cryptography, Garner's algorithm, Generalised continued fractions

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M-POLYNOMIAL ANALYSIS OF DEGREE-BASED TOPOLOGICAL INDICES IN GONORRHEA DRUG MOLECULES

M.G.N. Lakshani[1]*, G.J. Lanel[1] and D.C. Gunawardhana[1,2]

[1]*Department of Mathematics, University of Sri Jayewardenepura, Nugegoda, Sri Lanka.*
[2]*Department of Mathematical Sciences, South Eastern University of Sri Lanka, Oluvil, Sri Lanka.*
*gayaninavodya12@gmail.com

Mathematical Chemistry is a fascinating field that blends mathematics and chemistry. Topological indices are numerical descriptors derived from molecular structures using a molecular graph. It describes the molecular structure in which the atoms and bonds are treated as vertices and edges, respectively, and all multiple bonds were treated as multi-edges, and all hydrogen atoms were included in the molecular graph. This is an enhanced method that has been newly incorporated in this study when computing topological indices to reduce assumptions of traditional computing techniques using molecular graphs of compounds. This method gives more reliable results when analysing drugs for diseases using degree-based numerical descriptors. Gonorrhea is a sexually transmitted disease, known as venereal disease, caused by the bacterium *Neisseria gonorrhoeae*, which is estimated at 82.4 million new cases among adults aged 15 – 49 worldwide. In this study, structures of important drugs, including Ceftriaxone, Cefixime, Cefotaxime, Probenecid, Spectinomycin, Cefpodoxime, Ciprofloxacin and Ofloxacin, used to treat gonorrhea were investigated. The objective of this study was to compute degree-based topological indices for the selected drugs for the disease using a polynomial approach. *M*-polynomial is a generalised algebraic polynomial used to derive degree-based topological indices, and this polynomial approach provides closed forms for topological indices formulae, which help further studies. In this research, the first, second, and third Zagreb indices, the forgotten index, the hyper Zagreb index, the atom-bond connectivity index, the product connectivity index, the sum connectivity index, the harmonic index, and the geometric-arithmetic index were selected for the computations using the suggested enhanced method. The highest values of indices reflect greater branching on the molecular structure. These findings assist in designing novel drugs for the treatment of analysing the physicochemical and the biological properties of drugs using the quantitative structure-property relationship (QSPR) and quantitative structure-activity relationship (QSAR) studies.

Keywords: Gonorrhea, Mathematical Chemistry, *M*-polynomial, Topological indices

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GENERALISED LARS FRAMEWORK FOR VARIABLE SELECTION IN HIGH-DIMENSIONAL BINARY CLASSIFICATION

T. Kayathiri[1]*, M. Kayanan[2] and P. Wijekoon[3]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.
[2]Department of Physical Science, University of Vavuniya, Vavuniya, Sri Lanka.
[3]Department of Statistics and Computer Science, University of Peradeniya, Peradeniya, Sri Lanka.
*skayathiri1994@gmail.com

High-dimensional logistic regression refers to situations where the number of predictor variables exceeds the number of observations in binary classification. This technique is particularly valuable in domains such as genomics, biomedical imaging, social sciences, ecology and finance. Despite its advantages, high-dimensional logistic regression presents several challenges, including the risk of overfitting, instability in parameter estimation, increased computational demands, multicollinearity among predictors and complexities, in selecting the most relevant variables. To address these issues, various penalised methods have been developed, including the Least Absolute Shrinkage and Selection Operator (LASSO) and Elastic Net (ENet). The ENet method combines the strengths of both LASSO and the Logistic Ridge Estimator (LRE), providing a more flexible regularisation approach. In this study, a generalised version of the Least Angle Regression (GLARS) algorithm is proposed for variable selection, aiming at mitigating multicollinearity among predictor variables in high-dimensional logistic regression. This method combines the LARS algorithm and LASSO with existing estimators: Maximum Likelihood Estimator (MLE), Logistic Ridge Estimator (LRE), Logistic Liu Estimator (LLE), Modified Almost Unbiased Ridge Logistic Estimator (MAURLE), Modified Almost Unbiased Logistic Liu Estimator (MAULLE), Principal Component Logistic Estimator (PCLE), r-k class, and r-d class estimators. GLARS updates coefficients iteratively using least-angle directions derived from these biased estimators. Furthermore, the performance of each biased estimator integrated within the LARS algorithm is evaluated using log-loss on both empirical and real datasets, including applications to colon tumour and diffuse large B-cell lymphoma (DLBCL) data. Findings indicate that LARS-PCLE performes the best for the given empirical dataset, LARS-r-d for the colon data, and LARS-LLE for the DLBCL dataset, with corresponding log-loss values of 0.2188, 0.8425, and 0.2949, respectively. These results highlight that the effectiveness of biased estimators within the LARS framework varies with dataset characteristics. Future work will focus on developing an *R* package to assist in selecting the appropriate estimator and computing coefficients for various data types.

Keywords: High dimension, Least angle regression, Logistic regression, Log-loss evaluation, Penalised estimators

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COPULA-BASED FRAMEWORK FOR MODELLING HETEROSCEDASTIC RELATIONSHIPS: AN ALTERNATIVE TO SIMPLE LINEAR REGRESSION

D.K. Hemachandra[1]*, S.G.J. Senarathne[1,2] and M.B. Dehideniya[1,2]

[1]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Computer Science and Statistics, University of Peradeniya, Peradeniya, Sri Lanka.*
*deepkaushi93@gmail.com

Traditional regression models rely on assumptions such as normally distributed residuals and constant variance, which are often violated in real-world applications. In particular, heteroscedasticity in residuals can significantly reduce model accuracy and reliability. This study addresses the above limitations by employing bivariate Archimedean copulas, which offer greater flexibility in capturing complex dependencies and handling non-normal data. A copula-based model is proposed as an alternative to simple linear regression for addressing heteroscedasticity and systematically evaluate its performance under diverse scenarios. A simulation study was conducted using known parameter values to generate synthetic data, considering different sample sizes (30, 50, and 100) and dependence levels (correlations of 0.55, 0.75, and 0.90) between explanatory and response variables. Parameters of the copula-based model were estimated via maximum likelihood estimation, while ordinary least squares were applied for simple linear regression. Model performance was compared in terms of predictive accuracy, using the Mean Absolute Prediction Error (MAPE). Results demonstrate that the copula-based models consistently achieve lower prediction errors across sample sizes and dependence levels. These findings indicate that copula-based approaches provide a more effective alternative to simple linear regression when classical assumptions are violated. Future research could extend this framework to structured model selection in multiple regression and multivariate contexts under heteroscedasticity.

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Keywords: Archimedean copula, Maximum likelihood estimation, Mean absolute prediction error, Non-normal data, Ordinary least squares

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PERFORMANCE OF MAXIMUM LIKELIHOOD AND LINDLEY PRIOR BAYESIAN ESTIMATOR FOR THE POISSON DISTRIBUTION

N.T.S. Cooray* and R. Tharshan

Department of Mathematics and Statistics, University of Jaffna, Jaffna, Sri Lanka.
*thisarasachinthani@gmail.com

Accurate parameter estimation is essential for reliable statistical modelling. The Poisson distribution is commonly used to model count data, with the traditional method for estimating its parameter is the Maximum Likelihood Estimation (MLE) method. However, the effectiveness of the MLE method can diminish when data is limited and the mean is small, a situation often associated with a higher proportion of zero counts (zero-inflation). Such scenarios frequently arise in fields such as actuarial science, biomedical research, and environmental studies. In this context, one can resort to other types of estimators as an alternative to the MLE method. This study investigates and compares the performance of the MLE method and the Bayesian estimation method under a Lindley prior based on squared error loss and quadratic loss functions in various situations. The focus is on scenarios involving small sample sizes and low mean values. A comparative simulation study was conducted to compare these estimators using the mean squared error as the evaluation criterion. To formulate various situations, several Poisson rate parameters (λ = 0.03, 0.05, 0.07,…, 9.99), sample sizes (n = 10, 20, 30, …, 180, 190, 200), and Lindley prior shape parameters (θ = 0.25, 0.5, 0.75, … , 10), and under each situation, 1000 Poisson-distributed samples were generated to improve the precision of the estimation. Then, in total, 399,200 situations were considered in this study. Results obtained from the given situations show that the Bayesian estimators based on squared error loss and quadratic loss functions outperform MLE for small sample sizes (n < 100) and very low mean values (λ < 0.05) and their performances are the same in all reviewed situations. Conversely, for larger sample sizes and higher mean values, MLE provides superior performance. To examine the consistency of the simulation study with real-world applications, two real datasets were considered covering the above ranges and found that the results are in line with the simulation findings. This study is limited to the situations and the Lindley prior considered above. It could be extended to cover other possible scenarios and priors. These findings highlight the advantage of the Bayesian estimation method in scenarios involving limited count data with a smaller mean.

Keywords: Bayesian estimation, Lindley prior, Loss functions, Maximum likelihood estimation, Poisson distribution

RESCON 2025 CMS 28

IMPACT OF CLIMATE FACTORS ON THE DENGUE INCIDENTS IN KURUNEGALA DISTRICT, SRI LANKA

H.P.B. Madhushani, S. Arumairajan and A. Laheetharan*

Department of Mathematics and Statistics, University of Jaffna, Jaffna, Sri Lanka.
*lahee@univ.jfn.ac.lk

Dengue fever has become a serious and growing public health concern across Sri Lanka. Climate plays a crucial role in the growth and spread of Aedes mosquitoes, the primary vector of dengue. Identifying which climate factors influence mosquito populations and dengue transmission is essential for developing effective prevention and control strategies. This study examines the relationship between climate variables and dengue incidences in Kurunegala, one of the high-risk districts in Sri Lanka, during the period 2013 – 2021. The explanatory variables considered were monthly average rainfall, average wind speed, maximum and minimum temperatures, and average daytime and night-time relative humidity, while the number of dengue incidences was treated as the response variable. Multicollinearity among the explanatory variables was first checked using Variance Inflation Factor (VIF) analysis. A Poisson regression model was initially fitted; but residual deviance indicated over-dispersion. To address this, Quasi-Poisson and Negative Binomial regression models were applied, with model parameters estimated via maximum likelihood. Model adequacy was assessed using residual deviance tests, and the Akaike Information Criterion (AIC) was employed for model selection. The Negative Binomial model performed the best, effectively handling over-dispersion. Results revealed that rainfall and wind speed significantly affected monthly dengue incidence. Rainfall showed a positive association, consistent with the creation of water collections favourable for mosquito breeding. In contrast, higher wind speeds were negatively associated with dengue cases, likely due to the limitation of mosquito movement and transmission. These findings provide valuable insights for predicting dengue outbreaks and developing early warning systems. Incorporating time-lagged rainfall variables could further enhance model accuracy by capturing the delayed effects of rainfall on dengue transmission.

Keywords: Climate factors, Dengue incidence, Negative Binomial Regression, Poisson regression, Quasi-Poisson regression

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COMPARING MAXIMUM LIKELIHOOD AND BAYESIAN ESTIMATORS BASED ON WEIGHTED SQUARED ERROR AND ABSOLUTE ERROR LOSS FUNCTIONS FOR THE POISSON PARAMETER ESTIMATION

S. Sankavi* and R. Tharshan

Department of Mathematics and Statistics, University of Jaffna, Jaffna, Sri Lanka.
*sankaviuvi@gmail.com

The Poisson distribution is a standard model for count data, and several estimators are available for estimating the Poisson parameter λ. Among these, the Maximum Likelihood Estimator (MLE) is widely used. Alternatively, since the gamma distribution is defined on $(0, \infty)$, Bayesian estimators based on a gamma prior under various loss functions can also be employed. The gamma distribution, commonly used as a prior, is defined by a shape parameter a and a scale parameter b. However, comparative studies of such estimators with MLE are limited in the literature. This study evaluates the performance of the Bayesian estimators under different loss functions, including Squared Error Loss (SEL), Quadratic Loss (QL), Absolute Error Loss (AEL) and Weighted Squared Error Loss (WSEL), and compares them with the MLE through a comprehensive simulation study using the Mean Squared Error (MSE) criterion. To examine their performance in various small sample sizes n and some possible various parameter settings of a, b and λ simulation considered n = 4, 8, 12, …, 48; a = 0.5, 2.5, 4.5; b = 0.5, 2.5, 4.5; and λ = 0.5, 1.0, 1.5, …, 10 resulting in 2160 different scenarios. Under each scenario, 1,000 Poisson-distributed datasets were generated to provide a robust basis for assessing estimator performance. For the above given situations, the findings indicate that, when the sample size is large ($n \geq 50$) the MSEs of all estimators are almost zero across all settings. However, for smaller sample sizes ($n < 50$), the performances are different. Specially. MLE is more effective and consistently outperforms compared to the Bayesian estimators when $5 \leq \lambda \leq 10$ For smaller values of λ ($\lambda < 5$), Bayesian estimators showed superior performance, with their effectiveness influenced by the prior parameters' values a and b. For some specific settings of a and b, AEL and WSEL perform better than the QL and SEL. To validate the simulation findings, three real-world datasets were considered, covering above mentioned ranges of n and λ. The results demonstrated a strong alignment between the simulations and practical applications. Since the SEL, QL, AEL, and WSEL functions are not in closed form with respect to the parameters, it is difficult to mathematically define the range of parameters for which a particular estimator performs well. Further, this study method can be extended by incorporating other possible estimators for λ. Overall, the research highlights the strengths and applicability of both MLE and Bayesian estimators across various ranges of λ.

Keywords: Bayesian estimation, Gamma distribution, Loss functions, Maximum likelihood estimator, Poisson distribution

RESCON 2025 CMS 30

NETWORK-BASED SPATIAL MODELING FOR TRAFFIC VOLUME PREDICTION

I.K.S.H. Wijayawansha*, S.G.J. Senarathne and M.B. Dehideniya

Department of Statistics and Computer Science, University of Peradeniya, Peradeniya, Sri Lanka.
*shehanharindu@gmail.com

Accurately predicting traffic volume is critical for effective urban planning, congestion reduction, and infrastructure development. While numerous statistical and machine learning approaches have been applied to this task, many overlook temporal patterns and the influence of predictors, while failing to capture the unique spatial structure of urban road networks. Spatial models based on Euclidean distances address spatial dependence to some extent; but they do not reflect the actual movement constraints of road networks, where connectivity and road layout govern traffic flow. This study introduces a novel approach for predicting traffic volume by integrating road network-based distances into a spatial regression framework. Traffic count data from 237 locations in Glasgow (15,384 observations, 2000 – 2023) were used. Predictors included temporal features (weekday, peak/off-peak, quarter, and week number) and road characteristics (*e.g.*, road type). A regression-kriging model was developed, combining fixed-effect predictors with spatial effects derived from a Gaussian Process based on road distances. An empirical variogram was computed from Generalised Linear Model residuals and fitted with an exponential model to estimate spatial parameters (nugget, partial sill, and range). These parameters were then used to construct a spatial covariance matrix and simulate spatial effects from the posterior distribution. Incorporating these effects into a Bayesian spatial regression significantly improved performance, achieving a pseudo-R^2 of 0.849 and RMSE of 0.494, compared with 0.478 and 0.915 in the non-spatial model. Compared to Euclidean-based models (R^2 = 0.839, RMSE = 0.517), the road distance-based model more effectively captured true spatial dependencies in traffic patterns. This statistically grounded and interpretable approach offers practical value for transportation planning and urban analytics.

Keywords: Bayesian spatial regression, Generalised linear model, Kriging, Posterior distribution, Spatial model

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SINGLE IMAGE DEFOGGING USING A DEPTH- AND EDGE-AWARE MODIFIED CYCLEGAN

S. Lathagini[1], T. Kokul[2]* and U.A.J. Pinidiyaarachchi[3]

[1]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Computer Science, University of Jaffna, Jaffna, Sri Lanka.*
[3]*Department of Statistics and Computer Science, University of Peradeniya, Peradeniya, Sri Lanka*
*kokul@univ.jfn.ac.lk

Visibility in outdoor imagery is frequently compromised by adverse atmospheric conditions, with fog representing one of the most common and challenging phenomena. Effective single-image defogging is critical for a wide range of applications, including autonomous navigation and traffic surveillance systems. In recent years, approaches based on Generative Adversarial Networks (GANs) have demonstrated notable improvements in defogging performance. Despite these advancements, such methods often exhibit limitations, particularly in their insufficient utilisation of scene depth information and their difficulty in preserving fine structural details throughout the enhancement process. To address these limitations, this study proposes a novel approach that incorporates both depth maps and edge maps, alongside raw degraded images, into a CycleGAN-based model. This integration aims to generate realistic defogged images while effectively preserving structural and geometric details. The depth and edge maps are derived from the raw degraded images during both the training and testing phases. In the proposed generator and discriminator architectures, features extracted from the depth and edge maps are concatenated with those from the raw images to enrich the input representation. Furthermore, a depth attention block is integrated into both the generator and discriminator to enhance spatial feature learning through attention mechanisms. The proposed approach is trained and evaluated using the publicly available RESIDE and Haze-1K datasets. Experimental results on the test sets demonstrate that the method outperforms existing approaches, achieving an average PSNR of 24.80 and an average SSIM of 0.927 on the RESIDE dataset, and a PSNR of 23.28 with an SSIM of 0.923 on the Haze-1K dataset. The findings of this study clearly highlight the importance of incorporating depth and edge cues in single-image defogging, as they contribute significantly to preserving spatial and structural details.

Keywords: CycleGAN**,** Depth Map, Edge Map, Single image defogging

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TEMPORAL AWARE TEXT-DRIVEN STYLE TRANSFER FOR MOTION-BASED VIDEO TRANSFORMATION

A.D.D.S. De Silva* and R. Siyambalapitiya

Department of Statistics and Computer Science, University of Peradeniya, Peradeniya, Sri Lanka
*addsdesilva8@gmail.com

Video stylisation plays a crucial role in creative domains such as virtual reality, game development, content creation, and filmmaking. However, existing traditional video style transfer methods often produce flickering and popping due to inconsistent frame stylization. They typically rely on reference style images or computationally heavy modules such as neural atlas layers, making them unsuitable for real-time use. This research introduces a deep learning-based framework for text-guided style transfer on single or multiple objects in videos, focusing on temporal consistency and low computational cost. Two approaches are proposed; combining You Only Look Once version 8 (YOLOv8) for object detection, Deep Simple Online and Realtime Tracking (DeepSORT) for tracking, and the Segment Anything Model (SAM) for precise segmentation. Stylisation is performed using CLIPStyler, which applies descriptive text prompts as style instructions, making the process fully text-driven and independent of reference images. A custom dataset of elephants was created and annotated for training and evaluation. In the first approach, stylisation was applied only to segmented object frames, which were then blended with unaltered background frames. This method is efficient but slightly affects background quality. To address this, the second approach first generated a fully stylised video and then used segmentation masks to isolate stylised objects, merging them with the original background frames. This preserved background clarity while maintaining object stylisation. Quantitative evaluation produced strong results: Intersection over Union (IoU) = 0.9689, dice coefficient = 0.9689, F1-score = 0.88, precision = 0.90, and recall = 0.87. A user study with 30 participants, including professional videographers, found that over 90% agreed the style aligned with the text, object shapes were preserved, and background artefacts were minimal. These results demonstrate the framework's effectiveness for object-level stylisation. Future work will explore advanced detection models, improved segmentation with SAM 2, zero-shot object detection, and voice-based style control.

Keywords: CLIPStyler, Temporal consistency, Text-guided style transfer, Video object segmentation

RESCON 2025 CMS 33

COMPARATIVE ANALYSIS OF LIGHTWEIGHT COMPUTER VISION MODELS FOR DETECTION AND CLASSIFICATION OF TOMATO PLANT CANOPIES FOR EDGE DEPLOYMENT

H.K.N.C. Wickramasinghe* and R. Siyambalapitiya

Department of Statistics and Computer Science, University of Peradeniya, Peradeniya, Sri Lanka.
*nilmiwickramasinghe@gmail.com

This research investigates the use of lightweight computer vision models for detecting and classifying tomato plant canopies into complete and incomplete types, with a focus on deployment on edge devices for practical use in agricultural environments. The main objective was a comparative evaluation of three lightweight models, You Only Look Once version 8 nano (YOLOv8n), Single Shot MultiBox Detector (SSD) MobileNet-v2 Feature Pyramid Network Lite 320 (SSD-MobileNet-v2-FPNLite-320), and EfficientDet-D0. The models were trained using a custom dataset collected at the Horticultural Crop Research and Development Institute, supplemented with additional internet-sourced images. Images were preprocessed by auto-orienting and resizing to a resolution of 224 × 224 pixels. To improve generalisation, data augmentation was applied, including horizontal and vertical flips, 90° rotations, brightness variation (±15%), and light blurring (up to 1 px), generating three augmented samples per training image. Model evaluation was based on precision, recall, and mean average precision at 50% Intersection over Union (mAP50). YOLOv8n achieved the highest detection accuracy, with an mAP50 of 93.0%, outperforming SSD-MobileNet-v2 (60.4%) and EfficientDet-D0 (46.9%). For edge deployment, the YOLOv8n model was optimised using TensorFlow Lite and deployed on a Raspberry Pi 3 Model B (ARM Cortex-A53 CPU @ 1.2 GHz, 1 GB RAM) equipped with an OV5647-62 field-of-view camera module. The model ran in the TensorFlow Lite runtime without GPU delegates or hardware acceleration, using single-threaded CPU inference, and achieved real-time detection performance of 4.4 frames per second (FPS). This work lays the groundwork for future research on autonomous path planning in constrained agricultural environments such as polytunnels and greenhouses. The system supports point-to-point navigation, enabling Cable-Driven Parallel Robots (CDPRs) or gantries with three degrees of freedom to adjust until a complete canopy view is obtained, after which the system proceeds along the optimised path. This targeted navigation improves coverage efficiency and enhances monitoring consistency.

Keywords: Cable-driven parallel robots, Canopy detection, Computer vision, Edge devices, Tomato plants

RESCON 2025 CMS 34

AN ENTROPY-BASED ATTRIBUTE SELECTION TECHNIQUE FOR INTERPRETABLE BREAST CANCER DETECTION

H.D.A.W. Subawickrama[1]*, U.G.I.G.K. Udagedara[2], S.A.A. Nishantha[3] and S.P. Abeysundara[4]

[1]*Department of Physical Science, Rajarata University of Sri Lanka, Mihintale, Sri Lanka.*
[2]*Department of Engineering, Computing and Mathematical Sciences, Lewis University, Romeoville, IL, United States.*
[3]*Department of Mathematics and Computer Sciences, University of St. Francis, Joliet IL, United States.*
[4]*Department of Statistics & Computer Science, University of Peradeniya, Peradeniya, Sri Lanka.*
*amandisubawickrama586@gmail.com

Breast cancer is one of the most common and life-threatening cancers among women worldwide, with approximately 2.3 million new cases and over 600,000 deaths reported annually, according to the World Health Organisation. In Sri Lanka alone, nearly 3,000 new cases are diagnosed each year, underscoring the urgent need for reliable and efficient diagnostic techniques. Recently, data-driven methods have shown great potential in improving diagnostic accuracy and reducing subjectivity. This study introduces a Shannon entropy-based attribute selection approach for breast cancer detection using the Wisconsin Diagnostic Breast Cancer (WDBC) dataset of 569 instances. Unlike Principal Component Analysis (PCA), which transforms data into abstract components, the proposed method directly identifies informative attributes without altering the original data. Using the selected 13 attributes, a Support Vector Machine (SVM) classifier achieved 93.00% accuracy, with a precision of 0.95 (benign) and 0.86 (malignant), and a recall of 0.96 and 0.83, respectively. For comparison, PCA, with 13 principal components followed by SVM, yielded a slightly higher accuracy of 95.83%, but at the cost of interpretability, as PCA-derived features lack clinical relevance. When the number of components was chosen via scree plot (k = 2), accuracy further decreased to 91.67%. Unlike PCA, the proposed entropy-based approach retains clinically meaningful attributes, such as mean radius and texture, making the results more interpretable for medical professionals. Additionally, it demonstrated greater computational efficiency by avoiding the matrix decomposition required in PCA. These findings suggest that entropy-based feature selection provides a more interpretable, efficient, and clinically relevant alternative to transformation-based methods for breast cancer detection. Future work will involve testing the method on large-scale, real-time datasets to assess scalability and practical applicability in healthcare.

Keywords: Attribute selection, Breast cancer detection, Classification, Principal component analysis, Shannon entropy, Support vector machine

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COMPARATIVE ANALYSIS OF MACHINE LEARNING MODELS FOR DEPRESSION DETECTION IN SOCIAL MEDIA TEXT

M.U.K. Gunawardhna*, K.B. Shalika, R.M.T.C. Bandara and W.A.W.U. Wickramaarachchi

Department of Information Communication Technology, Rajarata University of Sri Lanka, Mihintale, Sri Lanka.
*udikagunawardhna@gmail.com

Depression is a prevalent mental disorder that requires early detection. However, traditional clinical methods often face challenges in identifying their onset. Social media platforms, where users frequently share personal thoughts and emotions, provide a valuable source for detecting depressive symptoms. Although research in this area is expanding, relatively few studies have examined multiple machine learning (ML) models across different feature-extraction methods. Prior work has focused mainly on Twitter-based data and support vector machine (SVM) classifiers, with limited attention to other classifiers. Addressing this gap, this study evaluated three ML models, SVM, logistic regression (LR), and long short-term memory (LSTM) networks with dense layers on Facebook posts using two feature-extraction methods: term frequency-inverse document frequency (TF-IDF) and Global Vectors for Word Representation (GloVe) embeddings. A publicly available dataset was employed, and user demographics, such as age, age category and gender, were considered. Ground-truth depression labels were derived from an existing labelled dataset, where individuals diagnosed with depression were assigned a label of 1 and those without depression were assigned a label of 0. Eighty percent of the dataset was allocated to training and 20.0% to testing, ensuring class balance between depressed and non-depressed samples. Results indicated that TF-IDF with SVM achieved the highest accuracy of 95.5%, outperforming both LR and LSTM models, which each achieved an accuracy of 84.0%. This study demonstrates the effectiveness of combining SVM with TF-IDF in detecting depression in Facebook text and highlights the potential of extending research beyond Twitter-based studies. The findings contribute to the literature by systematically analysing multiple models and feature-extraction techniques using previously unexplored Facebook data, thereby supporting more robust and generalizable mental health monitoring through social media.

Keywords: Depression detection, Machine learning, Social media analysis, Support vector machine

RESCON 2025 CMS 36

ASSESSING FLOATING SOLAR POTENTIAL IN SRI LANKA USING A HYBRID SARIMA-LSTM FORECASTING APPROACH

S.D.A.V.S. Premathilaka*, R.D. Yapa and R. Punchi-Manage

Department of Statistics and Computer Science, University of Peradeniya, Peradeniya, Sri Lanka
*akilapr@eng.pdn.ac.lk

Sri Lanka's energy sector is significantly dependent on fossil fuels. Despite considerable solar irradiance potential, solar energy currently accounts for only 5% of the country's electricity production. Large-scale solar expansion is constrained by land-use conflicts. Floating Solar Photovoltaics (FPV), deployed on reservoir surfaces, offer a sustainable alternative by utilising underutilised water bodies without competing for land. This study aimed to forecast the solar energy generation potential across 18 major reservoirs in Sri Lanka. The analysis used monthly aggregates of daily meteorological and solar irradiance data from January 2010 to December 2022. Solar energy generation was estimated based on a 1 m^2 panel area after adjusting for environmental and efficiency factors. For each site, the dataset was divided into training (80%) and testing (20%) subsets. A Seasonal Auto-Regressive Integrated Moving Average (SARIMA) model was first applied to capture the linear and seasonal patterns of the time series. The residuals from SARIMA were then used to train Long Short-Term Memory (LSTM) models to capture non-linear dependencies. The final hybrid forecast for the 32-month test period was obtained by combining the SARIMA forecasts with the LSTM-predicted residuals. Model performance was evaluated using Root Mean Square Error (RMSE), Mean Absolute Error (MAE), the coefficient of determination (R^2), and Mean Absolute Percentage Error (MAPE). Results showed that the average monthly solar output ranged between 30 – 120 kW h m^{-2}, with February to April being the most productive period. The hybrid model performed strongly, achieving MAPE values under 3.5% at all sites, and mostly below 2%, highlighting its high accuracy and reliability in predicting solar energy potential across diverse locations.

Keywords: Floating solar photovoltaics, Long short-term memory, Renewable energy, Seasonal auto-regressive integrated moving average

RESCON 2025 CMS 37

MODELING DELAY BEHAVIOR IN COMMERCIAL AVIATION: A STATISTICAL DISTRIBUTION APPROACH

K.S.D. Ravihari* and S.P. Abeysundara

Department of Statistics and Computer Science, University of Peradeniya, Peradeniya, Sri Lanka.
*s19497@sci.pdn.ac.lk

Flight delays remain a persistent challenge for the aviation industry, impacting both passenger satisfaction and operational efficiency. This study aimed to identify suitable probability distributions for flight delay durations and to model their underlying patterns more effectively than conventional predictive methods. Data were obtained via web scraping from FlightAware.com, comprising approximately 26,000 flights operated by major international airlines between popular global airports from January 2023 to April 2025. The dataset included records from six major airlines and 11 high-traffic departure-arrival airport pairs. After cleaning and preprocessing, delays were calculated as the difference between actual and scheduled times, focusing on delays of 15 minutes or more, consistent with industry standards. Exploratory analysis revealed that delay durations exhibited multimodal and positively skewed behaviour. Several continuous probability distributions, including Lognormal, Weibull, Gamma, Pareto and Exponential, were fitted to the data, with goodness-of-fit assessed using the Anderson–Darling test. Model selection was guided by the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) to balance fit and complexity. Recognising the limitations of single distributions, mixture models were estimated using the Expectation-Maximisation algorithm, with optimal components determined through likelihood ratio tests. Results showed that lognormal mixture models best captured the complex distribution of delays, although the number of mixture components varied, reflecting heterogeneity across flights and airlines. Distinct distribution peaks were observed at specific thresholds, such as 15 minutes for arrivals and 17 minutes for departures. These findings provide actionable insights for airlines and airport authorities, supporting improved scheduling and operational strategies. Future research could enhance and stratify these models by incorporating additional factors such as weather conditions, aircraft characteristics and air traffic congestion, leading to more robust statistical analysis.

Keywords: Aviation statistics, Flight delays, Mixture models, Operational efficiency, Probability distributions

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COMPARATIVE PERFORMANCE ANALYSIS OF PARAMETER ESTIMATION METHODS FOR THE BINOMIAL DISTRIBUTION

K.S.D. Fernando* **and H.T.K. Abeysundara**

Department of Statistics and Computer Science, University of Peradeniya, Peradeniya, Sri Lanka.
*s19364@sci.pdn.ac.lk

Estimating parameters of probability distributions is a fundamental aspect of inferential statistics, as it directly affects the accuracy, efficiency, and robustness of inference. This study compared the performance of three parameter estimation methods; Minimum Hellinger Distance Estimation (MHDE), Minimum Density Power Divergence Estimation (MDPDE) and Maximum Likelihood Estimation (MLE), for the Binomial distribution, with a focus on both efficiency and robustness under varying conditions. Monte Carlo simulations were conducted by systematically varying sample size (n), success probability (p) and contamination levels, under a fixed number of trials, to identify the most suitable estimation method. Contamination was introduced by replacing a proportion of observations generated from the Binomial distribution with the number of trials, thereby generating synthetic data with outliers. The estimators were evaluated using key metrics such as bias, variance, and Root Mean Squared Error (RMSE). Results indicated that MLE produced the lowest RMSE on clean data, but its performance deteriorated in the presence of contamination. In contrast, both MHDE and MDPDE showed greater stability and reliability against outliers. Furthermore, increasing the success probability slightly reduced the RMSE for MLE, while MHDE and MDPDE remained relatively stable. With larger sample sizes, MHDE displayed a slight decrease in RMSE, suggesting improved efficiency compared to MDPDE. Notably, MHDE and MDPDE outperformed MLE under higher contamination levels, while MDPDE converged to MLE in uncontaminated settings. Overall, MHDE demonstrated superior robustness and efficiency in contaminated scenarios, making it a compelling alternative to MLE for practical applications.

Keywords: Binomial density, Maximum Likelihood Estimation, Minimum Density Power Divergence, Minimum Hellinger Distance, Parameter estimation

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SURVIVAL ANALYSIS OF PEDIATRIC MORTALITY AND HOSPITAL STAY DURATION AT SBSCH, SRI LANKA

G.M.M.S. Gunawardhana* and S.P. Abeysundara

Department of Statistics & Computer Science, University of Peradeniya, Peradeniya, Sri Lanka.
*malkisuhadani@gmail.com

Child survival is a key indicator of public health and socio-economic development, particularly in low- and middle-income countries. Understanding the factors influencing hospital stay duration and survival among pediatric patients are crucial for optimising clinical outcomes and healthcare resource allocation. While previous studies have examined pediatric survival, most have focused on specific conditions such as cancer. This study investigated survival outcomes and associated factors among pediatric admissions to the Sirimavo Bandaranaike Specialised Children's Hospital (SBSCH) over four years from 2019 to 2022. The dataset comprised 87,914 admissions, with variables including admission number, age, gender, admission and discharge dates, and mode of discharge. The data were complete and free of missing values. The event of interest was defined as patient death, and survival time corresponded to the hospital stay duration, measured in days from admission to discharge. Patients who remained admitted at the end of the observation period were treated as censored cases. Preliminary analysis revealed a marked decline in hospital admissions during the COVID-19 pandemic. Kaplan–Meier survival analysis showed that the probability of survival decreased over time, with 50% of the population remaining event-free up to 94 days. Survival curves varied significantly by disease and age categories, with the longest time to event observed among patients diagnosed with abnormal clinical findings. School-aged children, preschoolers, and adolescents demonstrated higher survival probabilities compared to other age groups. The proportional hazards (PH) assumption was assessed using Schoenfeld residuals: age ($p = 0.089$) and gender ($p = 0.829$) satisfied the assumption, while disease status violated it ($p < 0.05$), leading to an invalid overall Cox model ($p < 0.05$). A stratified Cox proportional hazards model was therefore fitted using age category, sex and disease category as stratification factors. The model's discriminative ability, assessed using Harrell's C-index, was 0.50, indicating no better performance than random prediction. Furthermore, toddlers and preschoolers exhibited significantly lower hazard rates compared to infants ($p < 0.05$). These findings highlight the importance of tailoring interventions to specific age groups and provide evidence-based insights to guide clinical decision-making and healthcare resource planning.

Keywords: Cox proportional hazards model, Kaplan–Meier, Pediatric admissions, Survival analysis, Time-to-discharge analysis

RESCON 2025 CMS 40

ASSESSMENT OF THE WATER QUALITY IN NORTHERN AREA OF SRI LANKA BASED ON THE STATISTICAL TECHNIQUES

D.M.T.K. Dasanayaka[1]*, H.T.K. Abeysundara[1] and R. Chandrajith[2]

[1]*Department of Statistics and Computer Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Geology, University of Peradeniya, Peradeniya, Sri Lanka.*
*tharindukavinda1999@gmail.com

Groundwater contamination is a serious environmental concern, particularly in urban and coastal areas. This study provides a comprehensive assessment of water quality issues in the northern part of Sri Lanka, with a focus on the critical dependence on groundwater resources. A total of 258 water samples were analysed for 18 water quality parameters, including chemical constituents (cations and anions) and physical properties such as pH. The aim was to identify regions more suitable for habitation based on groundwater quality. Multivariate statistical techniques and machine learning algorithms were applied to analyse spatial variations in water quality. The Random Forest algorithm was employed to identify the most significant parameters contributing to water quality variations across seven regions. Model performance was improved using 800 trees, with evaluation based on sensitivity and specificity metrics. Variable importance was measured using the Mean Decrease Gini Index. Cluster analysis was then performed on the significant parameters to identify groups with similar patterns. *K*-means clustering revealed four groups (K = 4), with the Elbow Method used for selection, and a silhouette score of 0.3 obtained. The Water Quality Index (WQI) was calculated for each water sample and compared with WHO guidelines to assess suitability for drinking. Clusters were categorised as normal, good, medium-good, and poor-quality water. Results indicated that Vavuniya, Kalpitiya, and Jaffna had a higher proportion of poor-quality water samples, whereas Mannar, Mullaitivu, and Jaffna-Mullaitivu showed more balanced distributions. These findings highlight the need for continuous groundwater monitoring in Northern Sri Lanka to ensure safe water use.

Keywords: Cluster analysis, Ground water quality, Machine learning algorithm, Multivariate statistical techniques, Random forest

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ANALYSING FACTORS ASSOCIATED WITH CASUALTY SEVERITY IN ROAD TRAFFIC ACCIDENTS: A GENERALISED LINEAR MODELING APPROACH

U.G.D. Sashinka*, R.D. Yapa and S.A.R. Punchi-Manage

Department of Statistics and Computer Science, University of Peradeniya, Peradeniya, Sri Lanka.
*dilmini.sashinka@sci.pdn.ac.lk

Road traffic accidents remain a significant public health challenge in Sri Lanka, necessitating a comprehensive understanding of factors contributing to casualty severity. This study investigates the determinants of the number of casualties per road traffic crash in the Kandy Police Division using generalised linear modelling (GLM) with a Poisson distribution. This study was based on the analysis of 2,099 crashes recorded from January 2022 to March 2024. A log-linear model was initially fitted with a comprehensive set of predictors, including environmental, temporal, vehicular, and collision-related variables. Model selection was conducted using stepwise Akaike Information Criterion (AIC) based variable elimination as AIC balances model fit and complexity. This process produced a simplified model with improved interpretability and minimal loss of explanatory power (AIC = 5,229; likelihood ratio test ΔD = 18.42, df = 20, p = 0.559). The estimated dispersion parameter was 0.673, indicating no evidence of overdispersion and supporting the suitability of the Poisson framework. Key predictors retained in the final model included road surface condition, traffic control status, vehicle type, collision type, urban versus rural location, and the number of vehicles involved. Crashes involving motorcycles and three-wheelers showed elevated casualty risks, with rate ratios of 1.28 and 1.21, respectively, compared to cars. Passenger-involved collisions were associated with a 2.75-fold increase in casualties (p = 0.002), while pedestrian involvement led to a 91% increase (p = 0.038) relative to collisions with stationary objects (baseline). Wet road surfaces and the absence of traffic control mechanisms were associated with increased risks of approximately 14% and 16%, respectively. The number of vehicles involved also showed a positive association with casualty count (rate ratio = 1.27). The average number of casualties per incident was 1.12, while the variance was 0.76, further validating model adequacy. These findings highlight key influences on injury severity and provide evidence-based insights to assist authorities and policymakers in planning effective road safety interventions.

Keywords: Casualty modeling, Injury risk factors, Log-linear model, Poisson regression, Road safety

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A HYBRID MACHINE LEARNING AND PROCESS-BASED MODELING FRAMEWORK FOR FLASH FLOOD PREDICTION IN DATA-SPARSE BASINS: A CASE STUDY OF SRI LANKA'S KELANI RIVER BASIN

K. Sangeetha[1,2]* and T. Keerthanaram[3]

[1]*Department of Physical Science, University of Vavuniya, Vavuniya, Sri Lanka.*
[2]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[3]*Department of Bio-Science, University of Vavuniya, Vavuniya, Sri Lanka.*
*sangeethamahendran279@gmail.com

Flash flooding in tropical basins poses a critical environmental hazard, requiring advanced prediction capabilities, particularly in data-sparse regions, such as Sri Lanka's Kelani River Basin, where catastrophic events in 2016 and 2018 caused significant socioeconomic damage. On the global scale, most existing flood prediction studies either rely solely on physics-based hydrological models or Machine Learning (ML) models. Limitations of the above models are especially pronounced in data-scarce tropical regions, where hybrid approaches remain underexplored despite their potential to combine the strengths of both modelling paradigms. This study addresses these limitations by developing a novel hybrid framework that integrates process-based hydrological modelling with ML to enhance predictive accuracy. The primary objectives include: (i) developing satellite–gauge rainfall fusion using Deep Convolutional Generative Adversarial Networks (DGANs) to overcome spatial data gaps, (ii) coupling the Weather Research and Forecasting Hydrological model with Long Short-Term Memory (LSTM) networks for dynamic error correction, and (iii) validating operational utility for early warning systems. The methodology incorporates multi-source data integration, including Global Precipitation Measurement (GPM) Integrated Multi-satellite Retrievals for GPM rainfall, Shuttle Radar Topography Mission 30 m Digital Elevation Model, and Department of Meteorology ground observations. Within the framework, DGANs impute missing rainfall values, while LSTM networks correct residuals between simulated and observed discharge. This workflow integrates multi-source data preprocessing, a physics-based hydrological core, and ML-based residual correction into a unified hybrid architecture, enabling robust flood forecasts in data-sparse tropical basins. Results demonstrate 32% reduction in rainfall root mean square error compared to conventional kriging, with the hybrid system achieving Nash-Sutcliffe efficiency of 0.85 (calibration) and 0.79 (validation), outperforming standalone Hydrologic Engineering Centre-Hydrologic Modelling System (HEC-HMS) (0.62) and LSTM (0.71) models. The framework also achieves an F1-score of 0.89 for flood detection at 6-hour lead times, while reducing false alarms by 25% compared to existing systems. Additionally, Convolutional Neural Network-based downscaling improves peak flow predictions in ungauged sub-basins by 18%. These findings establish a transferable methodology that delivers 23 – 30% accuracy gains over conventional approaches, enabling actionable early warnings for Sri Lanka's Disaster Management Centre. Future work will integrate ensemble weather forecasting and expand applications to adjacent basins.

Keywords: Climate resilience, Disaster management, Flood forecasting, Hydrological modelling, Machine learning

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COMPARATIVE FORECASTING OF WATER QUALITY INDEX USING LONG SHORT-TERM MEMORY AND EXTREME GRADIENT BOOSTING

H.K.H.K. Dissanayake* and S.A.R. Punchi-Manage

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

Monitoring and forecasting river water quality is critical for sustainable water resource management, particularly in densely populated regions. This study evaluates and compares the performance of deep learning and machine learning models in forecasting the Weighted Arithmetic Water Quality Index (WAWQI) across 20 monitoring stations along the River Thames. Physicochemical parameters, including pH, temperature, total suspended solids (TSS) and nitrates, collected from 2009 to 2017, were used to compute WAWQI, with missing values approximated through linear interpolation. Long Short-Term Memory (LSTM) neural networks were trained using an eight-month input sequence to capture temporal dependencies, while Extreme Gradient Boosting (XGBoost) models utilised lagged WAWQI values (lags 1 – 3) and time-based features. Both models were independently developed for each site and evaluated using an 80:20 train-test split. For benchmarking, classical time-series models such as Seasonal Auto-Regressive Integrated Moving Average (SARIMA) and Prophet were also applied. Results show that both LSTM and XGBoost outperform classical time-series models. Model performance was evaluated using Root Mean Squared Error (RMSE), Mean Absolute Error (MAE), and Mean Absolute Percentage Error (MAPE). LSTM outperformed XGBoost at most sites, achieving lower RMSE at 12 sites and lower MAE and MAPE at 13 sites, highlighting its strength in capturing seasonal and temporal trends. Although the largest MAPE improvement was relatively small (1.0%), it was consistent across sites. LSTM performance declined at sites with irregular or noisy data, where XGBoost provided more robust predictions by modelling non-linear relationships and adapting to varying patterns. In addition, LSTM required longer computational training time, while XGBoost was significantly faster and more efficient for frequent retraining. These findings emphasise the importance of tailoring model selection to site-specific characteristics. Combining temporal deep learning approaches with tree-based methods can enhance the reliability and scalability of water quality forecasting, supporting informed decision-making in environmental monitoring and water resource management.

Keywords: Environmental monitoring, Extreme gradient boosting, Long short-term memory, Time-series forecasting, Water quality index

RESCON 2025 CMS 75

IMPACT OF SOCIAL MEDIA USAGE ON DEPRESSION AND ANXIETY: A MIXED-METHODS STUDY ACROSS DIVERSE DEMOGRAPHICS

P. Nallaperuma[1,2]*, C. Sri Manukalpa[2], K. Bandara[2] and R. Kankanamge[2]

[1]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*SLIIT City University, BOC Merchant Tower, Colombo, Sri Lanka.*
*pubudu22malith@gmail.com

The pervasive integration of digital technologies into daily life has transformed social interaction paradigms; yet its implications for mental health, particularly depression and anxiety, remain a critical public health concern. Although existing literature presents conflicting findings, few studies have systematically examined how social media usage patterns influence mental health across diverse demographic groups. Addressing this gap, this study employed a mixed-methods approach combining a systematic literature review with an empirical investigation of 220 Sri Lankan participants, including students, employed professionals, and unemployed individuals. Data collected through a validated questionnaire assessing social media behaviors, depressive symptomatology (*e.g.*, social isolation posts, upward social comparisons), and anxiety indicators (*e.g.*, restlessness, concentration difficulties) were analyzed using Python-based computational methods. Results revealed a dose-response relationship between social media engagement and mental health outcomes: 34.1% of participants spending 2 – 4 h daily on platforms such as Facebook and Instagram exhibited clinically significant depression and/or anxiety symptoms, while 22.7% of heavy users (> 4 h day^{-1}) met thresholds for undiagnosed mood disorders. Notably, behavioral markers (*e.g.*, negative emotional valence in posts, frequent social comparisons) emerged as stronger predictors than usage duration alone, while self-compassion ($\beta = -0.42$, $p < 0.01$) and deliberate usage practices acted as protective moderators. These findings challenge the homogeneity assumption in digital mental health research, support the development of machine-learning tools to detect at-risk users based on linguistic and engagement patterns, and underscore the need for tiered interventions combining psychoeducation on mindful usage with platform-level design modifications, thereby offering a demographic-sensitive framework for understanding technology-mediated mental health risks.

Keywords: Anxiety, Computational mental health, Depression, Digital well-being, Social media

RESCON 2025 CMS 76

INTERACTIVE 3D VIRTUAL TOURISM SYSTEM: DESIGN AND IMPLEMENTATION FOR SRI LANKA'S HERITAGE SITES

W.A.I.M. Rupasinghe and D.G.S.P. Thilakarathne*

Department of Computer Systems Engineering, University of Kelaniya, Kelaniya, Sri Lanka.
*sanjulaprsan@gmail.com

Sri Lanka's tourism industry still relies largely on passive promotional methods that provide little opportunity for interactive pre-travel experiences, limiting tourist motivation to visit heritage sites. While virtual tourism is expanding globally, Sri Lanka has used minimal adoption of VR-based applications, with prior studies focusing mainly on hospitality contexts, such as experiential marketing in hotels. No research has examined VR in relation to cultural tourism and heritage attractions, leaving a significant gap in immersive pre-travel experiences. This study addresses that gap by developing and testing an interactive 3D virtual environment for heritage sites such as Thuparamaya and Kuttam Pokuna, with the aim of exploring the impact of immersion on user engagement, cultural learning, and visit intention. A systematic approach was used: on-site capture through photography and 360° content; 3D geometry generation in Blender; implementation in Unity for navigation, interaction, and visualisation; and the development of an online platform providing contextual history. Technical performance was evaluated using metrics such as memory usage and loading time, while usability was assessed through a survey (n = 200) measuring ease of navigation, immersion, satisfaction, and cultural learning. Findings indicated that 72% participants found the system easy to navigate, 68% reported enhanced cultural knowledge, and over 80% expressed greater curiosity and intention to visit the destinations after using the platform. Statistical analysis confirmed significant correlations between immersion, satisfaction ($p < 0.05$), and travel intention ($p < 0.05$), demonstrating that VR can outperform traditional websites as a destination marketing tool. This research provides empirical evidence of VR's effectiveness in enhancing user experience and destination attractiveness. Future directions include expanding the platform to other heritage sites, integrating VR headsets, and examining issues of accessibility, sustainable tourism, and cultural learning in virtual environments.

Keywords: 3D modelling, Destination marketing, Virtual reality, Virtual tourism

RESCON 2025 CMS 77

SEMANTIC ANALYSIS OF PHRASAL VERBS USING BERT FOR CONTEXTUAL MEANING DISAMBIGUATION

S. Ibrahim[1], M. Angel[2], V. Abishethvarman[2]*, S. Prasanth[3] and B.T.G.S. Kumara[1]

[1]Department of Software Engineering, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka.
[2] Department of Computing & Information Systems, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka.
[3]Faculty of Engineering and Applied Science, Memorial University of Newfoundland, Labrador, Canada.
*abishethvarman@gmail.com

Phrasal verbs remain a major challenge in natural language processing (NLP) due to their idiomatic, polysemous, and context-sensitive nature. Unlike literal expressions, their meanings are often non-compositional, making them difficult for transformer-based architectures such as Bidirectional Encoder Representations from Transformers (BERT) to interpret reliably. Previous research has applied BERT-based models to verb disambiguation but has rarely addressed phrasal verb semantics. Moreover, limited work has explored parameter-efficient fine-tuning methods specifically for semantics-related NLP tasks. This study bridges the above gap by adapting transformer models through parameter-efficient fine-tuning for improved phrasal verb understanding. The use of Quantised Low-Rank Adaptation (QLoRA) for supervised fine-tuning of BERT wass investigated in this study to enhance phrasal verb disambiguation. A curated dataset of approximately 10,000 phrasal verb instances was constructed and split into 70% training, 15% validation, and 15% test sets. The base BERT model was first evaluated to establish baseline performance, followed by QLoRA fine-tuning. Model performance was assessed using multiple lexical and semantic evaluation metrics, including cosine similarity, Bilingual Evaluation Understudy (BLEU), Recall-Oriented Understudy for Gisting Evaluation–Longest Common Subsequence (ROUGE-L), Jaccard similarity, and Metric for Evaluation of Translation with Explicit ORdering (METEOR). Across all metrics, QLoRA fine-tuning yielded measurable improvements: cosine similarity increased from 0.5889 to 0.6189, BLEU from 0.2570 to 0.3150, and ROUGE-L from 0.4623 to 0.4901. These results demonstrate that lightweight supervised adaptation enhances BERT's ability to capture phrasal verb semantics while reducing computational overhead. The findings show that a fine-tuned foundational transformer model can excel in this baseline setting, indicating potential scalability to larger language models. This work advances idiomatic language processing in NLP and highlights the broader promise of parameter-efficient fine-tuning for resource-constrained semantic understanding tasks.

Keywords: BERT, Context-aware, Fine-tuning, Phrasal verbs, QLoRA, Semantic classification

RESCON 2025 CMS 78

IMPROVING BOTTLING LINE EFFICIENCY WITH DEEP LEARNING: A COMPARATIVE STUDY OF YOLO VARIANTS FOR DEFECT DETECTION

P.G.M.D. Kumara, S. Pirashanth, W.K. Sandaruwan, J.M.D.S. Jayasinghe and W.U. Wickramaarachchi*

Department of Information and Communication Technology, Rajarata University of Sri Lanka, Mihintale, Sri Lanka
*wirajudara@tec.rjt.ac.lk

Quality control in beverage production is crucial to ensuring product quality and customer satisfaction. Traditional methods, such as manual inspection, are prone to human error, inefficiency, and increased operating cost. Defect detection during beverage production is a key quality control process that aims to identify issues such as missing labels, incorrect liquid levels, and cap-sealing errors. Existing approaches rely on manual inspection or semi-automated systems that are often slow, inaccurate, and error-prone. The research gap identified through a comprehensive literature review is the absence of a fully automated, high-accuracy defect detection system with real-time functionality and low computational expense. To address the above gap, this study explores the application of deep learning techniques for autonomous defect inspection in beverage production. Three object detection models were experimented: You Only Look Once version 5 (YOLOv5), version 8 (YOLOv8) and version 11 (YOLOv11), with different training epochs (15, 60, and 100) to evaluate their suitability for real-time defect inspection. Three image datasets were prepared, consisting of 406 images of bottles with and without missing labels, 295 images of bottles with correct and incorrect liquid levels, and 330 images of bottles with properly sealed and defective caps. Results indicated that YOLOv8 achieved the highest performance, with accuracy rates of 87% for bottle cap defects, 90% for missing labels, and 96% for incorrect liquid levels at optimal training epochs, along with an average F1-score of 74.7%. Overall, all models demonstrated strong detection accuracy, indicating their potential for industrial automation in beverage manufacturing. However, the study has limitations, including reliance on high-quality training datasets, sensitivity to illumination conditions, and challenges in scaling across different bottle types. Future work could focus on enhancing model robustness under varying environmental conditions and incorporating additional sensor-based inspection methods. This study contributes to computerised quality inspection in beverage production by demonstrating the effectiveness of deep learning for defect detection, thereby supporting the development of more powerful, cost-saving, and scalable industrial automation solutions.

Keywords: Computer vision, Industrial automation, Industrial inspection, Object detection, Quality inspection

RESCON 2025 CMS 79

LIGHTWEIGHT AND EFFICIENT SRI LANKAN TRAFFIC SIGN DETECTION USING PRUNED AND QUANTIZED YOLOv12-N

M.M. Sumaiya*, **W.G. K.D. Weerasinghe and D.D.A. Arthanayake**

National Institute of Business Management, Colombo, Sri Lanka.
*msumaiya21@gmail.com

Traffic signs play a crucial role as a universal visual language in ensuring road safety, and neglecting or missing them can significantly contribute to accidents. To address this challenge, Traffic Sign Detection and Recognition (TSDR) has become a key feature in Advanced Driver Assistance Systems (ADAS). This study presents an optimised lightweight deep learning model for real-time traffic sign detection, specifically tailored for Sri Lankan traffic signs and traffic lights, with deployment potential in low-computational environments such as edge devices and embedded systems. Three model variants, YOLOv8n, YOLOv11n and YOLOv12-N, were trained on the dataset using the Ultralytics framework. The YOLOv12-N model was selected as the base model for its optimal balance between detection accuracy and computational efficiency. Structured pruning and post-training quantisation, two key model compression techniques, were then applied for optimisation. The computational cost (FLOPs) was reduced by 50% through L1-norm-based channel sparsity pruning, while maintaining critical validation metrics such as mean average precision at IoU 0.5 (MAP: 83.53%), precision (86.23%), and F1-score (81.31%). Dynamic quantisation further reduced the model size by 70.64%, with the final quantised model retaining strong detection capability (MAP: 78.38%, F1-score: 75.96%). The results confirm that YOLOv12-N can be effectively compressed and deployed without significant accuracy loss. This demonstrates the potential of combining pruning and quantisation to develop an efficient real-time traffic sign detection system suitable for low-computation platforms. Future integration into ADAS could enhance road safety, while applications in driver behaviour monitoring tools could support adherence to traffic regulations.

Keywords: Lightweight, Model pruning, Post-training quantization, Traffic sign detection and recognition, YOLOv12-N

RESCON 2025 CMS 80

DATA-DRIVEN APPROACH TO RUBBER YIELD FORECASTING: A CASE STUDY

H.R.N.B. Meththananda*, J. Senarathne and S. Kodithuwakku

Department of Statistics and Computer Science, University of Peradeniya, Peradeniya, Sri Lanka.
*bhagyameththananda97@gmail.com

Rubber cultivation plays a vital role in Sri Lanka's economy, with yield influenced by various climatic and agronomic factors. This study investigated rubber yield dynamics using five years of monthly data from 2019 to 2023, comprising 6,007 observations collected from a large commercial rubber processing industry. Key variables included tappable trees, stand per hectare, tapping days, number of trees per tapper, rainfall, and tapping techniques. To capture these complex relationships, machine learning (ML) models, Lasso Regression, *K*-Nearest Neighbours (KNN), Random Forest (RF), and Extreme Gradient Boosting (XGBoost) regressor were employed. An ensemble model using a voting regressor was constructed by combining the outputs of all four models to enhance predictive robustness. Additionally, a Long Short-Term Memory (LSTM) network was utilised for long-term forecasting, effectively identifying temporal dependencies and seasonal patterns. The dataset was shuffled and divided into 70% for training, 20% for testing, and 10% for validation. XGBoost achieved the best short-term performance, with a coefficient of determination (R^2) of 0.93 and the lowest mean absolute error (MAE) of 489.17 on the test set, outperforming other short-term forecasting models and effectively capturing complex, non-linear relationships. For long-term forecasting, the LSTM model delivered exceptional precision with minimal errors, achieving an MAE of 0.18 on the test set, enabling accurate yield predictions critical for planning tapping activities and managing seasonal variations. The study reveals that tappable trees, stand per hectare, and tapping days are the most significant yield determinants, with cross-correlation analysis indicating that prior-month rainfall has a 0.002 higher correlation with yield than current-month rainfall due to the disruptive impact of heavy rain on tapping activities. These findings highlight the importance of integrating agronomic practices and climatic factors into predictive models, offering critical insights to enhance productivity and sustainability in Sri Lanka's rubber industry.

Keywords: Climatic factors, *k*-nearest neighbours, Long short-term memory, Random forest, Voting regressor

Life Sciences

RESCON 2025 LS 01

EFFECT OF COIR DUST-BASED GROWTH MEDIA ON GROWTH, CROP YIELD, FIELD DISEASES AND NUTRITIONAL QUALITY OF GREEN BEAN (*Phaseolus vulgaris* L.) RAISED IN A PROTECTED HOUSE

Y.B.M.P.S. Yapa Bandara[1], N.B.U. Dissanayaka[2], K.M.S. Kodikara[3] and W.A.M. Daundasekera[1]*

[1]*Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Horticultural Crop Research and Development Institute, Gannoruwa, Peradeniya, Sri Lanka.*
[3]*Regional Agriculture Research and Development Center, Bandarawela, Sri Lanka.*
*malkanthid@sci.pdn.ac.lk

Green bean (*Phaseolus vulgaris* L.) is a valuable legume crop that is highly vulnerable to pests, diseases, and environmental stress. This study evaluated the feasibility of cultivating *P. vulgaris* cv. HORDI Bean 3 in soilless media under glasshouse conditions as an alternative to conventional soil-based methods. Plants were grown in plastic pots using five different soilless media (T1 – T5), comprising coir dust, coir chips, and partially burned rice husk (PBRH) in ratios of 60:40:0, 60:30:10, 60:20:20, 60:10:30, and 60:0:40, respectively. A soil-based mix of sand, topsoil, and cow dung (1:1:1) served as the control (T6). Each treatment included six replicates arranged in a randomised complete block design (RCBD). Fertigation was provided using Albert's solution for soilless media and a mixture recommended by Department of Agriculture as the control. Crop growth parameters, disease severity, and yield were monitored throughout the growth cycle. Seedlings failed to establish in T1 and T2. Early growth stages in the other soilless treatments showed reduced leaf and flower development, but by the end of the cycle, no significant differences in growth or yield were observed compared to control. Elevated glasshouse temperatures (27 – 34) °C caused flower drop across all treatments. No pest or disease incidence occurred in any treatment. X-ray fluorescence spectroscopic analysis revealed higher silica (Si) concentrations in pods from soilless treatments, likely attributed to the presence of PBRH, rich in Si. Levels of nitrogen, phosphorus, potassium, manganese, iron, copper, and molybdenum in the pods were consistent across treatments, while the control showed significantly higher levels of magnesium, calcium, sulfur, chlorine, and zinc. The results suggest that soilless cultivation of green beans in a glasshouse can reduce disease risks while maintaining yield and quality comparable to soil-based systems. Further trials, particularly during the rainy season, are recommended to validate these findings.

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Keywords: Environmental stress, Flower drop, Green bean, Protected agriculture, Soilless culture

RESCON 2025 LS 02

RHIZOSPHERE-ASSOCIATED *Klebsiella* IN PROMOTING CHILLI GROWTH

G.R. Fernando[1,2], S. Abeysinghe[2], S.M.K. Widana Gamage[2]* and R.G.S.C. Rajapakse[1]

[1]*Department of Molecular Biology and Biotechnology, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Botany, University of Ruhuna, Matara, Sri Lanka.*
*shirani@bot.ruh.ac.lk

Klebsiella inhabit soil, water, human, animal guts, plants and endophytic environments. While some strains are infectious and opportunistic pathogens, others have been developed as commercial biofertilisers. This study evaluated plant growth promotion (PGP) potential of three chilli rhizosphere-associated *Klebsiella* strains. Two strains, CSTM6 and CSTM14 were identified as *K. aerogenes,* and CWSM11 as *K. variicola* by 16S rRNA sequencing. They were screened for PGP attributes, including phosphate, potassium and zinc solubilisation, siderophore production, nitrogen fixation and indole-acetic-acid (IAA) production. Effects on chilli seedling growth were evaluated through seed inoculation and application of fermentation broth to the potting mixture, with three replicates per treatment and control. Plant growth was measured 45-days after inoculation. All three strains solubilised $Ca_3(PO_4)_2$, $ZnCO_3$ and ZnO. Only CWSM11 solubilised apatite and all tested potassium sources. Strain CSTM14 solubilised mica and MOP, while CSTM6 solubilised only MOP. The iron-chelating siderophore production was limited to two CSTM strains. All three strains were found diazotrophic and contributed to enhancing the availability of essential nutrients in the rhizosphere. They also secreted high levels of IAA (> 50 mg L^{-1}) with CSTM strains producing > 200 mg L^{-1}. Biofilm formation is an important trait for effective seed inoculation of bacteria. Strains CSTM6 was found to be a moderate biofilm maker (optical density = 0.45), while the others were weak producers. Plant growth assessments, including shoot and root lengths, biomass, leaf number and chlorophyll content, showed that both seed inoculation and application of fermentation broth significantly enhanced seedling growth compared to controls. *Klebsiella* fermentation broths, rich in secondary metabolites, notably outperformed on shoot growth by enhancing shoot length, shoot fresh weight, leaf number and chlorophyll content. Root growth was promoted only with CWSM11 fermentation broth treatment. These findings highlight that *K. aerogenes* and *K. variicola* strains from the chilli rhizosphere promote growth by enhancing nutrient availability and producing IAA.

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Keywords: *Capsicum annuum, Klebsiella*, Plant growth promoting bacteria

RESCON 2025 LS 03

MONITORING DISEASE PROGRESSION IN RICE BLAST: INSIGHTS FROM SUBSEQUENT INFECTION CYCLES

W.M.S.H. Weerakoon[1,3]*, S.P. Abeysundara[2], D.M.H.R. Dissanayaka[1,3] and H.A.C.K. Ariyarathna[1]

[1]*Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Statistics and Computer Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[3]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
*shashikaw@sci.pdn.ac.lk

Rice blast caused by *Magnaporthe oryzae* is among the most destructive diseases that cause 20 to 30% of yield loss in various rice-growing regions worldwide. As a polycyclic pathogen, it is capable of producing several disease cycles within a single growing season, which accelerates epidemic development when susceptible plant hosts and conducive environments coexist. This study was aimed to investigate the rice blast pathosystem in Sri Lankan production environments by characterising disease progression. The pathogen *M. oryzae* was cultured on oatmeal agar and induced to sporulate. A conidial suspension (1×10^5 conidia per mL) was prepared and used to inoculate 3-week-old 'Pachchaperumal' (*Oryza sativa* L.) rice variety under controlled conditions, where the daily temperature ranged from 10.9 °C (minimum) to 32.2 °C (maximum). The experiment was conducted using a completely randomized block design with three replicates. Each replicate contained 20 rice plants. Inoculated plants were maintained under > 90% relative humidity to favor blast disease development. Daily observations were recorded starting from 3 days post-inoculation. For each day, the number of visible disease spots was counted in each plant. Data was analysed by regression spline models, and the rate of infection was estimated by numerically differentiating the fitted spline functions, yielding a continuous approximation of the daily rate of change in disease spots. Two distinct infection cycles were observed. The first peak in disease development occurred on day 16 (16.2 – 16.3 days), followed by a second, low peak at day 20 (20.3 – 20.5 days). Determination of disease progression rate in the first cycle provided early insight into epidemic potential enabling the optimal timing for control measures, and to predict subsequent infection cycles.

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Keywords: Blast pathosystem, Disease progression, *Magnaporthe oryzae*, Rice blast

RESCON 2025 LS 04

BIO-ORGANO-MINERAL FERTILISER APPLICATION PROMOTES CARBON SEQUESTRATION AND STABILISATION IN RICE ROOT-ZONE SOILS

S.N.B. Ekanayake[1], A.J.M.S.H. Jayasekara[1], M. Premarathna[1]*, G. Seneviratne[1], H.M.S.P. Madawala[2] and B.S. Nanayakkara[2]

[1]*Microbial Biotechnology Unit, National Institute of Fundamental Studies, Kandy, Sri Lanka.*
[2]*Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka.*
*mahesh.pr@nifs.ac.lk

Limited land availability restricts soil carbon sequestration (SCS), highlighting the need for improved, climate-beneficial techniques for farmers. This study explores the potential for SCS and stabilisation through the use of biofilm biofertiliser (BFBF) in combination with modern bio-organo-mineral fertilisers (BOMF). Field experiments were conducted in Ampara, Anuradhapura, Polonnaruwa, and Puttalam in Sri Lanka, during the wet season in 2023/2024. Three previously optimised fertiliser treatments; (a) BOMF practice (500 kg NPK BOMF ha^{-1} + 2.5 L BFBF ha^{-1}), (b) hybrid practice (225 kg PK BOMF ha^{-1} + 62.5 kg CF N ha^{-1} + 2.5 L BFBF ha^{-1}), and (c) chemical fertiliser (CF) practice (340 kg CF NPK ha^{-1}), and a (d) control (no fertiliser) were applied in 10×10 m^2 rice plots in a randomised complete block design with three replicates in each site. Root-zone soil samples were collected at a depth of 0.25 m and air-dried for measuring soil organic C (SOC) and labile C (SLC) (mg kg^{-1}), which were used to calculate SCS. Fourier transform infrared spectroscopic diagnostic bands; water-soluble C (~3400 cm^{-1}), aliphatic B-humin (~2920 and 2850 cm^{-1}), ketones in humin residues (~1730 cm^{-1}), and humified-aromatic stable C (~1620 – 1650 cm^{-1}) were used to measure C mineralisation and stabilisation. The results indicated that the hybrid practice sequestered significantly ($p < 0.05$) higher quantities of C (41.75 Mg ha^{-1}) than the CF practice (24.91 Mg ha^{-1}). In addition, the hybrid practice also exhibited significant ($p < 0.05$) increases in water-soluble C, aliphatic B-humin, ketones in humin residues, and humified-aromatic stable C contents by 66%, 10%, 66%, and 59%, respectively, compared to the CF practice. In conclusion, both labile and stable carbon fractions increase with the application of BOMF-based hybrid practices, suggesting a promising and climate-smart approach to enhancing SCS in rice cultivation.

Financial assistance from Ministry of Science and Technology, Sri Lanka (Grant No. 2507) is acknowledged.

Keywords: Biofilm biofertiliser, Carbon sequestration, Climate-smart agriculture, Root-zone soil

RESCON 2025 LS 05

IMPACT OF BIOFILM BIOFERTILISER-BASED BIO-ORGANO-MINERAL FERTILISER PRACTICE ON PEST AND DISEASE MANAGEMENT IN RICE CULTIVATION IN SRI LANKA

A.J.M.S.H. Javasekara[1], K.A.D. Sathsarani[1], M. Premarathna[1]*, G. Seneviratne[1], H.M.S.P. Madawala[2] and B.S. Nanayakkara[2]

[1]*Microbial Biotechnology Unit, National Institute of Fundamental Studies, Kandy, Sri Lanka.*
[2]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
*mahesh.pr@nifs.ac.lk

In rice cultivation, the use of eco-friendly fertilisers is becoming important to enhance crop productivity by supporting nutrient availability, and effective insect pest and disease management. This study examined the effectiveness of biofilm biofertiliser-based bio-organo-mineral fertilisers (BOMF) on insect pest and pathogen management, and in enhancing crop productivity in rice cultivation. Field experiments were conducted in Ampara district using a randomised complete block design with three replicates. The fertiliser practices and control tested were: (a) BOMF practice (500 kg BOMF NPK ha^{-1} + 2.5 L BFBF ha^{-1}), (b) hybrid practice (225 kg BOMF PK ha^{-1} + 62.5 kg CF N ha^{-1} + 2.5 L BFBF ha^{-1}), (c) chemical fertiliser (CF) practice (340 kg CF NPK ha^{-1}, as per the Department of Agriculture recommendations), and (d) control (no fertiliser). The percentages of plants with pest attacks (PP) and diseases (PD) were measured at the 50% flowering stage, using density counting method based on observations from three quadrants per plot. Grain dry yield was measured at harvest. Statistical analyses included One-way ANOVA and Tukey's HSD test following normality confirmation. The control (3.14%), BOMF (1.59%), and hybrid fertiliser (4.82%) practices showed significantly ($p < 0.05$) reduced PP compared to CF practice (16.86%). The BOMF (19.54%) and hybrid fertiliser (17.04%) practices showed significantly ($p < 0.05$) reduced PD compared to CF practice (31.29%) and control (32.47%). In addition, the hybrid fertiliser practice achieved significantly ($p < 0.05$) the highest crop yield (7804 kg ha^{-1}), while BOMF (4470 kg ha^{-1}), CF (4641 kg ha^{-1}), and control (3816 kg ha^{-1}) produced comparable yields. In conclusion, the eco-friendly BOMF-based hybrid fertiliser practice effectively manages insect pests and diseases in rice while enhancing grain yield, demonstrating strong potential for sustainable rice cultivation.

Financial assistance from Ministry of Science and Technology, Sri Lanka (Grant No. 2507) is acknowledged.

Keywords: Biofilm biofertiliser, Crop protection, Pest attacks, Rice, Sustainable agriculture

RESCON 2025 LS 06

PRELIMINARY INVESTIGATION OF MUTATION TYPES EXISTING IN TWO DWARF RICE VARIETIES IN SRI LANKA

S. Navarethinam[1,2] and M.P.C.S. Dhanapala[1,2]*

[1]Department of Molecular Biology and Biotechnology, University of Peradeniya, Peradeniya, Sri Lanka.
[2]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.
*chandimasd@sci.pdn.ac.lk

Dwarfism in rice is a desirable trait often associated with improved yield and better lodging resistance. As a vital phytohormone, gibberellic acid (GA) influences plant growth and development. Gene mutations disrupting gibberellic acid biosynthesis or signaling pathways are known to lead reduced plant stature. This study examines whether the dwarfism in two Sri Lankan dwarf rice (*Oryza sativa*) varieties is linked to mutations in genes involved in GA biosynthesis and signaling pathways. To evaluate the GA responsiveness, three-week-old seedlings from two dwarf and normal-height reference rice (*Oryza sativa*, Tikiri Kekulu) varieties were subjected to foliar application of 50 µM GA once daily for seven days, using three independent pots per variety and treatment (nine plants per pot; total 27 plants). Plant height measurements were recorded weekly, with pots randomly arranged in the greenhouse. Measurement analysis revealed that GA-treated dwarf plants exhibited growth similar to the normal variety, while untreated dwarf plants remained stunted. This response suggests that dwarfism results from disruptions in endogenous GA biosynthesis. To confirm the presence of genetic mutations, eight key genes were selected for molecular analysis-five involved in the GA biosynthesis pathway (*OsKS1*, *OsKO2*, *OsKAO*, *OsGA20ox2*, and *OsGA3ox2*) and three in the GA signaling pathway (*SLR1*, *GID1*, and *GID2*), respectively. Primers designed to amplify these genes with shorter coding regions will be amplified and analysed using genomic DNA, while longer genes will be analysed using cDNA. This ongoing study will continue with RNA extraction, cDNA synthesis, PCR amplification, and Sanger sequencing to compare the target gene sequences among the dwarf varieties and the reference variety. The study is expected to reveal mutations underlying the dwarf phenotype and enhance understanding of GA-related gene regulation, with potential applications in molecular breeding for the development of high-yielding semi-dwarf rice varieties.

Financial assistance from Postgraduate institute of Science, University of Peradeniya (Grant No. PGIS/2024/06) is acknowledged.

Keywords: Dwarf rice varieties-Sri Lanka, GA biosynthesis and signaling pathway, GA-deficient mutants

RESCON 2025 LS 07

BEE POLLINATORS ENHANCE B-ONION SEED PRODUCTION IN THE DRY ZONE OF SRI LANKA

H.M.A.M. Herath and W.A.I.P. Karunaratne*

Department of Zoology, University of Peradeniya, Peradeniya, Sri Lanka.
*inokap@sci.pdn.ac.lk

Production of B-onion (*Allium cepa* L.), a key cash crop in Sri Lanka, falls short of consumer demand due to limited quality seeds and high-cost of commercial seeds. This study investigated the role of insect pollination on B-onion seed production in the dry zone, Sri Lanka, focusing on key pollinators, seed yield, dry weight and germinability. Six experimental plots with B-onion (local breed, 72 plants) were established in a home garden (~112 ft^2), Sigiriya. A total of 50 umbels were randomly selected; 25 open to insects and 25 individually covered with meshed nets. Observations were made on diurnal insect visits, and their floral resources. Seed yield and germinability were compared between open and covered flowers. Germinability test was conducted using the Petri dish method and the Envelop method. After eight days, germination percentages and seedling lengths were recorded. The pollen bee, *Halictus lucidipennis,* was the most frequent visitor, followed by the honeybees, *Apis cerana* and *A. florea*. Nesting sites of *H. lucidipennis* were observed within the plots. The overall diurnal visiting pattern of bees revealed a peak around 8:00 – 9:00 a.m., and this matched with their peak pollen-collecting time, while nectar collection remained throughout the day. The species-specific foraging patterns highlighted distinct preferences: *H. lucidipennis* and *A. cerana* being more active in the morning (8:00 – 9:00 a.m.) for pollen foraging, while *A. florea* preferred midday (12:00 – 1:00 p.m.) for nectar foraging. Further, *A. cerana* preferred nectar foraging during evening (4:00 – 5:00 p.m.). Open umbels had significantly higher seed number (opened: 537±33, closed: 134.2±15.0, $p < 0.05$) and weight (opened: 2.105±0.130 g, closed: 0.534±0.064 g, $p < 0.05$) than covered umbels. A higher germination percentage of seeds developed in open umbels than in closed umbels resulted from both the Petri dish (opened: 89.33%, closed 79.33%, $p < 0.05$) and the Envelop method (opened 93.33%, closed 72.67%, $p < 0.05$) showed a significant difference with longer seedlings. These findings highlight the crucial role of bee pollinators in enhancing B-onion seed production and quality. Future research should assess the vigor of the next generation plants and the efficiency of different pollinators on seed set.

Keywords: B-onion seed production, Germinability, *Halictus lucidipennis*, Insect pollination, Visiting pattern

RESCON 2025 LS 08

PREDICTING THE THREAT: BIBLIOMETRIC ANALYSIS AND SPECIES DISTRIBUTION MODELING OF INVASIVE SAILFIN CATFISHES (*Pterygoplichthys*) IN SRI LANKA

A. Abesinghe[1]* and J. Sandamali[2]

[1]*Department of Biological Sciences, Auburn University, Alabama, USA.*
[2]*Department of Spatial Sciences, General Sir John Kotelawala Defense University, Southern Campus, Sooriyawewa, Sri Lanka.*
*aja0077@auburn.edu

Sri Lanka, an island rich with endemic freshwater biodiversity, faces significant ecological threats from invasive alien species. Among these, sailfin catfishes of the genus *Pterygoplichthys* (notably *P. pardalis, P. disjunctivus*, and their hybrids) introduced via the aquarium trade have established feral populations locally. Their taxonomic identity outside South America remains disputed due to insufficient phylogenetic scrutiny. These robust algae grazing species outcompete native fishes, destabilise benthic habitats through burrowing activity, exacerbate bank erosion, disrupt trophic networks, imperil shorebirds by altering nesting sites, modify macrophyte dynamics, and damage fishing equipment and agricultural infrastructure. In Sri Lanka, *Pterygoplichthys* species have colonised multiple aquatic environments spanning the wet, intermediate, and dry climatic zones, including major river systems such as the Mahaweli, Malwathu Oya, and Kelani. However, comprehensive mapping of their distribution remains incomplete. A bibliometric analysis was conducted using Web of Science records, identifying 296 *Pterygoplichthys*-related publications globally, of which 132 explicitly addressed their invasive impacts. Notably, only three studies originated from Sri Lanka, underscoring a significant local research gap. The paucity of regional data accentuates the need for prioritised research and monitoring to inform evidence-based management. Species distribution modeling (SDM) was employed using 19 BIOCLIM bioclimatic variables obtained from the WorldClim v2.1 dataset, together with elevation data and 328 native-range occurrence points from South America to project potentially suitable habitats for *Pterygoplichthys* across Sri Lanka. The species distribution model (AUC = 0.895) predicted a potential range for *Pterygoplichthys* across Sri Lanka, with high suitability concentrated in the Western, Northwestern, and Sabaragamuwa Provinces. These findings highlight the need to begin building a foundation for conservation planning, stakeholder engagement, and the development of proactive biosecurity strategies that are critical for safeguarding Sri Lanka's freshwater ecosystems against the growing impact of invasive sailfin catfish.

Keywords: Bibliometric analysis, Biological invasions, *Pterygoplichthys,* Species distribution models

RESCON 2025 LS 09

EVOLUTIONARY DIVERSIFICATION AND HISTORICAL BIOGEOGRAPHY OF NANNENINI JUMPING SPIDERS IN THE SOUTH ASIAN HIGHLANDS

K.M.R.K.T. Herath[1,3], A. Jose[2], A.V. Sudhikumar[2] and S.P. Benjamin[1,4]*

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka.*
[2]*Centre for Animal Taxonomy and Ecology, Department of Zoology, Christ College, Irinjalakuda, Kerala, India.*
[3]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[4]*Alexander Koenig Research Museum of Zoology, Adenauerallee, Germany.*
*suresh.benjamin@gmail.com

The northward drift of the Indian subcontinent and its subsequent biotic exchanges with adjacent landmasses have significantly influenced South Asian biodiversity, though they remain active subjects of scientific debate. This study investigates biogeographic patterns and evolutionary relationships within a clade of spiders endemic to South Asia, focusing on two newly identified species from India. Fieldwork was conducted across all climatic regions of Sri Lanka, including wet zone forests (Hiyare, Hiniduma FR, Labugama, Pompakele FR, and Sinharaja FR), montane forests (Hakgala SNR, Horton Plains NP, Piduruthalagala, Loolecondera Estate, Upcot, and Knuckles Range), dry zone forests (Katharagama Peak and Mihintale Sanctuary), and in tropical forests of Southern Western Ghats, Kerala, India. DNA extracted from leg tissue of two newly identified species was sequenced for mitochondrial gene *CO1*, nuclear ribosomal RNA fragments (*18S* and *28S*), and nuclear *H3*. Phylogenetic trees based on the concatenated four gene matrix were constructed using both Maximum Likelihood (ML) and Bayesian inference methods. A time calibrated analysis was performed to estimate diversification timing, and ancestral area reconstruction was conducted to infer the historical geographic distribution of ancestral lineages. Phylogenetic analyses strongly supported the monophyly of the Nannenini clade, with three distinct subclades. Nannenini spiders likely dispersed across South and Southeast Asia between the Late Oligocene and Early Miocene, a period marked by major climatic and tectonic shifts that facilitated their lineage diversification. During the Late Miocene, cooling and increased acidification restricted forest adapted species to montane refugia, especially in Sri Lanka's central highlands and the mountainous regions of India, promoting isolation and driving speciation among montane adapted Nannenini species. Montane environments likely acted as critical climate refugia, maintaining biodiversity during adverse climates and facilitating later expansion, highlighting the crucial role of Sri Lanka's central highlands and India's montane zones in regional biodiversity.

Keywords: Climate change, Divergence dating, Montane refugia, South Asia, Speciation

RESCON 2025 LS 10

RELATIONSHIP BETWEEN SEXUAL MATURITY AND THROAT COLOUR INTENSITY IN THE MALE LITTER SKINK, *Lankascincus fallax*

P.A.S. Roshima, R.L. Jayaratne and K.D.B. Ukuwela*

Department of Biological Sciences, Rajarata University of Sri Lanka, Mihintale, Sri Lanka.
*kanishka@as.rjt.ac.lk

Colour polymorphism is a widespread phenomenon in the animal kingdom, and elucidating the mechanisms that generate and sustain this phenotypic diversity remains a central goal in evolutionary biology. *Lankascincus fallax*, an endemic skink to Sri Lanka, exhibits three distinct throat colour morphs (red with white spots, black with white spots and white). The brighter throat colours occur exclusively in larger males. In this study, the relationship between sexual maturity (*i.e.* testicular maturity) and throat colour intensity in male *L. fallax* was examined. Testicular maturity was determined through histological examination of testes in 19 preserved *L. fallax* specimens. Throat colour intensity was quantified by extracting intensities of Red, Green and Blue (RGB) colour channels from standardised digital photographs of the throat in live skinks (Black = 9, Red = 2, White = 24), using ImageJ software. Results showed that individuals with mature testes had a significantly larger mean snout-vent length (SVL: 39.75 mm, range 35.24 – 43.97 mm) compared to those with immature testes (mean SVL: 28.39 mm, range 26.94 – 29.48 mm; $t = 7.162$, $p < 0.001$), indicating a strong relationship between body size and testicular maturity. In red and white throated individuals, there was a positive correlation of red intensity with SVL and a negative correlation with blue and green intensities, suggesting that red colouration becomes more pronounced as red throated individuals grow. In black and white throated individuals, there was a positive correlation of blue intensity with SVL and a negative correlation with red intensity suggesting that blue colouration becomes more pronounced as black throated individuals grow. These patterns indicate that throat colour intensity increases with the body size (*i.e.* SVL) in *L. fallax* males. Taken together, these findings suggest that bright throat colours of male *L. fallax* serve as a reliable indicator of sexual maturity.

Keywords: Colour polymorphism, RGB colours, Snout-Vent length, Testicular histology

RESCON 2025 LS 11

NOCTURNAL BEETLE ASSEMBLAGES AND THEIR TAXONOMIC AND FUNCTIONAL DIVERSITY ACROSS SUB-MONTANE HABITATS IN RIVERSTON, SRI LANKA

W.M.H.U. Wijerathna, U.G.S.L. Ranasinghe and S.P. Benjamin*

National Institute of Fundamental Studies, Kandy, Sri Lanka.
*suresh.benjamin@gmail.com

Beetles represent a significant portion of Sri Lanka's insect fauna. However, little is known about how their diversity patterns and ecological functions vary across sub montane habitats. In this study, the diversity and the functional structure of nocturnal beetle assemblages across three habitat types, central forest (CF), forest edge (FE) and grassland (GR), were investigated in Riverston, northern Knuckles Conservation Forest. Field surveys were conducted during 2019 and 2020, including dry and rainy seasons using UV-light traps (total 72 trapping events). Beetles were identified to family level and classified into six feeding groups (Herbivores, Predators, Scavengers, Fungivores, Moss feeders, and Xylophagous). Assemblages were analysed for taxonomic and functional diversity using abundance data. In total, 10,133 beetles from 65 families were recorded. FE supported the highest abundance and richness (44.52%, 58 families), followed by CF (35.72%, 56) and GR (19.74%, 46). The most common family was Staphylinidae in FE (18.4%) and GR (24.7%), while Pselaphidae dominated in CF (43.8%). Shannon and Pielou indices showed no significant differences (FE; $H' = 2.58$, $J = 0.23$, CF; $H' = 2.30$, $J = 0.18$, GR; $H' = 2.55$, $J = 0.29$; $p = 0.3679$), indicating stable alpha diversity. However, Bray-Curtis dissimilarities revealed moderate beta diversity between habitats (CF–FE = 0.61, CF–GR = 0.59, FE–GR = 0.46). CF had the highest functional richness (4.82) and RaoQ (0.72), while FE showed the highest divergence (0.71) indicating the presence of functionally distinct taxa. FE had the most even functional distribution (0.75). NMDS of functional composition revealed distinct separation between CF and GR (73.2% dissimilarity). This study highlights that habitat structure plays a critical role in shaping the functional composition of beetle communities, even when taxonomic diversity appears stable. These findings underscore the importance of conserving a mosaic of habitats to ensure the maintenance of overall beetle biodiversity. A future study will extend to additional sub-montane locations to assess the consistency of these patterns across a broader spatial scale and further inform habitat-based conservation strategies.

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Keywords: Beetles, Conservation, Diversity patterns, Ecological functions, Sub-montane

RESCON 2025 LS 12

STUDY OF MIXED-SPECIES FORAGING FLOCKS IN FOREST PATCHES OF NONPAREIL ESTATE, BELIHULOYA

P.U. Piyushani, S.N. Weerakkody and E.P. Kudavidanage*

Department of Natural Resources, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka.
*enokakudavidanage@gmail.com

Mixed-species foraging flocks (MSFFs) represent a key ecological phenomenon that enhances foraging efficiency, predator avoidance and interspecific cooperation, among birds. This study aimed to explore the composition, structure, species roles, and habitat associations of MSFFs within the intermediate zone forest patches and plantations of Nonpareil Estate, Belihuloya, Sri Lanka, between February and April 2025, during 06:00 – 09:00 h. Field observations revealed a total flock richness of 21 – 26 species, with dominant species including the red-vented bulbul (*Pycnonotus cafer*; relative abundance 10.79%, mean 8.62±8.86 individuals, mean participation (85.72±27.14)%), Sri Lanka White-eye [*Zosterops ceylonensis;* relative abundance 9.85%, mean 7.88±3.75 individuals, mean participation (84.29±19.64)%], and pale-billed flowerpecker (*Dicaeum erythrorhynchos;* relative abundance 7.19%, mean 5.75±2.50 individuals, 100% participation). The white-bellied drongo (*Dicrurus caerulescens*) was identified as both a nuclear and sentinel species due to its central position in flocks, high vigilance, and frequent alarm calling, while the orange minivet (*Pericrocotus flammeus*) also served as a nuclear species. The red-vented bulbul acted as a leading species, often initiating flock movement. Regular participants with moderate flocking indices (0.30 – 0.59) were mostly midstory dwellers, whereas occasional participants (0.05 – 0.29) occurred in the understory, canopy, and ground layers. MSFFs were most frequently observed in edge habitats and remnant forest patches near human settlements, whereas monoculture plantations (*Eucalyptus* and *Pinus*) did not support flock formation. One isolated flock was identified in a riparian zone near Hirikatuoya River, characterised by open grassland and scattered canopy. The study contributes baseline ecological data on MSFFs in the intermediate zone of Sri Lanka. It enhances understanding of species-specific roles, habitat preferences, and spatial flocking patterns. These findings are important for conservation planning, especially in fragmented habitats, and serve as a reference for comparative studies across other ecosystems in the Wet Zone and the Central Highlands, particularly in the face of ongoing climate and land-use changes.

Keywords: Flock participation, Habitat preferences, Mixed-species foraging flocks, Species composition, Sri Lanka

RESCON 2025 LS 13

A COMPARATIVE ANALYSIS OF PASSIONFRUIT (*Passiflora edulis* f. *flavicarpa* Deg.) WINE FERMENTATION USING *Saccharomyces cerevisiae* VERSUS INDIGENOUS PASSIONFRUIT MICROFLORA

I.U.K. Nanayakkara[1]*, B.S. Nanayakkara[1], R.P.N.P. Rajapakse[2] and K.M.G.G. Jayasuriya[1]

[1]*Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Food Science and Technology, University of Peradeniya, Peradeniya, Sri Lanka.*
*uthkarshaisuri@gmail.com

Passionfruit (*Passiflora edulis f. flavicarpa* Deg.) is valued for nutritional and bioactive properties, suitable for winemaking. This study evaluated fermentation with commercial *Saccharomyces cerevisiae* (yeast) and indigenous passionfruit microflora to assess physicochemical and bioactive effects on the wine. Wines used both inocula, six replicates per treatment. Fermentation was monitored weekly for four weeks by determining pH, temperature, residual sugar (°Brix) content, and alcohol content, although the first 7 – 10 days may capture critical changes. Microbial diversity was assessed on Sabouraud Dextrose Agar and Plate Count Agar, confirming *S. cerevisiae* in both fermentations. Antioxidant activity and antimicrobial activity were determined using DPPH free-radical scavenging assay and agar well diffusion, respectively, against *Staphylococcus aureus, Enterococcus faecalis* (Gram-positive), *Escherichia coli, Pseudomonas aeruginosa* (Gram-negative), and *Candida albicans*. Data was analysed using two-way ANOVA by Past4.03. Yeast-fermented wine (YW) showed a significantly higher ($p < 0.05$) pH (3.8±0.06), higher alcohol content (10.60±0.43)%, lower residual sugar content (9.20±0.36) °Brix and rapid increment in temperature compared to indigenous wine (IW) with pH (2.40±0.12), alcohol content (3.10±0.91)%, and sugar content (9.92±0.34) °Brix. Microbial colony diversity decreased over time in both wines. Compared to YW, IW produced significantly greater antioxidant activity (IC_{50} of 2.14±0.14 mg mL^{-1}) for yeast wine ($p < 0.05$). Compared to IW, YW exhibited smaller inhibition zones: *S. aureus* (14.08±3.00 vs. 0 mm), *E. faecalis* (19.22±1.60 vs. 10.92±2.00 mm), *E. coli* (14.33±1.00 mm vs. 5.31±1.47 mm), *P. aeruginosa* (8.00±0.84 vs. 0 mm), and no inhibition against *C. albicans*. Indigenous microflora enhances antioxidant and antimicrobial properties of passionfruit wine, supporting potential functional benefits. Yet, further validation (toxicity, sensory, *in vivo* studies) is needed. The lower alcohol content in indigenous wine may limit its classification as a wine, suggesting the need for optimisation.

Keywords: Agar well diffusion, Antimicrobial activity, Antioxidant activity, Bioactive compounds, DPPH assay

RESCON 2025 LS 14

WATER QUALITY AT SELECTED SITES OF THE RIVER KALU, SRI LANKA: *Escherichia coli* AND PHYSICOCHEMICAL ASPECTS

S. Mayadunne[1], B.S. Nanayakkara[2]*, C.L. Abayasekara[2], D.M.M.B. Dehideniya[3] and P. Hapuarachchige[4]

[1]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka.*
[3]*Department of Statistics and Computer Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[4]*Department of Sociology, University of Peradeniya, Peradeniya, Sri Lanka.*
*buddhie@sci.pdn.ac.lk

River Kalu in Sri Lanka serves as a major source of recreational water. Increasing environmental degradation due to urbanisation and industrialisation threatens its water quality. The aim of the study was to assess water quality in terms of microbiological and physicochemical parameters at seven sites along the river, during pluvial and non-pluvial periods. Water samples were analysed for *Escherichia coli* and physicochemical parameters; pH, biochemical oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids (TSS), turbidity and chloride, following APHA standards. *Escherichia coli* counts exceeded the permissible limit of 410 cfu/100 mL for recreational purposes (USEPA, 2012), in two study sites, Halwathura and Kalutara. The *E. coli* levels differed by sampling location, with the lowest average recorded at the origin (98.5±144.3 MPN/100 mL) and the highest at Kalutara (708.6±744.2 MPN/100 mL), the river mouth. The counts were significantly higher at Kiriella ($p = 0.016$) and Narthupana ($p = 0.019$), compared to other locations. While not significant, *E. coli* levels were generally higher during the non-pluvial period (388.0±492.0 MPN/100 mL) than in the pluvial period (257.3±431.4 MPN/100 mL) ($p = 0.069$). Turbidity, TSS and chlorine were notably elevated during the pluvial season compared to the non-pluvial, with turbidity rising from 4.6±3.8 NTU to 12.0±9.0 NTU ($p < 0.001$), TSS increasing from 19.2±30.0 mg L^{-1} to 46.7±49.3 mg L^{-1} ($p < 0.001$) and chloride levels from 4.3±5.5 mg L^{-1} to 14.8±23.6 mg L^{-1} ($p < 0.001$). BOD, COD and pH did not exhibit significant seasonal differences. The findings highlight progressive water quality deterioration along the river, with significant microbial and chemical pollution at downstream sites. These results underscore the need for integrated water quality monitoring and pollution control strategies to safeguard public health and environmental sustainability. Correlation among parameters needs to be investigated as future work.

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Keywords: *Escherichia coli*, Faecal indicator organism, River Kalu, Water quality

RESCON 2025 LS 15

MOLECULAR DETECTION AND SEROTYPING OF *Listeria monocytogenes* IN PASTEURISED MILK FROM COLOMBO DISTRICT, SRI LANKA

T.S. Thalpavila[1,2], O.T. Weerasinghe[1,2], M.S.F. Shanu[3], R. Wimalasekera[1] and W.A.S. Wijendra[2]*

[1]*Department of Botany, University of Sri Jayewardenepura, Colombo, Sri Lanka.*
[2]*Medical Research Institute, Colombo, Sri Lanka.*
[3]*Department of Botany, Open University of Sri Lanka, Nugegoda, Sri Lanka.*
*wijendra@mri.gov.lk

Listeria monocytogenes is a pathogenic bacterium that can cause severe illness and may be fatal in high-risk populations, including in immunocompromised individuals and pregnant women. Mitigating the risks associated with *Listeria* contamination in food products is a critical public health priority. There is a lack of recent research addressing *L. monocytogenes* in pasteurised milk from retail outlets. This study investigated the prevalence and serotypes of *L. monocytogenes* in pasteurised milk samples from retail outlets in the Colombo District, using molecular methods. Fifty pasteurised milk samples were collected from retail outlets in the district. Primary enrichment of *Listeria* spp. in samples was carried out using Listeria Selective Enrichment Broth (LSEB), followed by streaking onto Listeria Selective Agar (LSA) plates, for the isolation of typical *L. monocytogenes* colonies. DNA was extracted from all isolates and molecular confirmation was carried out through Nested PCR. Multiplex PCR was used for serotyping, as *L. monocytogenes* has 13 known serotypes, with a few that are most often linked to human listeriosis. The results revealed that *L. monocytogenes* was present in 20 out of 50 samples (40%), indicating a significant risk associated with dairy consumption. From the 50 milk samples, 46 presumptive *Listeria* isolates were obtained, of which 23 were confirmed as *L. monocytogenes* and subjected to serotyping. Serotype 1/2b was identified in 8.69% of the positive samples, while a combination of serotypes 4b and 1/2C was found in 4.34%, suggesting the potential for strain coexistence. Additionally, 86.95% of the isolates remained untyped with the markers used in this study, underscoring the need for additional characterisation and broader molecular approaches to capture the full diversity of circulating strains. Although detected in low numbers, the presence of *L. monocytogenes* serotypes 1/2b and the combination of 4b and 1/2C in pasteurised milk indicate a potential public health concern, underscoring the need for strengthened surveillance and food safety regulations in Sri Lanka.

Keywords: Foodborne bacteria, Food safety, *Listeria* spp., Pasteurised milk, Serotypes

RESCON 2025 LS 16

STUDY ON *Enterococcus* spp. ABUNDANCE IN SEAWATER AND BEACH SAND IN MOUNT LAVINIA BEACH

B.A.A. Bodhinagoda and **K.N. Samarasekera***

Department of Botany, University of Sri Jayewardenepura, Nugegoda, Sri Lanka.
*kaumadi@sjp.ac.lk

Enterococcus spp. is considered a faecal-indicator organism in marine water quality analysis. This study explored faecal pollution at Mount Lavinia beach by studying the abundance of enterococci and the impact of selected physical parameters in seawater and sand samples. Samples were collected from three selected sites in Mount Lavinia beach based on proximity to pollution outlets and potential for recreation. The composite sampling method recommended by the American Public Health Association was followed in this study, and the samples were analysed using membrane filtration method to quantify the enterococci abundance. Bacteria were isolated using m-*Enterococcus* agar and quantified as colony-forming units (CFU). Physical parameters, including temperature, pH, conductivity and salinity, were measured in collected seawater and sand samples. Statistical analysis of examined parameters was carried out using Python. According to Mann-Whitney U test, enterococci count showed a significant difference between sand and seawater in the study area (p = 0.006). However, there were no significant differences between the three selected sites for enterococci counts in both seawater and sand samples ($p > 0.05$). The mean enterococci counts were higher in sand than in seawater. Beach quality was evaluated according to the global standards given by the World Health Organization and United States Environmental Protection Agency (EPA). Accordingly, the 95th percentile value of enterococci (8995 CFU/100 mL) exceeded the maximum limit (500 CFU/100 mL), categorising the beach as Group D, the lowest microbial quality. The geometric mean enterococci concentration was 3,843 CFU/100 mL, which exceeded the EPA-recommended safety limit of 35 CFU/100 mL. The 90th percentile value (statistical threshold value) was 8,460 CFU/100 mL, which was above the EPA Statistical Threshold Value criterion of 130 CFU/100 mL. Therefore, the microbial beach quality indicates that the beach does not meet international water quality standards, making it unsuitable for recreational use.

Keywords: Beach quality, Colony forming units, *Enterococci*, Faecal pollution, Membrane filtration

RESCON 2025 LS 17

EFFECTS OF MICROBIAL FERMENTATION ON THE ANTIOXIDANT POTENTIAL OF *Pouteria campechiana* (CANISTEL)

G.A.P.C. Isurandi* and R. Amarakoon

Department of Microbiology, University of Kelaniya, Kelaniya, Sri Lanka.
*chamani.isurandi@outlook.com

Although *Pouteria campechiana* (Canistel, Sinhala; Lawulu) is highly nutritious, it remains underutilised, because of rapid ripening, off flavor development, and a short shelf life. Consequently, the development of effective processing strategies to preserve its quality until consumption is of significant importance. This study aimed to develop a fermented food product from canistel and to evaluate the effects of fermentation on its antioxidant properties. *Lactobacillus plantarum* DMBUK 113080 was introduced into heat-sterilized mesocarp of canistel immersed in 2.5% brine, and fermented at 37 °C for 24, 48 and 72 hours. Both the unfermented and fermented samples were dried and powdered. Antioxidant potential of the methanolic extracts of canistel was determined using 2,2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging activity measurement. Significant differences in the mean antioxidant activities between the samples were assessed using one-way ANOVA, followed by Tukey's multiple comparison tests for each triplicate. The percentage inhibition calculated for each sample was used to plot the graph with the respective concentrations of the sample standards to obtain the IC_{50} value. The corresponding IC_{50} values of canistel decreased significantly ($p < 0.05$) with fermentation. The 72-hour fermented canistel showed the highest antioxidant activity (IC_{50}; 322.07±2.34 µg mL^{-1}) compared to those of unfermented (IC_{50}; 443.95±1.56 µg mL^{-1}) and other fermented samples [408.36±1.82 µg mL^{-1} (24 h), 374.97±1.22 µg mL^{-1} (48 h)]. IC_{50} values below 1.0 mg mL^{-1} indicate extremely high antioxidant activity. Therefore, both unfermented and fermented canistel fall within this category. Fermentation significantly enhances the antioxidant activity of canistel. Therefore, this product can be recognised as a fermented food which is rich in beneficial functional properties. The process offers a cost-effective solution to reduce post-harvest losses of the canistel fruit.

Keywords: Antioxidant activity, DPPH assay, Fermentation, *Lactobacillus plantarum*, *Pouteria campechiana*.

RESCON 2025 LS 18

ORAL PREVALENCE OF *Candida* AND ITS ASSOCIATION WITH DENTAL CARIES IN CHILDREN

C. Gunasena[1]*, D.P. Jayarathne[2], M.R.D.M. Senanayake[1], M.P. Paranagama[2], and J.A.M.S. Jayatilake[1]

[1]*Department of Oral Medicine and Periodontology, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Basic Sciences, Faculty of Dental Sciences, University of Peradeniya, Peradeniya, Sri Lanka.*
*chandirag@dental.pdn.ac.lk

Oral commensal *Candida* has been suggested to contribute to the pathogenesis of dental caries. However, studies on *Candida* in oral cavity and caries lesions of patients with dental caries are lacking. This study investigated the presence of *Candida* in oral cavities and dental caries lesions in patients with dental caries. A group of 60 children (6 – 12 years) seeking treatment for dental caries from the Dental Teaching Hospital Peradeniya, Sri Lanka were included. None had received dental treatment or antimicrobial therapy within the preceding three months. *Candida* from oral rise and the caries biofilm samples were isolated on Sabouraud dextrose agar and identified using Gram stain, germ tube test, CHROMagar, and Polymerase Chain Reaction (PCR). Hemolysin and phospholipase activities of 12 selected *C. albicans* isolates each from oral and caries lesions were assessed using in vitro plate assays. Site distribution of *Candida* was analysed using Chi square test, while mean hemolysin and phospholipase activities were compared with paired t test. The sample comprised 31 males (50.8%) and 29 females (47.15%). *Candida* prevalence was higher in the oral cavity (76.6%,46/60) than in caries lesions (58.3%, 33/60). *C. albicans* predominated in the oral cavity (84.8%,41/46), whereas Non-albicans Candida (NAC) species were common in caries lesions (51.4%, 18/33). There was a significant difference in *Candida* distribution between these two sites (χ^2 = 5.33, p = 0.021). Hemolysin activity of *C. albicans* from caries lesions was significantly higher than that of oral isolates (p = 0.02), while phospholipase activity showed no significant difference (p = 0.65). These findings demonstrate that *C. albicans* predominates in the oral cavity, whereas NAC species are more frequent in caries lesions. The elevated hemolysin activity of *C. albicans* from caries lesions suggests a potential role in caries pathogenesis, while NAC species may also contribute to lesion development.

Financial assistance from University Research Council (URC), University of Peradeniya (Grant No. URG/2024/09/D) is acknowledged.

Keywords: *Candida*, Dental Caries, Virulence, Non-albicans *Candid*a, PCR

RESCON 2025 LS 19

SEASONAL DYNAMICS AND ENVIRONMENTAL CORRELATES OF ANTIBIOTIC-RESISTANT BACTERIA IN SURFACE AND GROUNDWATER OF THE KELANI RIVER BASIN, SRI LANKA

A.K.M.M.K. Meddage[1,2], G.Y. Liyanage[2,3], F.S. Idroos[2] and P.M. Manage[2]*

[1]University of Sri Jayewardenepura, Nugegoda, Sri Lanka.
[2]Centre for Water Quality and Algae Research, Department of Zoology, University of Sri Jayewardenepura, Nugegoda, Sri Lanka.
[3]Department of Aquatic Bioresources, University of Sri Jayewardenepura, Nugegoda, Sri Lanka.
*pathmalal@sjp.ac.lk

Antimicrobial resistance (AMR) is one of the most pressing threats to global health and development. Many studies indicate that climate change exacerbates this issue by promoting the spread of infections and pharmaceutical residues, thereby creating environmental conditions conducive to the proliferation of AMR. This study aimed to investigate the seasonal occurrence, spatial distribution, and environmental correlates of antibiotic-resistant bacteria (ARB) in surface and groundwater within the Kelani River Basin, Sri Lanka. A total of seventy-one water samples were collected during both wet and dry seasons, representing the entire river basin. Furthermore, ten commonly used antibiotics were selected for ARB screening: Ciprofloxacin (CIP), Cefuroxime (CXM), Cloxacillin (CLOX), Amoxicillin (AMX), Co-Amoxiclav (CO-AMX), Tetracycline (TET), Azithromycin (AZT), Erythromycin (ERM), Sulfamethoxazole (SMX), and Gentamicin (GEN). Water quality parameters were analysed according to the APHA standard methods. ARB isolation was conducted using the standard pour plate technique. A total of 1,050 ARB was isolated. Out of which, 611 were isolated during the wet season and 439 during the dry season. The highest frequency of antibiotic resistance was detected for CLOX (20.79% in the wet season; 19.82% in the dry season). In contrast, the lowest resistance was recorded for TET (2.62% – wet; 2.51% – dry) and (2.13% – wet; 1.59% – dry). Spatially, the upper-middle catchment region showed the highest ARB contamination. Total coliform levels showed significant contamination ($p < 0.05$) throughout the river, with the highest concentrations observed in the meandering zone. Spearman's correlation analysis revealed significant associations between ARB prevalence and selected water quality parameters, including water temperature (both seasons), total phosphorus (wet season), and nitrogenous compounds (both seasons; $p < 0.05$). The findings of the present study revealed that seasonal variability plays a significant role in emerging the distribution and abundance of ARB in the Kelani River Basin. Therefore, integrated water quality management strategies are urgently required to efficiently mitigate the risks associated with antibiotic resistance in aquatic environments.

Financial assistance from the Research Council of University of Sri Jayewardenepura, Sri Lanka (Grant No. RC/URG/SCI/2024/34), and Hayleys Fabric PLC, Sri Lanka, is acknowledged.

Keywords: Amoxicillin, Antibiotic resistance, Kelani river, Seasonal variation, Tetracycline

RESCON 2025 LS 20

ANTIBACTERIAL ACTIVITY OF SELECTED PLANT EXTRACTS AGAINST AN ORAL ISOLATE OF *Acinetobacter baumannii*

Y.R.B. Wickramanayake, T.C. Weeraratne and W.A.P.P. de Silva*

Department of Zoology, University of Peradeniya, Peradeniya, Sri Lanka.
*depriyanka@sci.pdn.ac.lk

Acinetobacter baumannii, a multidrug-resistant Gram-negative bacterium, is increasingly recognised as an oral pathogen. With rising resistance to antibiotics, plant-derived alternatives are gaining attention. This study aimed to evaluate the antibacterial activity of root extracts of *Cocos nucifera*, *Areca catechu* and *Piper nigrum* plants individually, and their synergistic activity against *A. baumannii.* Dental plaque samples were collected after obtaining the consent from participants. Those samples were cultured in nutrient media, and pure colonies were isolated from the morphologies which appeared consistently across all the samples. The isolated bacterium was identified via 16S rRNA gene sequencing and subsequently used for Anti-Bacterial Sensitivity Testing (ABST) via the disk diffusion method. Crude plant extracts were prepared using methanol, and concentrated via rotary evaporation and subjected to ABST, individually and in combination (1:1:1 ratio) using the disk diffusion method. Two 0.2% chlorhexidine containing mouthwashes and distilled water were used as positive and negative controls, respectively. *Areca catechu* and *C. nucifera* extracts showed moderate inhibition of approximately 13 mm, whereas *P. nigrum* had no effect. The combination extract and chlorhexidine mouthwashes produced comparable inhibition zones of ~15 – 16 mm, with no statistically significant difference ($p > 0.05$). The antibacterial activity of the combined extracts did not significantly differ from the individual effects of *A. catechu* or *C. nucifera* ($p > 0.05$), suggesting that the combination of these plant extracts would not provide enhanced effectiveness over their individual application. In conclusion, both *A. catechu* and *C. nucifera* root extracts exhibited notable antibacterial activity against *A. baumannii*, individually and in combination, highlighting their potential as promising plant-based alternatives for combating *A. baumannii* infections.

Keywords: *Acinetobacter baumannii*, Antibacterial activity, Multidrug resistance, Oral pathogens, Plant extracts

RESCON 2025 LS 21

Osbeckia octandra (HEEN BOWITIYA) HERBAL TEA: EFFECT ON METABOLIC INDICES IN METABOLIC DYSFUNCTION ASSOCIATED FATTY LIVER DISEASE

A.M.D.S. Karunaratna[1,2], S. Ekanayake[1]* and C.K. Ranawaka[3]

[1]*Department of Biochemistry, Faculty of Medical Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka.*
[2]*Department of Basic Sciences, Faculty of Allied Health Sciences, General Sir John Kotelawala Defense University, Ratmalana, Sri Lanka.*
[3]*Department of Gastroenterology, Colombo North Teaching Hospital, Ragama, Sri Lanka.*
*sagarikae@sjp.ac.lk

Metabolic dysfunction-associated fatty liver disease (MAFLD) is a common, multisystemic disorder. *O. octandra* is used in traditional medicine to treat liver diseases and diabetes mellitus. The study aimed to evaluate the effect of *O. octandra* herbal tea on metabolic indices in MAFLD. A 16-week, randomised, controlled, open-label trial including 122 MAFLD patients assigned to a test group ($n = 62$), receiving *O. octandra* tea (6.0 g plant powder per day, every other day) with standard therapy and lifestyle intervention, or a control group ($n = 60$), receiving standard therapy with lifestyle intervention alone was conducted at Colombo North Teaching Hospital. Glycemic indices, lipid profile, hs-CRP, and free thyroxin (FT4) were determined at baseline and after 16 weeks. The paired *t*-test and analysis of covariance test were used to analyse the data. Fasting blood glucose (FBS) and HbA1c showed a non-significant increase in both arms ($p > 0.05$) at follow-up, with no significant differences in the changes between the test and control groups ($p = 0.87$, $p = 0.67$). Total cholesterol and low-density lipoprotein cholesterol showed a significant increase in both groups ($p < 0.05$) at follow-up. However, a non-significant increase (0.6%) in high-density lipoprotein cholesterol (HDL-C) (reference > 40 mg dL^{-1} for males, > 50 mg dL^{-1} for females) ($p = 0.71$), and a decrease (6%) in triglycerides (reference < 150 mg dL^{-1}, $p = 0.16$) were observed following the intervention in the test group. The changes of lipid profile parameters were not significantly different between the test and control groups at follow-up ($p > 0.05$). Hs-CRP reduced significantly in both test and control groups ($p = 0.03$, $p = 0.002$), with no significant difference between the test and control groups ($p = 0.14$). A non-significant increase in FT4 was observed in the control group after 16 weeks ($p = 0.053$), while the changes did not differ significantly between the test and control groups ($p = 0.14$). The ingestion of *O. octandra* herbal tea every other day for four months contributed to a slight increase in HDL-C and a decrease in triglycerides, with no major impact on other studied parameters in MAFLD patients.

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Keywords: Fasting blood sugar, Lipid profile, Metabolic dysfunction-associated fatty liver disease, Metabolic indices, *Osbeckia octandra*

RESCON 2025 LS 22

FUNCTIONAL PLASTICITY OF SEEDS OF THE INVASIVE SPECIES *Miconia crenata*: IMPLICATION FOR EFFECTIVE MANAGEMENT

E.L.M. Muthumali* **and K.M.G.G. Jayasuriya**

Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka.
*mekalamuthumali98@gmail.com

Invasive plant species *Miconia crenata* poses a significant threat to biodiversity and ecosystem stability in Sri Lanka. Its rapid spread necessitates the development of effective management strategies, which require a deeper understanding of its biology, particularly the plasticity of seed functional traits. This study investigated seed dormancy variations through monthly dry storage treatments, germination patterns under different light conditions [Light/dark condition (12 h/12 h) and complete dark conditions (24 h)], environmental adaptability via the hydrotime model across three populations from Riverston (7°31'23.6"N 80°44'11.7"E), Hanthana (7°15'31.5"N 80°36'01.9"E) and Galle (6°03'31.0"N 80°18'47.9"E), and the impact of bioclimatic factors on seed functional traits, specifically moisture content (oven drying method), dry weight, germination timing, dormancy, and osmotic stress tolerance [0, –0.1, –0.2, –0.5, and –1 MPa poly(ethylene glycol) solutions], each tested with four replicates. Germination trials under different light conditions revealed the variability in the portion of non-dormant seeds among populations. Dry storage treatments revealed significant differences in dormancy patterns ($p < 0.001$) with distinct dormancy cycles. However, there was no significant difference in seed moisture content ($w = 2.867$, $p = 0.236$), dry weight ($F = 3.777$, $p = 0.087$), and the hydro-time constant (H_Θ; $z = 2.997$, $p = 0.22$) among populations. Riverston seeds exhibited the lowest base water potential (-2.54 MPa), indicating greater drought tolerance ability, while Galle seeds showed higher moisture content (14.41%), higher base water potential (–3.34 MPa), and lower dormancy, reflecting adaptation to wetter environments. Canonical Correspondence Analysis (CCA) demonstrated a strong correlation between temperature (BIO1), and diurnal range (BIO2), with seed functional traits, highlighting the environmental influences on germination behavior. The study confirms high plasticity in seed traits of *M. crenata*, enabling its successful establishment in diverse climates. Future research should focus on analysing genetic variation and assessing seed trait responses under simulated natural conditions to refine management approaches.

Keywords: Ecosystem management, Germination plasticity, Invasive species, *Miconia crenata*, Seed dormancy

RESCON 2025 LS 23

SEED TRAIT DRIVEN INVASIVENESS OF *Dillenia suffruticosa*: PERSPECTIVES ON REPRODUCTIVE BIOLOGY AND ECOLOGICAL IMPACT

H.P. Dayananda[1]*, K.P.P. Maheshya[1], K.M.G.G. Jayasuriya[2], B.S. Nanayakkara[2] and P.N. Yapa[3]

[1]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka.*
[3]*Department of Biological Sciences, Rajarata University of Sri Lanka, Mihintale, Sri Lanka*
*Hasipoorni123@gmail.com

Dillenia suffruticosa (Dilleniaceae) aggressively invades low-lying areas of Sri Lanka's wet zone. While several studies have assessed the ecological impacts of *D. suffruticosa*, limited research has explored the causes of its invasiveness. Seed traits and reproductive biology remain under-investigated despite their likely contribution to invasiveness. This study aimed to examine the effects of selected seed structural and functional characteristics in relation to the invasiveness of the species. Mature seeds and fruits were collected from the Pitawala Conservation Forest Reserve. Aril retention, buoyancy, moisture level, germination speed, seed coat proportion, and seed shape index were assessed using standard procedures. Seeds from fifteen individuals were analysed to determine seed shape index, seed coat proportion, and moisture content. Buoyancy was assessed using five replicates of 25 seeds per individual, while germination was evaluated using three replicates of 25 seeds per individual. Comparatively fast germination and relatively low T50 Value (26 days) indicated rapid and successful germination. Seed shape index (0.049±0.013) suggested a compact, spheroid form, supporting efficient dispersal and soil penetration. A moderate embryo-to-seed ratio (0.398±0.050) indicated adequately developed embryos that may contribute to the invasive potential through efficient post-dispersal establishment. Seed coat ratio (0.31±0.14) reflected moderate protection with adequate permeability, potentially aiding fast germination responsiveness. Buoyancy tests showed that a substantial proportion of seeds remained afloat for extended periods (100% up to 14 days), highlighting the potential for hydrochorous dispersal in riparian or flood-prone habitats. Seeds exhibited a high moisture content of 28.79±2.56%, suggesting physiological readiness for rapid germination, a trait associated with opportunistic establishment in disturbed environments. The fleshy, colorful aril likely attracts frugivores, aiding its spread across habitats. This combination of traits may enhance the invasive potential of the species. The findings demonstrate that seed structural and functional traits play a central role in the invasiveness of *D. suffruticosa*. Future research should focus on integrating findings into management practices to mitigate their spread in vulnerable ecosystems.

Financial assistance from the Postgraduate Institute of Science (Grant No. PGIS/2022/08) is acknowledged.

Keywords: *Dillenia suffruticosa*, Dispersal mechanisms, Germination biology, Invasive species, Seed traits

RESCON 2025 LS 24

IN SILICO DRUG DISCOVERY OF FLUOROQUINOLONE-LIKE COMPOUNDS FROM PHYTOCHEMICALS

K.A.M.A.G.D.M. Gunathilaka

Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka.
dilushagunathilaka1995@gmail.com

Fluoroquinolones are broad-spectrum antibiotics with rising rates of resistance. They are commonly used to treat pneumonia, urinary tract infections, gastroenteritis, and gonococcal infections. Prescription is restricted due to the increased risk of rare, significant adverse events. The discovery of novel drug alternatives is a promising strategy to overcome these challenges. Phytochemicals are gaining increased scientific attention due to their favorable attributes as antimicrobials. The core purposes of the research were to develop a Machine Learning (ML) pipeline using Konstanz Information Miner (KNIME) to discover potential phytochemicals with fluoroquinolone-like properties and evaluate their drug-likeness based on Lipinski's rule of five. In this study**,** KNIME version 4.7.7 was used together with the RDKit community node library. Structural data were acquired for 20 fluoroquinolone antibiotics, 20 non-antibiotic drugs, and 401 phytochemicals from ChEMBL, in Simplified Molecular Input Line Entry System (SMILES) format. The RDKit Fingerprint node was used to generate MACCS fingerprints, and then data were prepared for ML. Artificial Neural Network (ANN), Random Forest (RF), and Support Vector Machine (SVM) algorithms were trained on the filtered ChEMBL dataset to discriminate active compounds from inactive ones. ML models achieved overall prediction accuracies of 98.9%, 99.5%, and 88.2%, respectively, in predicting fluoroquinolone-like phytochemicals. Based on structural similarities, the algorithms identified 3 (ANN) and 34 (SVM) phytochemicals as potential fluoroquinolone-like candidates. The three ANN-predicted phytochemicals, such as neocryptolepine, deschloroelatol, and elatol represent the most promising alternatives for further analysis. Predicted molecules were filtered with Lipinski's rule of five. Thirty-five phytochemicals can be used as orally active drugs from the predicted hits. However, further *in vitro* and *in vivo* efficacy evaluations need to be conducted on these phytochemicals to confirm their potential to discover novel fluoroquinolones. As future directions, candidate compounds will be screened using the 96-well plate method.

Keywords: Antimicrobial resistance, Drug discovery, Fluoroquinolones, KNIME, Machine Learning

RESCON 2025 LS 25

THERAPEUTIC PROPERTIES OF *Acavus* SNAIL MUCUS IN BURN WOUND CARE: A TRADITIONAL REMEDY REVISITED THROUGH SCIENTIFIC INQUIRY

M.N.F. Rukshana[1]*, A.M.R.S. Bandara[2], B.S. Nanayakkara[3], K. Wijayaratne[4], M.B. Wijesinghe[5], R.T.D.K.B. Karunachandra[4] and D.R.G.W.B. Ellepola[1]

[1]*Department of Zoology, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Science Education Unit, University of Peradeniya, Peradeniya, Sri Lanka.*
[3]*Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka.*
[4]*Department of Physics, University of Peradeniya, Peradeniya, Sri Lanka.*
[5]*Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.*
*nzm.rukshana@gmai.com

Natural substances play a vital role in traditional medicine, serving as a foundation for drug discovery. While plant-based remedies have been extensively studied, animal-derived substances have gained less attention for their pharmacological potential. However, snail mucus has emerged as a promising remedy for burn-wound management due to its hydrating, cooling, antimicrobial and potential wound-healing properties. In Sri Lankan traditional medicine, *Acavus* snail mucus is applied to burns, where it is believed to promote healing and minimise scarring. However, its therapeutic properties remain underexplored. This study investigated the antimicrobial, physicochemical, and biochemical properties of *Acavus* snail mucus, focusing on its potential for burn-wound healing. The cooling property was assessed by determining water content, specific heat capacity and density, and comparing these with *Aloe vera* gel, *Achatina* snail mucus, and silver sulfadiazine cream. Antimicrobial activity was tested against *Escherichia coli, Pseudomonas aeruginosa, Staphylococcus aureus, Enterococcus faecalis* and *Candida albicans,* using the well-diffusion method. Biochemical analyses included protein quantification (OD280), molecular characterisation via Fourier transform infrared (FTIR) spectroscopy, and pH determination. *Acavus* mucus had a high-water content of 99.053±0.0361% ($p > 0.05$), and a specific heat capacity of 4.221±0.050 kJ kg^{-1} $°C^{-1}$ comparable to that of *Aloe vera* (3.945±0.336 kJ kg^{-1} $°C^{-1}$; $p > 0.05$), supporting its cooling properties. Its density (0.986±0.002 g mL^{-1}) was significantly higher than that of *Aloe vera* and *Achatina* mucus ($p < 0.05$). No antimicrobial activity was observed under tested conditions. The UV absorbance peaked at 277.5 nm, indicating the presence of aromatic amino acids. FTIR analysis confirmed the presence of proteins (11.635 mg mL^{-1}) and identified amide bands I, III and A, indicative of peptide bonds and protein secondary structures. The mucus was alkaline with pH 8.26±0.015. These findings support *Acavus* mucus has hydrating and cooling properties with some bioactive compounds at play. Although antimicrobial activity was absent, its potential antioxidant and anti-inflammatory properties warrant further investigation to validate its traditional use in burn-wound care.

Keywords: *Acavus* snails, Burn wound healing, Cooling property, Snail mucus, Traditional medicine

RESCON 2025 LS 26

DEVELOPMENTAL STAGE-SPECIFIC ACUTE TOXICITY AND BIOCOMPATIBILITY OF *Argyreia populifolia* AQUEOUS PLANT EXTRACT IN ZEBRAFISH (*Danio rerio*): A FET236 BIOASSAY-BASED EVALUATION

K.D.M. Manthila[1], R.M.T.S. Rathnayaka[1], R.M.C.L. Abesekara[1], S.T.M.C. Sanjula[1], S.A.S. Sanjula[1], M.R.K. Farween[1], H.D.T. Madhuranga[1,2] *, D.N.A.W. Samarakoon[1], N.D.K. Ranadeeva[1], A.R. Jayamaha[2] and A.S. Hapuarachchi[2]

[1]*Department of Biomedical Science, Kaatsu International University, Battaramulla, Sri Lanka.*
[2]*Research and Innovation Division, Kaatsu International University, Battaramulla, Sri Lanka.*
*madurangadikkubura@gmail.com/t_maduranga@kiu.ac.lk

Medicinal plants have long served as a foundation for therapeutic discovery, due to their rich phytochemical diversity and broad-spectrum bioactivity. *Argyreia populifolia,* commonly known as 'Girihilla' in Sinhala, belongs to Family Convolvulaceae and is a native plant to Sri Lanka. It is widely used in various Ayurvedic preparations for conditions such as diabetes mellitus, dog bites, and asthma. However, the toxicity profile of the aqueous extract has not yet been investigated. Therefore, the present study aimed to evaluate biocompatibility and acute toxicity using the zebrafish embryo assay (FET236) according to the OECD guideline. Wild-type zebrafish were maintained at 27 ºC under regulated levels of pH (7±0.5), nitrates (< 0.009 g L^{-1}), nitrites (8 – 12 g L^{-1}), and ammonia (< 0.005 mg L^{-1}). *Argyreia populifolia* aqueous plant extract was prepared using aerial parts via the maceration method, and dilutions from 2 mg mL^{-1} to 1000 mg mL^{-1} were made. As per OECD guideline, ten fertilized eggs per concentration were exposed and tested in triplicate, using tank water as the control. Hatch rate, mortality rate, survival rate, heart rate, and developmental deformities were assessed at 48, 54, 72, 80, and 96 hours post fertilisation (hpf). Data were analysed with two-way ANOVA and Dunnett's test using GraphPad Prism 9 software. Hatchability decreased with increasing concentrations of *A. populifolia* extract, peaking at 2 mg mL^{-1} at 96 hpf. Survival rate followed a similar trend, dropping to 0% at ≥ 16 mg mL^{-1} from 72 hpf. Heart rate remained normal until 4 mg mL^{-1}, and a 100% survival rate was observed at 72 hpf. The LC_{50} was calculated as 1.57 mg mL^{-1}. Observed deformities included yolk sac edema (35%), pericardial edema (21%), lack of pigmentation (41%), and lack of somite formation (29%). These findings indicate moderate toxicity at lower concentrations, with minimal effects at 2 mg mL^{-1}. Therefore, further phytochemical analysis and isolation of active compounds are recommended to identify safer components for potential therapeutic or commercial applications.

Keywords: Acute toxicity, *Argyreia populifolia,* Biocompatibility, FET assay, Zebrafish embryo

RESCON 2025 LS 27

PREVALENCE, TRENDS, AND ASSOCIATED FACTORS OF GROWTH FALTERING AMONG CHILDREN IN BAMBARADENIYA MOH AREA

J.F. Jumana[1]*, Y.R.S.E.W.B.W.M.R.S.G. Yatiwelle[1] and D.A. Gunawardane[2]

[1]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Community Medicine, University of Peradeniya, Peradeniya, Sri Lanka.*
*fathimajumana26@gmail.com

Rural communities in Sri Lanka face heightened nutritional vulnerability, particularly during the 2022 economic crisis. However, community-based evidence on infant growth patterns in these settings remains limited. This study aimed to investigate the prevalence, trends, and factors associated with growth faltering among children aged 0 – 18 months in the Bambaradeniya MOH area. Anthropometric and demographic data were collected from Child Health Development Records and through interviews with caregivers at polyclinics. Weight-for-age Z-scores (WAZ) from birth to 18 months were analysed, with growth faltering defined as a decline of more than 0.25 standard deviation in WAZ from birth. Descriptive statistics, trend analysis, and multivariate logistic regression were used to examine growth patterns and associated factors. This study included 386 children. Growth faltering occurred in 38.1% of the sample, with the highest prevalence observed in the 12 – 18 months age group (44.8%). During the first year, the prevalence was similar in infants aged 0 – 6 months (36.6%) and 6 – 12 months (36.8%). Most growth faltering cases (90.5%) had an onset within the first four months of life. The mean and median WAZ scores fell below the WHO standards across the low, normal, and overweight birth weight categories, without evidence of catch-up growth. Multivariate logistic regression identified three significant factors associated with growth faltering: low birth weight (odds ratio [OR]: 0.09, 95% confidence interval [CI]: 0.03 – 0.33, $p < 0.001$), low household income (OR: 2.95, 95% CI: 1.01 – 8.56, $p = 0.047$), and age less than four months (OR: 21.36, 95% CI: 11.07 – 41.19, $p < 0.001$). Other sociodemographic variables, including maternal age, employment, education, infant sex, and birth order, were not significantly associated with growth faltering. These findings highlight the burden of early growth faltering in rural Sri Lanka and underscore the need for targeted nutritional interventions in vulnerable populations.

Keywords: Growth faltering, Infants, Low birth weight, Rural health, Sri Lanka

RESCON 2025 LS 28

RELATIONSHIP BETWEEN MATERNAL BMI, GESTATIONAL WEIGHT GAIN AND NEONATAL BIRTH WEIGHT IN MATHURATA MOH AREA

Y.R.S.E.W.B.W.M.R.S.G. Yatiwelle* **and D.A. Gunawardane**

Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.
*sathsarayatiwelle22@gmail.com

Epidemiological studies globally have demonstrated that maternal pre-pregnancy body mass index (BMI) and gestational weight gain (GWG) are key determinants of maternal and neonatal outcomes. However, evidence remains limited in the Sri Lankan context. Nuwara Eliya District reports a high prevalence of low birth weight (LBW) of about 25% compared to the national average of 17%. Within the Mathurata MOH area, this rate rises to nearly 30% underscoring a critical public health concern. This analytical cross-sectional study aimed to describe pre-pregnancy BMI and GWG and explore their association with neonatal birth weight among pregnant mothers registered in the Mathurata MOH area from 01st January 2020 to 31st December 2022. The inclusion criteria were pregnant mothers registered with Public Health Midwives who had weight measurements taken before 12 weeks of gestation and were followed until delivery with weight recorded at or after 37 weeks. Mothers under 18 years and twin pregnancies were excluded. Of 1052 eligible births, 421 were selected using random sampling and categorised into BMI and GWG groups. Data were analysed using chi-square and ANOVA tests. Results revealed significant associations between pre-pregnancy BMI and lower segment caesarean section (LSCS), gestational diabetes mellitus (GDM) and prepregnancy diabetes ($p < 0.001$, $p < 0.002$ and $p < 0.001$, respectively). Pre-pregnancy BMI was also strongly associated with neonatal birth weight ($p < 0.001$), with underweight mothers more likely to deliver LBW infants (73.3%). Pre-pregnancy BMI was significantly associated with GWG ($p < 0.001$), with the majority of underweight women experiencing inadequate weight gain (74.14%). Similarly, GWG showed significant associations with neonatal birth weight, LSCS, pre-pregnancy diabetes and GDM ($p < 0.001$, $p < 0.001$, $p < 0.001$ and $p < 0.042$, respectively). In conclusion, maternal pre-pregnancy BMI and GWG are crucial determinants of neonatal birth weight. These findings highlight the urgent need for weight management strategies during pregnancy, particularly in high-risk areas like Mathurata in the Nuwara Eliya District, to improve maternal and neonatal health outcomes.

Keywords: Birth weight, Gestational weight gain, Maternal nutrition, Pre-pregnancy BMI, Sri Lanka

RESCON 2025 LS 29

IN VITRO ANTIFUNGAL ACTIVITY OF SELECTED GRAS SALTS AGAINST POSTHARVEST FUNGAL PATHOGENS OF *Capsicum annuum* (BANANA PEPPER)

P.D.S.M. Weerasinghe and W.A.M. Daundasekera*

Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka.
*malkanthid@sci.pdn.ac.lk

Banana pepper (*Capsicum annuum* L.) is an economically important vegetable crop grown worldwide. Fungal diseases cause substantial postharvest losses of banana pepper. This study investigated the effect of Generally-Recognised-As-Safe (GRAS) salts; calcium chloride ($CaCl_2$) and potassium silicate (K_2SiO_3), on *in vitro* growth of postharvest fungal pathogens, *Colletotrichum* sp., *Fusarium* sp., *Aspergillus* sp., *Lasiodiplodia* sp. and *Pestalotia* sp., isolated from banana pepper. The direct inhibitory effect of GRAS salts on pathogen growth was tested by assessing radial growth on GRAS salt-amended potato dextrose agar (PDA) and mycelial growth in static cultures of potato dextrose broth (PDB) at 1% $CaCl_2$ and 800 mg L^{-1} K_2SiO_3 concentrations with three replicates. Effect of GRAS salts on spore germination of pathogens was also tested. Treatments with $CaCl_2$ and K_2SiO_3 did not significantly ($p < 0.05$) reduce the pathogen growth in either PDA or PDB while $CaCl_2$ treatment exhibited a stimulatory effect on radial growth (cm) of *Colletotrichum* sp., *Fusarium* sp. and *Pestalotia* sp. (5.8, 5.5 and 8.5, respectively) versus their controls (5.1, 2.7 and 7.5, respectively). Treatment with $CaCl_2$ significantly reduced the spore germination of *Fusarium* sp. (by 37.48%) and *Aspergillus* sp. (by 67.21%) while K_2SiO_3 treatment significantly reduced the spore germination of *Fusarium* sp. (by 52.77%) against controls. The differential effects observed suggest that the efficacy of $CaCl_2$ and K_2SiO_3 be influenced by the specific fungal species, their developmental stage, or potential chemical interactions between calcium and silicate ions with other constituents present in PDB and PDA media. Notably, both calcium and silicate solutions, when prepared in sterile distilled water, exhibited antifungal activity, as demonstrated by the spore germination assay. These observations highlight the need for further *in vivo* investigations to gain a clearer understanding of the effects of these GRAS salts on the growth of the tested postharvest pathogens.

Keywords: Banana pepper, Calcium chloride, Fungal pathogens, Postharvest, Potassium silicate

RESCON 2025 LS 30

Not Presented at RESCON 2025

RESCON 2025 LS 31

BIOFILM EXUDATES RESUSCITATE VIABLE-BUT-NON CULTURABLE BACTERIA IN PADDY ROOT-ZONE SOIL

S.D.P.N. Jayasinghe[1], M. Premarathna[1]*, G. Seneviratne[1], H.M.S.P. Madawala[2] and B.S. Nanayakkara[2]

[1]*Microbial Biotechnology Unit, National Institute of Fundamental Studies, Kandy, Sri Lanka.*
[2]*Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka.*
*mahesh.pr@nifs.ac.lk

Microbes become dormant with low levels of metabolic activity in response to stress, known as viable but nonculturable (VBNC). Biochemicals exuded from developed microbial biofilms (BFEx) have been reported to trigger metabolic activity of VBNC microbes. The present study aimed to evaluate the potential of BFEx on resuscitation of VBNC bacteria live in paddy root-zone soil. A field experiment was conducted during 2023/2024 *Maha* (wet) season in paddy fields across Anuradhapura, Polonnaruwa, Ampara, and Puttalam districts of Sri Lanka. Four fertiliser treatments: (a) BOMF practice (500 kg BOMF NPK ha^{-1} + 2.5 L BFBF ha^{-1}), (b) hybrid practice (225 kg BOMF PK ha^{-1} + 62.5 kg CF N ha^{-1} + 2.5 L BFBF ha^{-1}), (c) chemical fertiliser (CF) practice (340 kg CF NPK ha^{-1}, as per the Department of Agriculture recommendations), and (d) control (no fertiliser) were applied in 100 m^2 plots using RCBD design with three replicates per treatment. Soil samples from each plot were serially diluted and plated on nutrient agar, with and without the addition of 10 µL sterile BFEx per plate and incubated at 37 °C for 24 hours to enumerate bacterial colonies. The difference in colony counts with and without BFEx was taken as a proxy for reactivated VBNC bacteria. One-way ANOVA followed by Tukey's HSD test was performed to compare the means. The results indicated that the breaking of dormancy of VBNC bacteria was significant in Polonnaruwa ($p < 0.05$), while it was not significant in Anuradhapura ($p = 0.124$), Ampara ($p = 0.275$), or Puttalam ($p = 0.078$) at 5% significance level, although a trend was observed. In conclusion, the findings suggest that BFEx has the potential to resuscitate VBNC bacteria in paddy root-zone soil, although this effect appears to be location-specific. Further studies are needed to elucidate the species-specific mechanisms underlying this resuscitation.

Keywords: Biofilms, Rice, Soil microbes, VBNC

RESCON 2025 LS 32

SEROLOGICAL AND MOLECULAR DETECTION OF CITRUS TRISTEZA VIRUS (CTV) ASSOCIATED WITH CITRUS CULTIVATIONS IN MONERAGALA DISTRICT, SRI LANKA

D.G.K. Dilmini[1], S.S. Paththinige[2], A.D.R.P. Aluthge[2], R.T. Ekanayake[2] and K.N. Samarasekera[1]*

[1]Department of Botany, University of Sri Jayewardenepura, Nugegoda, Sri Lanka.
[2]Plant Virus Indexing Centre, Homagama, Sri Lanka.
*kaumadi@sjp.ac.lk

Citrus tristeza virus (CTV) is one of the most economically significant pathogens affecting citrus production worldwide, resulting in severe yield losses and declines in infected trees. In Sri Lanka, particularly in the Moneragala District, citrus cultivation plays an important role in regional agriculture. However, data on the presence and distribution of CTV in Sri Lanka remain limited. This study aimed to detect CTV associated with citrus cultivations in the Moneragala District to better understand its prevalence and potential threat to local citrus production. Using random sampling, 100 symptomatic and asymptomatic leaf samples were collected from selected citrus cultivations. From each field, 25% of the total citrus trees were sampled, and for each tree, leaves from three different branches were combined to form a single sample. They were subjected to serological detection through TAS-ELISA using CTV-specific antiserum. A subset of the samples was subjected to total RNA extraction followed by reverse transcription polymerase chain reaction (RT-PCR) using CTV-specific primers that target the *p18* gene to further confirm the ELISA results. TAS-ELISA analysis revealed that 94 of the 100 samples (94%) were positive for CTV, and RT-PCR confirmed infection in 34 of 40 tested samples (85%). The remaining six samples tested negative in both assays. The results were further validated by Sanger sequencing. The sequence obtained was submitted to GenBank (Accession No. PV654199), marking the first reported CTV sequence from Sri Lanka. These findings underscore the importance of early detection and management of CTV in Sri Lankan citrus cultivations. Careful selection of rootstocks, implementation of certified propagation materials, and eradication of insect vectors to minimise the spread of the virus are essential in disease management. This study contributes valuable baseline data for future disease management strategies and epidemiological studies.

Financial assistance from National Agricultural Research Plan (Grant No. NARP/PVIC/2024/01) is acknowledged.

Keywords: Citrus tristeza virus, ELISA, Molecular detection, RT-PCR, Serological detection

RESCON 2025 LS 33

COMPARATIVE STUDY OF FUNGAL GROWTH IN *Myristica fragrans* (NUTMEG) KERNELS UNDER VARYING POSTHARVEST STORAGE CONDITIONS

K.A.B.S. Wijesinghe[1]*, E.O. Dayaratna[2] and W.A.M. Daundasekera[1]

[1]*Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Statistics and Computer Science, University of Peradeniya, Peradeniya, Sri Lanka.*
*buddhini.wijesinghe@sci.pdn.ac.lk

Fungal population dynamics are influenced by various environmental and handling factors, particularly in postharvest systems. This study investigated the temporal variation of total fungal populations in nutmeg (*Myristica fragrans*) kernels, focusing on fungal contamination under different drying and storage conditions, addressing the lack of published research on nutmeg processing in Sri Lanka. Two hundred nutmeg fruits were collected from a commercial grower at Pilimatalawa (7.2595° N, 80.5452° E), Sri Lanka, and divided equally into two treatment groups to compare traditional and improved postharvest practices. Fungal contamination was assessed through culture-based enumeration immediately post-harvest, post-drying, and during storage. Traditional methods involved sun-drying on reused palm mats and storage in dark, poorly ventilated rooms, while the improved method involved hygienic drying at (32±2) °C and storage with adequate lighting and ventilation. Results revealed a significant ($p < 0.05$) increase in fungal population with extended storage. Dominant contaminants included *Aspergillus flavus*, *A. niger*, *Penicillium* sp., and *Rhizopus* sp., with *A. flavus*, a known aflatoxin producer, particularly abundant in inadequately dried and poorly stored samples. Total fungal colony-forming units (CFU) were significantly ($p < 0.05$) higher in nutmegs subjected to open-air sun drying, and storage under poorly ventilated environments at Pilimatalawa, compared to those processed under improved laboratory-controlled hygienic conditions. *A. flavus* counts increased significantly ($p < 0.05$) after two weeks of storage, particularly under conventional conditions, emphasising its ability to thrive under suboptimal postharvest conditions. Water activity of the kernels (0.700 – 0.780) did not directly correlate with fungal counts, suggesting temperature and inoculum exposure during processing play greater roles in fungal growth. Ultraviolet fluorescence spectroscopy and scanning electron microscopy confirmed *A. flavus* through visible sclerotia formation on shells, indicating potential aflatoxin accumulation. These findings emphasise the need for optimised drying and storage practices to mitigate fungal contamination and ensure nutmeg safety and quality for export.

Keywords: *Aspergillus flavus*, Colony-forming units, Fungal contamination, *Myristica fragrans*

RESCON 2025 LS 34

DETERMINATION OF THE FEASIBILITY OF YOGHURT STARTER CULTURES OVER MULTIPLE FERMENTATION CYCLES IN SET YOGHURT PRODUCTION

M.M.C.J. Wickramasuriya[1]*, M.C.N. Jayasooriya[1] and W.A.S.B. Aththanayake[2]

[1]*Department of Food Science and Technology, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka.*
[2]*Milco (Pvt) Ltd, Gallalle, Polonnaruwa, Sri Lanka.*
*chanikajanandani96@gmail.com

Yoghurt performance depends on starter cultures, mainly *Lactobacillus delbrueckii* subsp. *Bulgaricus,* and *Streptococcus thermophilus*. Commercial yoghurt typically uses these cultures once, due to increased operational cost. This study evaluated the feasibility of multiple fermentation cycles using the back slopping method to reduce starter culture cost in commercial set-yoghurt production. Three commercial starter cultures (Yoflex Express 6, Yoflex SLB 3, and Yoprox 367) were tested with four fermentation cycles (C0 – C3). In back slopping, 3% fermented yoghurt was reused as inoculum for the next batch. Fermentation time, moisture content, pH, acidity, lactic acid bacteria (LAB) viability, texture, colour, and sensory evaluation (colour, aroma, taste, texture, after taste, and overall acceptability) were assessed during each cycle. Each test used three replicate yoghurts per culture. From cycle one to cycle three, pH and acidity showed a similar pattern to the initial cycle (C0). In C0, pH decreased from 4.5 (day one) to 4.2 (day fourteen), while acidity increased from 0.81% to 0.95%. Fermentation time decreased in the second fermentation cycle (2.0 h); but rose to 4.5 h in the third and fourth fermentation cycles, remaining typical commercial yoghurt fermentation time below 4.5 h. The moisture content remained within acceptable values (75.90 – 77.39%), with minor variation among starter cultures. Sensory evaluations by 30 untrained panelists using a five-point hedonic scale indicated consistent consumer acceptability across all cycles. Yeast counts were not observed in the initial fermentation cycles. Higher yeast counts were observed in the fourth fermentation cycle (246 CFU mL^{-1}). LAB viability declined with repeated use, raising contamination risk. Nevertheless, yoghurt starter cultures could be reused for up to four fermentation cycles with acceptable product quality with most parameters. Among cultures, Yoprox 367 and SLB 3 demonstrated the most stable performance, with minimal variation in quality and high acceptability.

Keywords: Back slopping, Lactic acid bacteria, Multiple fermentation cycle, Set-yoghurt, Starter cultures, pH

RESCON 2025 LS 35

MICROBIOLOGICAL WATER QUALITY AND BIOFILM FORMATION IN TAPS AND SHOWERHEADS IN SELECTED HALLS OF RESIDENCE AT THE UNIVERSITY OF PERADENIYA, SRI LANKA

P.A.S.K. Ananda, B.S. Nanayakkara* and K.M.G.G. Jayasuriya

Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka.
*buddhie@sci.pdn.ac.lk

Although biofilms in water systems affect water quality and health, their impact on microbial contamination of residential environments is rarely studied in Sri Lanka. Microbially contaminated water and biofilms pose health risks as they can harbor pathogens and antimicrobial-resistant microorganisms. The objectives of the current study were to investigate water quality in terms of total coliforms, *Escherichia coli* and *Pseudomonas* spp., to explore biofilm formation in taps and showerheads and to conduct a sociological survey on water-use at selected halls of residence of the University of Peradeniya, Sri Lanka. Fourty-eight water samples and 48 biofilm scraping samples were collected from taps and showerheads in four halls of residence: Wijewardene, Hilda Obeysekera, Ramanathan and Sarasaviuyana. Water samples were subjected to membrane filtration, and biofilm scrapings were quantified using the crystal violet assay. Biofilms were investigated using light microscopy (LM) and scanning electron microscopy (SEM). Relationship between biofilms and microbial density was detected using correlation analysis. In most samples, total coliform counts exceeded permissible limits for drinking water, according to WHO (0 CFU/100 mL) and SLSI (3 CFU/100 mL) standards, while *E. coli* showed localised contamination in Hilda Obeysekera (800 CFU/100 mL) and Sarasaviuyana (133 CFU/100 mL) halls, with low levels elsewhere (0 – 2 CFU/100 mL). No shower water samples exceeded permissible limits for recreational water (235 CFU of *E. coli*/100 mL). *Pseudomonas* spp. was not detected in any sample. In the crystal violet assay, biofilm formation showed significant differences ($p < 0.05$) across Halls, with Sarasaviuyana Hall showing the highest (0.343±0.046). Biofilms could be detected through LM and SEM. A weak negative correlation ($r = -0.32$) was observed between biofilm formation and total coliform density, suggesting that biofilms influence the presence of coliforms in water. According to the sociological survey, inadequate maintenance and irregular cleaning are possible contributors to contamination. These findings underscore the need to improve water quality management in residential halls.

Keywords: Crystal violet biofilm assay, *Escherichia coli*, Membrane filtration, Sociological survey, Total coliforms

RESCON 2025 LS 36

EVALUATION OF ANTIMICROBIAL, ANTIOXIDANT PROPERTIES AND TOXICITY OF *Ocimum tenuiflorum* L. EXTRACTS

M.M.S.H. Marasinghe[1]*, G.J. Panagoda[2], B.S. Nanayakkara[1], N. Piyasena[3] and K.M.G.G. Jayasuriya[1]

[1]Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka.
[2]Division of Microbiology, Department of Oral Medicine and Periodontology, University of Peradeniya, Peradeniya, Sri Lanka.
[3]Division of Natural Products, National Institute of Fundamental Studies, Kandy, Sri Lanka.
*sachinthahansaleem@gmail.com

Oral health is altered by pathogens and is a global health concern due to antimicrobial resistance. *Ocimum tenuiflorum* L. is widely recognized for its therapeutic potential in traditional medical systems. The objectives of the current study were to evaluate the antimicrobial, antioxidant properties and toxicity of crude ethanolic and aqueous extracts of the leaves of *O. tenuiflorum*. Ethanolic extracts of young, fresh leaves were prepared using ultrasonication (35 – 40 °C, 20 kHz, 15 min) and vacuum infiltration (25 – 30 °C, 1400 rpm, one h). Cold extraction was done by soaking paste in sterile distilled water at 27 ± 1 °C overnight and the filtrate was used as the aqueous extract. The antimicrobial activity was assessed using agar well diffusion bioassay in Mueller Hinton Agar against reference cultures of oral pathogens; *Staphylococcus aureus*, *Streptococcus pyogenes* and *Candida albicans*, *C. glabrata*, *C. krusei*, *C. tropicalis*, *C. parapsilosis* and 30 clinical isolates of *Candida* spp. The minimum inhibitory concentrations (MICs) were determined using the agar dilution method. Antioxidant capacity was analysed using 1,1-diphenyl-2-picryl-hydrazyl (DPPH) free-radical scavenging assay, while toxicity was assessed using the brine shrimp lethality assay. A significant antimicrobial activity was observed with ultrasonicated ethanolic extracts ($p < 0.05$) over vacuum infiltrated extracts. The ultrasonicated extracts showed a higher mean inhibition for *Candida* clinical isolates than vacuum infiltrated extracts ($p = 9.24\times10^{-5}$). The lowest MIC of 2.56 mg mL^{-1} was observed against *S. aureus*. Aqueous extracts did not show antimicrobial activity. Antioxidant capacity was higher in ultrasonicated extracts (IC_{50} = 45.53 mg L^{-1}) over vacuum infiltrated extracts (IC_{50} = 60.96 mg L^{-1}), though the difference was not significant (p = 0.40). Ultrasonicated extracts showed significantly low toxicity (LC_{50} of 9.20×10^{5} mg kg^{-1}), markedly lower than atropine, confirming its safe profile. Overall, ethanolic extracts of *O. tenuiflorum* possess antimicrobial and antioxidant properties, and ultrasonication is a more effective extraction method than vacuum infiltration for isolating bioactive compounds.

Keywords: Brine shrimp lethality, DPPH, Ethanolic extract, Fresh leaves, Minimum inhibitory concentration

RESCON 2025 LS 37

INSECT PEST DIVERSITY DURING THE 'YALA' SEASON IN A PESTICIDE-FREE RICE FIELD AND FARMERS' KNOWLEDGE, ATTITUDES, AND PRACTICES IN PEST MANAGEMENT IN HOMAGAMA, SRI LANKA

R.A.T.K. Rupasingha and T.C. Weeraratne*

Department of Zoology, University of Peradeniya, Peradeniya, Sri Lanka.
*thiliniw@sci.pdn.ac.lk

Pest attacks are a major issue in Sri Lankan rice fields, with species composition and abundance varying across the plant's growth stages. This study aimed to document insect pest diversity across different rice growth stages: vegetative, reproductive, and ripening, in a pesticide-free rice field. Additionally, the study evaluated the knowledge, attitudes, and practices (KAP) of 25 farmers related to pest management using a structured questionnaire. Biweekly pest sampling was conducted in the field during the '*Yala*' season (April to September 2024) in Homagama. All life cycle stages of the pests present in five systematically placed quadrats (50 cm × 50 cm), during a 10-min sampling effort, were reared in the laboratory and identified. A total of 32 insect pest species were identified during the survey, representing five insect orders: Coleoptera, Hemiptera, Homoptera, Lepidoptera, and Orthoptera, with Lepidoptera being the dominant group. Pest diversity peaked during the reproductive period (30 species, Shannon diversity index (H = 2.53), Pielou's Evenness Index (J = 0.75), followed by the ripening period (H = 1.95, J = 0.72). The rice caseworm, *Nymphula depunctalis,* unique to the vegetative stage, recorded the highest mean density (35.20±9.39). Among the 10 species found across all three plant growth stages, six species; *Euscyrtus* sp., *Eysarcoris* sp., *Oxya* sp., *Pelopidas mathias*, *Scotinophara coarctata*, and *Sphrageidus xanthorrhoea,* showed significant variation in abundance between rice growth periods ($p < 0.05$). All respondents were male, mostly over 55 years, with 88% having G.C.E. O/L or lower education. Although 80% farmers of the Homagama area showed good overall knowledge, only 24% farmers followed good pest control practices, with 96% relying on synthetic insecticides as the primary pest control method. While 68% farmers were aware about predators, none were familiar with parasitoids or pathogens. The study revealed a gap between farmers' knowledge and practice in pest management, highlighting the need for education on stage-specific control, as pest diversity and abundance varied across rice growth stages.

Keywords: Growth stages, Pest diversity, Pest management, Rice insect pests, Sustainable agriculture

RESCON 2025 LS 38

Not Presented at RESCON 2025

RESCON 2025 LS 39

FIRST RECORD OF GASTROINTESTINAL PARASITES IN THE INDIAN LITTLE SWIFT (*Apus affinis singalensis*) IN SRI LANKA

D.K. Ranahewa and P.K. Perera*

Department of Zoology, University of Peradeniya, Peradeniya, Sri Lanka.
*piyumali.perera@sci.pdn.ac.lk

The Indian Little Swift, belonging to family Apodidae, are resident breeding birds in Sri Lanka and can act as vectors capable of transmitting zoonotic pathogens. Bird droppings are a significant pathway for disease transmission, as pathogens can spread efficiently through the consumption of tainted water and the inhalation of contaminated airborne particles. This study records the first microscopic identification of gastrointestinal (GI) parasites in the droppings of the Indian Little Swift in the University of Peradeniya, Sri Lanka. Fresh faecal samples were collected from May to July 2025, directly from their droppings beneath nesting colonies located in 8 different areas of the University of Peradeniya. Samples were microscopically analysed using iodine wet method and fecal flotation technique to detect nematode eggs, trematode eggs, protozoan cysts, and oocysts. Out of eight nesting sites (representing ~18 – 60 individuals), droppings were detected only from six sites while no droppings were found beneath two nesting sites. Fecal flotation analysis revealed that the swifts were positive for both protozoans and helminths, including *Eimeria* spp., *Ascaridia* spp., *Strongyloides* spp., *Heterakis* spp., *Capillaria* spp., trematode-type eggs, and hookworm eggs. A type of sporulated coccidian oocyst, suggestive of the family Adeleidae and typically containing about ten sporocysts per oocyst was also detected, reflecting the insectivorous diet of the little swift. No parasitic stages could be observed by using iodine wet mounts/direct smears. Hookworms were detected in five out of the six nesting sites showing high infection intensities. In contrast, *Ascaridia* and *Hetarakis* were confined only in one nesting site exhibiting lower parasite burden. These findings provide important insights into the diversity of parasitic infections in the Indian Little Swift in Sri Lanka, enhancing the understanding of their zoonotic potential and their role as reservoir hosts for poultry.

Keywords: Gastrointestinal parasites, Sri Lanka, Swift, Wild birds, Zoonotic

RESCON 2025 LS 40

DETECTION OF *Leishmania* PATHOGENS IN *Phlebotomus argentipes* COLLECTED FROM KEKANADURA IN MATARA DISTRICT AND RAMBUKKANA IN KEGALLE DISTRICT, SRI LANKA

G.D.S.R. Piumali[1], W.M.S.H. Wijesundara[1], T.C. Weeraratne[2], W.G.D. Chathuranga[3] and W.A.P.P. de Silva[2]*

[1]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Zoology, University of Peradeniya, Peradeniya, Sri Lanka.*
[3]*Department of Zoology, University of Ruhuna, Matara, Sri Lanka.*
*depriyanka@sci.pdn.ac.lk

Cutaneous leishmaniasis is an endemic and increasingly reported vector-borne disease in Sri Lanka, caused mainly by the protozoan parasite *Leishmania donovani.* The disease is transmitted through the bite of infected female sandflies. This study aimed to detect the presence of *Leishmania* pathogen DNA in sandfly vectors collected from two regions in Sri Lanka with different risk classifications: Kekanadura in Matara District, a high-risk area, and Rambukkana in Kegalle District, a low-risk area. Sandflies were collected using CDC light traps from 6:00 p.m. to 6:00 a.m., monthly from January to April 2025. Collected sandflies were confirmed as *Phlebotomus argentipes* using standard taxonomic keys. A total of 168 sandflies were screened for the pathogen, 56 from Matara and 112 from Rambukkana study sites. Genomic DNA was extracted from full blood-fed female sandflies, and molecular detection was carried out using PCR targeting the internal transcribed spacer (ITS) region, using ITS forward (5'-CTG GAT CAT TTT CCG ATG-3') and L5.8S reverse (5'- TGA TAC CAC TTA TCG CAC TT-3') primers for pooled samples (8 individuals in a pool). The number of cases reported during the study period was taken from the Epidemiology unit, while the abundance of sandflies was reported from the light trap surveys. Altogether 35% and 42% of the sandflies tested PCR positive for *Leishmania* spp. from Rambukkana and Matara, respectively. According to the Epidemiology Unit, Sri Lanka, 39 leishmaniasis cases were reported in Matara and 15 from Kegalle during the study period. The mean monthly abundance of sandflies during the study period was 37.5±15.5 for Rambukkana and 25.0±9.1 for Matara. Despite Rambukkana being classified as a low-risk area, the detection of *Leishmania*-positive sandflies and their abundance suggests the possible emergence of the disease in the area necessitating continuous monitoring.

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Keywords: Entomological surveillance, Leishmaniasis, *Phlebotomus* sand flies

RESCON 2025 LS 41

DETECTION OF BOVINE THEILERIOSIS IN JAFFNA, SRI LANKA, USING POOLED MOLECULAR ANALYSIS

M.M.M.M.S. Kumari[1], T.H.P.S. Amarasingha[1], P. Gajavathany[2], M. Rajeshwaran[3], R.S. Rajakaruna[1] and P.K. Perera[1]*

[1]Department of Zoology, University of Peradeniya, Peradeniya, Sri Lanka.
[2]Department of Zoology, University of Jaffna, Jaffna, Sri Lanka.
[3]Veterinary Surgeon Office, Tellipalai, Jaffna, Sri Lanka.
*piyumali.perera@sci.pdn.ac.lk

Bovine theileriosis is a vector-borne parasitic disease that causes significant financial burden due to its detrimental effects on cattle health, particularly in Jaffna, Sri Lanka, where livestock remains an essential source of food and income. DNA pooling has not been utilised as a diagnostic strategy for *Theileria* detection in Sri Lanka with limited research available. This study aimed to utilise DNA pooling as a rapid, cost-effective technique to assess *Theileria* infection statuses of cattle herds in selected Jaffna farms. Blood samples (n = 60) and tick samples (n = 27) were collected from three cattle herds in Jaffna. Giemsa-stained blood smears were prepared from all samples for morphological analysis. Blood samples were pooled into three groups based on farm location, and molecular analysis targeting the MPSP gene was conducted on pooled and individual samples. A Chi square test was used to determine associations between prevalence and age, gender and farm locations. Microscopic analysis revealed an overall prevalence of 50.0% (30/60) for *Theileria* spp. whereas molecular analysis revealed a statistically higher prevalence (81.7%) (49/60, χ^2 = 13.374, p = 0.00025). The presence of *T. orientalis* (genotype 5, 7) and *T. annulata* were confirmed by bands at 776 bp and 785 bp, respectively. No significant association was found between prevalence and age (χ^2 = 2.456; p = 0.117), gender (χ^2 = 0.0223; p = 0.881) and farm locations (χ^2 = 1.684; p = 0.431). Two tick species were identified: *Heamaphysalis bispinosa* (24/27: 88.9%) and *Rhipicephalus linneai* (3/27: 11.1%). Pooled molecular analysis detected *Theileria* spp. in all three farms with a 12-fold cost reduction compared to individual PCR, with no false positives in negative pools. These findings suggest that molecular analysis of pooled blood samples be used to cost-effectively detect *Theileria* infections in cattle herds, enabling timely treatment and improved disease control.

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Keywords: Cattle, Jaffna, *Theileria*, Tick-borne diseases

RESCON 2025 LS 42

COMMUNITY KNOWLEDGE, ATTITUDES AND PRACTICES ON CANINE MANGE IN SRI LANKA

V.R. Uduwela* and **R.S. Rajakaruna**

Department of Zoology, University of Peradeniya, Peradeniya, Sri Lanka.
*vruduwela@gmail.com

Mange is a widespread but often neglected parasitic skin condition caused by *Sarcoptes scabiei* and *Demodex canis* mites. This study aimed to evaluate community knowledge, attitudes and practices (KAP) regarding mange and identify factors influencing them. Data was collected through a structured questionnaire using convenience sampling, covering respondents' sociodemographic characteristics and details of their knowledge, perceptions, and practices on mange management. Chi-square or Fisher's exact tests were applied to analyse associations between sociodemographic factors and respondents' knowledge, attitudes, and practices. Information was obtained from 150 questionnaires across 11 districts with a participation of mostly young adults aged 18 – 30 (63.8%) and predominantly females (60.7%). Majority of the respondents (78.6%) were dog owners, and among non-owners, 73.1% previously owned dogs. Dogs were mostly kept outdoors; where 20.7% of dogs were exclusively outdoors, 33.3% were outdoors most of the time, 30.0% were occasionally outdoors, 12.0% were rarely outdoors, and only 4.0% were never kept outdoors. Only 39.3% of participants accurately answered > 50% of knowledge-related questions and demonstrated sufficient knowledge on characteristics and diagnosis of mange. There were no significant associations between knowledge and education ($\chi^2 = 0.258$, $p = 0.879$), dog ownership ($\chi^2 = 1.529$, $p = 0.216$), or respondent age ($\chi^2 = 2.011$, $p = 0.366$). Of the respondents, 58.0% gave acceptable responses on satisfactory mange-related practices for more than 50% of questions on practices. No significant association was found between practices and sociodemographic variables. Most respondents (94.0%) expressed positive attitudes emphasising the importance of public awareness about mange and its treatment. Open-ended responses highlighted reliance on home remedies, such as neem-based products, vinegar, coconut oil, mothballs and commercial treatments like dog shampoo. The importance of caring for street dogs was also emphasised. This study underscores the need for awareness programs and despite knowledge gaps and inconsistent practices, there is willingness to support educational initiatives that lead towards dog welfare.

Keywords: Community perceptions, Dog mange, Public awareness, Questionnaire survey

RESCON 2025 LS 43

CLIMATE, PHENOLOGY, AND BIOTIC INTERACTIONS: A STUDY OF TEN TREE SPECIES AT UNIVERSITY OF PERADENIYA, SRI LANKA

J.M.R.K. Jayasinghe[1]*, E.H.C.M. Eeriyawala[1], M.B. Dehideniya[2] and A.M.T.A. Gunaratne[1]

[1]Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka.
[2]Department of Statistics and Computer Science, University of Peradeniya, Peradeniya, Sri Lanka.
*rumeshikaj@sci.pdn.ac.lk

Shifts in climatic factors over time influence phenology and associated biotic interactions in natural and man-made ecosystems. This study investigated the relationship of climatic factors, phenology and biotic interactions in ten selected plant species, namely *Peltophorum pterocarpum, Delonix regia, Mesua ferrea, Tabebuia rosea, Macaranga peltata, Spathodea campanulata, Filicium decipiens, Jacaranda mimosifolia, Samanea saman,* and *Muntingia calabura* at the Universtity of Peradeniya, Sri Lanka. Ten individuals were sampled from each of the ten selected plant species. The phenological events, including vegetative (flushing) and reproductive (flowering and fruiting) phenophases and biotic interactions (pollination and seed dispersal) associated with them were monitored from January to December 2024. Climatic factors (rainfall and temperature) during the study period were obtained from the Natural Resource Management Centre, Peradeniya. A positive correlation between high rainfall, and the flushing and flowering was recorded for *Peltophorum pterocarpum*, *Delonix regia, Mesua ferrea*, *and Tabebuia rosea*. In contrast, *Macaranga peltata* and *Filicium decipiens* recorded peak flowering during dry period (mean rainfall 0 mm and mean temperature 26.2 °C), avoiding floral damage due to excessive rainfall. All the tree species were pollinated by insects, except *Spathodea campanulata*, which was pollinated by birds. Seeds of *Macaranga peltata, Muntingia calabura, Samanea saman,* and *Filicium decieipiens* were dispersed by frugivores. Moreover, the fruiting period of *Mesua ferrea*, *Tabebuia rosea,* and *Delonix regia* overlapped with the wet period, ensuring favorable conditions for the seed germination after seed dispersal. High mean monthly rainfall during the wet season (101.8 – 131.5) mm reduced pollinator visits by two folds in *Peltophorum pterocarpum* and *Mesua ferrea* species, emphasising the effect of climate variables on plant-pollinator interactions. Climatic variability plays a pivotal role in shaping phenology and plant-animal interactions, with direct consequences for the reproductive ecology of tree species.

Keywords: Biotic interactions, Climate factors, Phenology, University of Peradeniya

RESCON 2025 LS 44

TAXONOMIC STATUS OF *Impatiens subcordata* Arn. (Balsaminaceae)

H. Jayanetti[1], D.M.D. Yakandawala[1]*, B. Gopallawa[1], I. Madola[2] and K. Yakandawala[2]

[1]*Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Horticulture & Landscape Gardening, Wayamba University, Kuliyapitiya, Sri Lanka.*
*deepthiy@sci.pdn.ac.lk

Impatiens subcordata Arn. (Family Balsaminaceae) is a herbaceous species endemic to Sri Lanka. The species is morphologically similar to *I. cordata* Wight, a species endemic to India. These morphological parallels raise a critical taxonomic question of whether these two geographically separated populations are distinct species, or conspecific. Resolving this taxonomic ambiguity is important for biodiversity conservation, as *I. subcordata*, endemic to Sri Lanka, was thought to be extinct but recently rediscovered in the wild. The objective of the present study was to re-evaluate the taxonomic positions of *I. cordata* and *I. subcordata* to discern whether the two were distinct species or not. This was done by performing both a morphometric analysis and a molecular phylogenetic analysis. Four different populations of *I. subcordata* were sampled to obtain morphological and molecular data. Morphological data were subjected to a cluster analysis using PAST software. The ITS, *atp*β-*rbc*L and *trn*L – *trn*F regions (chosen based on the availability of data for *I. cordata*) were sequenced. Maximum likelihood and Bayesian inference analyses were performed to reconstruct the phylogeny using *Hydrocera triflora* (L.) Wight & Arn. as the outgroup. Morphometric analysis of 16 characters revealed significant variation patterns, where *I. subcordata* populations clustered distinctly from *I. cordata.* Zero genetic distance was found between the *I. subcordata* populations. The reconstructed phylogenies strongly supported (bootstrap value of 100% from Bayesian inference analysis and posterior probability value of 1 from maximum likelihood analysis) *I. subcordata* as a monophyletic group, sister to *I. cordata.* Furthermore, morphological analysis indicates that the two species are also morphologically distinct. Overall results strongly indicate that while closely related, the Sri Lankan and Indian species are distinct, resolving a longstanding uncertainty about the validity of the species and thereby confirming the endemic status of *Impatiens subcordata* to Sri Lanka. This will contribute to the accurate documentation of endemic plant diversity and development of appropriate conservation strategies.

Financial assistance from WNPS-HEMAS Critically Endangered Endemic Species Conservation Project is acknowledged.

Keywords: Conservation, Molecular phylogenetics, Morphometrics, Sri Lanka

RESCON 2025 LS 45

CONSERVATION GENETICS OF THE ENDANGERED SKY ISLAND LIZARD, *Ceratophora stoddartii*

W.M.N. Tharaka and K.D.B. Ukuwela*

Department of Biological Sciences, Rajarata University of Sri Lanka, Mihintale, Sri Lanka.
*kanishka@as.rjt.ac.lk

The global decline in biodiversity necessitates urgent conservation action, with genetic diversity being vital for species survival and adaptation, underscoring conservation genetics as crucial tool in biodiversity preservation. *Ceratophora stoddartii* (Rhino-horned lizard) is an endangered arboreal agamid lizard species endemic to Sri Lanka's montane cloud forests. The species is highly vulnerable to habitat fragmentation and isolation within these 'sky island' habitats. This study presents the first population genetic analysis of a montane lizard species in Sri Lanka, evaluating genetic structure and diversity across the distribution range of *C. stoddartii* to inform conservation strategies. Tail tissue samples were collected from six montane forest sites spanning the species' distribution range. DNA was extracted and mitochondrial ND2 gene region was successfully amplified and sequenced in 17 individuals. Population genetic structure was assessed using phylogenetic analysis (Bayesian and Maximum Likelihood) and haplotype network analysis. Spearman's correlation analysis examined the relationship between genetic divergence and geographic distance. Molecular diversity indices estimated genetic diversity among populations. Phylogenetic analyses identified two major clades corresponding to the Raxawa Mountain population and Central Highlands populations indicating two distinct evolutionary lineages. Uncorrected pairwise genetic distances ranged between 0.00 – 4.89%, with Raxawa showing the highest divergence (3.53 – 4.89%). Within Central Highlands populations, divergence ranged from 0.00% to 3.80%. Haplotype analysis revealed eight unique haplotypes; none shared among sites. Spearman's correlation indicated significant positive relationship between genetic and geographic distance. Overall nucleotide diversity was moderate (π = 0.02613) while Raxawa population exhibited the highest nucleotide diversity (π = 0.00212). These results indicate that *C. stoddartii* comprises genetically distinct, geographically structured populations, with long-term isolation contributing to divergence. The deep divergence between the Raxawa Mountain and Central Highland lineages supports their recognition as separate conservation management units. Future studies integrating whole-genome sequencing and expanded geographic sampling are essential for refining conservation strategies and investigating historical drivers of population subdivision.

Financial assistance from the Sri Lankan Biodiversity Research Grant Scheme (Grant No. 24-02-RUSL) is acknowledged.

Keywords: Conservation management, Genetic diversity, Habitat fragmentation, Phylogenetic, Population structure

RESCON 2025 LS 46

UNDERSTANDING COMMUNITY AWARENESS OF ELECTRIC FENCING IN AREAS PRONE TO ELEPHANT ELECTROCUTIONS IN SRI LANKA

D.K. Rathnayake[1], S.N. Weerakkody[1,2,3] and E.P. Kudavidanage[1]*

[1]*Department of Natural Resources, Sabaragamuwa University of Sri Lanka, Belihuloya. Sri Lanka.*
[2]*Southeast Asia Biodiversity Research Institute, Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, Yunnan, China.*
[3]*Yunnan International Joint Laboratory of Southeast Asia Biodiversity Conservation & Yunnan Key Laboratory for Conservation of Tropical Rainforests and Asian Elephants, Yunnan, China.*
*enokakudavidanage@gmail.com

Electrocution has emerged as a major cause of mortality in Sri Lankan elephants (*Elephas maximus maximus*) in recent years. Electric fences established by the Department of Wildlife Conservation (DWC) and other commercially available deterrent systems help keep elephants away. However, unregulated private electric fences often cause elephant fatalities due to the use of lethal voltage and amperage for the power source. This study aimed to assess knowledge gaps and maintenance issues related to private electric fences in high-risk areas for electrocution-induced elephant deaths in Sri Lanka. Welikanda, Polpithigama, and Thanamalvila regions were identified as electrocution risk zones using primary data from the DWC. The Welikanda area recorded the highest number of electrocutions between 2010 and 2024, while the Polpithigama area recorded the highest number in 2024, and the Thanamalvila area recorded the highest number in the South-Eastern region. Semi-structured interviews were conducted with a random sample of 165 villagers in those three areas. Survey findings revealed three major issues: poor maintenance of private electric fences, limited awareness of government regulations, and a lack of proper voltage management in private electric fences. Knowledge of the recommended voltage was relatively high in Polpithigama (78%), Welikanda (68%), and Thanamalvila (60%). Yet, the percentage of respondents with knowledge regarding policies and regulations was less than 50% in all three areas. Among participants with private electric fences (92% of respondents), only 22% used solar energy, while 70% relied on the national grid as the power source, which has detrimental consequences for both wildlife and humans. The study highlights the need for community-based fence maintenance, community awareness campaigns on safe energiser use, voltage regulation, and stronger government monitoring of illegal or poorly planned fencing. These measurements are essential to reduce electrocution-related elephant mortality in Sri Lanka.

Keywords: Community awareness, Electrocution risk zones, Elephant mortality, Private electric fences

RESCON 2025 LS 47

UNDERSTANDING THE PATTERNS OF WILDLIFE CRIMES IN UDAWALAWE NATIONAL PARK, SRI LANKA FROM 2014 TO 2024

W.M.S.B. Weerakoon[1]*, S. Weerakkody[2,3] and E.P. Kudavidanage[1]

[1]*Department of Natural Resources, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka.*
[2]*Southeast Asia Biodiversity Research Institute, Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, Yunnan, China.*
[3]*Yunnan International Joint Laboratory of Southeast Asia Biodiversity Conservation & Yunnan Key Laboratory for Conservation of Tropical Rainforests and Asian Elephants, Yunnan, China.*
*shalithaweerakoon6@gmail.com

Wildlife crimes constitute an escalating global threat with serious consequences for biodiversity conservation and ecosystem integrity. Udawalawe National Park in Sri Lanka has emerged as a critical hotspot for such activities. This study analysed 1,118 wildlife crime incidents reported between 2014 and 2024, focusing on temporal patterns, offense diversity, and seasonal dynamics. Temporal analysis revealed marked surges in 2014, 2018, 2020 and 2023, with 2020 recording the highest incidence during the COVID-19 pandemic. Offense profiling identified 43 categories of crimes, though 10 accounted for 86.50% of all cases. Illegal entry into the park (37.39%) and Cannabis (*Cannabis sativa*) cultivation (17.89%) were the most frequent. Other common offenses included illegal fishing (6.80%) and illegal cattle entry (5.19%). During the study period, 639 cases were recorded, involving 742 suspects, with an average of nearly two suspects per case. Arrests were made in 435 cases (68.08%), while no arrests were made in 204 cases (31.92%), in those cases, captured items were destroyed or confiscated. Seasonal peaks occurred during the dry season (May – September) and the cultural festival period (March – April), suggesting that both ecological resource scarcity and socio-cultural practices influenced illegal activities. Law enforcement responses, therefore, reflected both notable achievements and persistent limitations in deterrence. These findings collectively emphasise the complex nature of wildlife crimes in Udawalawe National Park and highlight the urgent need for adaptive, evidence-based conservation strategies to protect Sri Lanka's wildlife heritage in the long term.

Keywords: Conservation, Crime diversity, Law enforcement, Protected areas, Wildlife crime

RESCON 2025 LS 48

AN ECONOMIC ASSESSMENT OF HUMAN ELEPHANT CONFLICT IN HAMBANTOTA DISTRICT, SRI LANKA

H.O. Parami[1], P. Gunawardene[2], S. Weerakkody[1,3,4] and E.P. Kudavidanage[1]*

[1]Department of Natural Resources, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka.
[2]Department of Forestry and Environmental Science, University of Sri Jayewardenepura, Nugegoda, Sri Lanka.
[3]Southeast Asia Biodiversity Research Institute, Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, Yunnan, China.
[4]Yunnan International Joint Laboratory of Southeast Asia Biodiversity Conservation & Yunnan Key Laboratory for Conservation of Tropical Rainforests and Asian Elephants, Yunnan, China.
*enokakudavidanage@gmail.com

Human elephant conflict (HEC) is a major issue in Sri Lanka, threatening rural livelihoods and the elephant survival. It is particularly prevalent in Hambantota district, where expanding unsustainable agriculture and development projects have intensified human-elephant interactions. This study aimed to quantify the economic impact of HEC by estimating monetary losses from crop and property damage, as well as human and elephant deaths. Data were collected using a mixed-methods approach, combining primary data from 236 respondents in the most impacted areas of Hambantota, Tissamaharama, Sooriyawewa and Lunugamwehera, with secondary data from Department of Wildlife Conservation and Agricultural and Agrarian Insurance Board. Primary data were analysed by using SPSS, and "the Value of Statistical Life" was used to monetise human fatalities. Between 2018 and 2024, the estimated value of human deaths was 12.2 billion LKR, the value of elephant deaths was 551 million, and agricultural damage cost was 11.6 million LKR. During this period, the government spent 423 million LKR on Electric fencing. The cumulative monetary loss from 2018 to 2024 was 12.8 billion LKR. Descriptive statistics showed that 70% households experienced moderate to severe financial losses, and lower income households bore the highest median losses indicating an inverse relationship between income and impact. HEC can be reduced sustainably through land use planning that balances human needs and the ecological and spatial needs of elephants for movement. Overall, the results showed that human-elephant conflict causes a significant monetary loss in rural communities, which eventually affects the national economy. Future strategies must prioritise strong, government-regulated electric fencing, promote affordable non-lethal alternative repellent methods, establish well-planned elephant corridors, reinforce institutional frameworks for immediate compensation, and commence effective awareness campaigns to ensure long-term human-elephant coexistence in Hambantota.

Keywords: Coexistence, Cost reduction, Mitigation strategies, Sustainable solutions

RESCON 2025 LS 49

COMPARATIVE ANALYSIS OF γ-AMINOBUTYRIC ACID, ANTIOXIDANT CAPACITY, AND TOTAL PHENOLIC CONTENT IN COMMON EDIBLE LEAFY PLANTS OF SRI LANKA

K.A.T. Nayanthika[1], V.D.N.M. Vithanage[1], L.J.P.A.P. Jayasooriya[1], M.P. Paranagama[2] and W.M.A.P. Wanigasekera[1]*

[1]Department of Basic Veterinary Sciences University of Peradeniya, Sri Lanka.
[2]Department of Basic Sciences, Faculty of Dental Sciences, University of Peradeniya, Sri Lanka.
*anojapw@vet.pdn.ac.lk

The *γ*-aminobutyric acid (GABA) is the principal inhibitory neurotransmitter in the central nervous system, regulating neuronal excitability and reducing anxiety. Antioxidants protect cells from oxidative stress by neutralising free radicals, lowering the risk of chronic diseases. This study evaluated the GABA content and antioxidant properties of six edible leaves: *Murraya koenigii* (Karapincha), *Asparagus racemosus* (Hathawariya), *Ipomoea aquatica* (Kankun), *Centella asiatica* (Gotu Kola), *Moringa oleifera* (Murunga), *and Pinacia oleracea* (Nivithi). GABA content was determined using the Kitaoka and Nakano spectroscopic method. Antioxidant capacity was assessed using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay and the ferric reducing antioxidant power (FRAP) assay. Total phenolic content (TPC) was measured using the Folin-Ciocalteu method. Methanol extracts (0.156 to 5.00 mg mL^{-1}) were prepared for all assays, and the activity at 1 mg mL^{-1} was extrapolated from the dose-response curves. *M. koenigii* had the highest GABA content (0.175 mg mL^{-1}), followed by *A. racemosus* (0.124 mg mL^{-1}), *I. aquatica* (0.065 mg mL^{-1}), *P. oleracea* (0.051mg mL^{-1}) *M. oleifera* (0.043 mg mL^{-1}) and *C. asiatica* (0.022 mg mL^{-1}). The highest radical scavenging activity as measured by DPPH assay, was observed in *M. koenigii* (IC_{50} = 1.49), while *I. aquatic, M. oleifera, C. asiatica, A. racemosus* and *P. oleracea* exhibited IC_{50} values 4.80, 4.92, 6.32, 19.46 and 80.50 mg mL^{-1}, respectively compared to vitamin C (IC_{50} = 0.16mg mL^{-1}). The highest FRAP value of 2.08 µmol trolox equivalents mL^{-1} was recorded for *C. asiatica* followed by of *M. koenigii* (1.66 µmol mL^{-1}) and *M. oleifera* (0.48 µmol mL^{-1}). *M. koenigii* also showed the highest TPC (0.20 mg mL^{-1} of gallic acid equivalents) followed by *M. oleifera* (0.09 mg mL^{-1}). Among the tested edible leaves, *M. koenigii* demonstrated the highest levels of GABA, antioxidant activity, and total phenolic content, indicating its strong potential as a functional food with neuroprotective and antioxidant properties.

Financial assistance from University of Peradeniya (Grant No. RG/2014/46/V) is acknowledged.

Keywords: Antioxidant Activity, DPPH, FRAP, GABA, Phenolic Content

RESCON 2025 LS 50

ANTIBACTERIAL EFFICACY OF HUMAN TEARS AND COMMERCIAL EYE DROPS AGAINST *Bacillus cereus* ISOLATED FROM EYEGLASS SURFACES

T.W.K.A.K. Dayarathne and W.A.P.P. de Silva*

Department of Zoology, University of Peradeniya, Peradeniya, Sri Lanka.
*depriyanka@sci.pdn.ac.lk

Bacillus cereus, a spore-forming environmental bacterium, is capable of persisting on frequently handled surfaces, such as eyeglasses, potentially posing a risk of ocular contamination. However, its prevalence on personal eyewear and the antimicrobial properties of human tears in controlling such bacteria remain poorly studied. This study evaluated the prevalence of *Bacillus cereus* in eyeglasses and the antibacterial effectiveness of human tears and selected commercial eye drops against the bacterium. Thirty samples were collected using sterile cotton swabs from the nose pads, ear clips, and eyeglass lenses worn by 10 individuals, and each was analysed individually. The samples were cultured in Luria-Bertani (LB) broth and subsequently plated on LB agar plates. The most frequently observed bacterial morphology was sub-cultured, and pure isolates were subjected to Gram staining, catalase, and slide coagulase tests for biochemical characterisation. Molecular identification confirmed the morphotype as *Bacillus cereus*. Human tears (60 µL per person) were collected from three individuals using Schirmer strips and tested separately. Antibacterial sensitivity testing was performed using the Kirby-Bauer disc diffusion method on Mueller-Hinton Agar. Discs were impregnated with the tears collected and three commonly available commercial eye drops containing amoxicillin-clavulanic acid, gatifloxacin, and ciprofloxacin. Distilled water was used as a negative control, and three replicates per treatment were performed. The plates were incubated at 37 °C for 24 hours. Gatifloxacin exhibited the highest mean inhibition zone (29.8±1.0 mm), followed by amoxicillin-clavulanic acid (29.4±1.1 mm) and ciprofloxacin (28.6±0.5 mm). Tears demonstrated notable antibacterial activity, with a mean inhibition of 26.5±0.2 mm, although it was slightly lower than that of the tested commercial eye drops. No inhibition zones were observed in the negative control. A significant difference was observed among the treatments (p = 0.034). This study reveals frequent *B. cereus* presence on eyeglasses and the notable antimicrobial activity of tears, in comparison with commercial eye drops.

Keywords: Antibacterial sensitivity test, Bacterial contamination, Ocular infections, Tears

RESCON 2025 LS 51

ANTIMICROBIAL AND SELECTED BIOCHEMICAL PROPERTIES OF MUCUS OF SRI LANKAN ENDEMIC SNAIL *Acavus haemastoma*

L.A.N. Deshan[1]*, L. Weerasekara[2], K. Wijesooriya[2], V. Pushpamal[3], E.Y. Fernando[1], D.C. Raheem[1], R. Ratnayake[4] and K.D.B. Ukuwela[1]

[1]*Department of Biological Sciences, Rajarata University of Sri Lanka, Mihintale, Sri Lanka.*
[2]*Department of Zoology, University of Peradeniya, Peradeniya, Sri Lanka.*
[3]*42, Kanneliya Road, Koralegama, Panangala, Galle.*
[4]*National Institute of Fundamental Studies, Kandy, Sri Lanka.*
*deshannamith@gmail.com

Developing novel antimicrobial treatments is crucial to combat the growing threat of antibiotic resistance. The mucus of the endemic snail, *Acavus haemastoma,* used in traditional medicine, could be a promising source of antimicrobial agents. This study investigated the antimicrobial properties of the mucus of *A. haemastoma*, compared the differences in antimicrobial activity between snails inhabiting two distinct habitats, and analysed the selected biochemical properties of the mucus. Mucus samples were collected from snails in two different habitats in Kottawa, Sri Lanka: the Kombala-Kottawa Forest Reserve (KKFR) and the adjacent home gardens. The antimicrobial activity of the mucus was tested against Methicillin-resistant *Staphylococcus aureus* (MRSA), *Escherichia coli*, *Pseudomonas aeruginosa* and *Candida albicans,* using the broth dilution method. Percentage inhibitions were also calculated, and several (2 – 4) mucus samples were randomly chosen from each habitat type for the biochemical analysis, including the determination of total carbohydrate content, total protein content, total phenol content, total antioxidant capacity, elemental composition, and protein profile. A significant difference was observed in the microbial growth between the mucus-treated and distilled-water-treated samples ($W = 9$, $p = 0.0081$) against *C. albicans* indicating the presence of anti-candidal activity. However, the results of percentage inhibitions between the two habitats tested for each microbial culture indicated that habitat had no effect on antimicrobial activity. Biochemical analyses revealed that the mucus from the natural forest had a higher carbohydrate content (705.5 mg L^{-1}) than that from the home gardens (224.1 mg L^{-1}). No substantial differences in mucus phenol concentration or antioxidant capacity were observed between the two habitats. Proteins were present at relatively higher concentrations compared to other biochemical components, suggesting that those ranging from 9.44 kDa to 270.77 kDa may be responsible for the anti-candidal activity in *A. haemastoma*. These findings suggest that the mucus of *A. haemastoma* be a promising source of an animal-derived antimicrobial agent.

Keywords: Antibiotic resistance, Antioxidant capacity, Elemental composition, Protein profile

RESCON 2025 LS 52

EFFECT OF ANTIBIOTIC-LOADED MONTMORILLONITE NANOCLAY IN DEGRADING SELECTED BACTERIAL BIOFILMS

G.H.S.S. De Silva[1*], **N.H. Madanayake**[1,2] **and H.M.S.P. Madawala**[1]

[1]*Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Institute for Frontier Materials, Deakin University, Geelong Waurn Ponds Campus, Geelong, Australia.*
*samangisanjula@gmail.com

Bacterial biofilms pose significant challenges in healthcare and industry due to enhanced resistance to antibiotics, which arise from their protective extracellular matrix and cellular structure, leading to persistent infections and development of antimicrobial resistance. This study explored the efficacy of ciprofloxacin (CIP) and tetracycline (TC) loaded montmorillonite (MMT) nanoclay in combating biofilm-forming bacteria. Antibiotic-loaded MMT nanocomposites were synthesised at three ratios of antibiotics. The synthesised composites were characterised using Fourier transformed infrared spectroscopy (FTIR) and scanning electron microscopy (SEM). Drug loading and entrapment efficiency analysis revealed that 1:2 ratio exhibited the highest loading efficiency (CIP: 83.5±0.9%; TC: 55.3±0.8%) for both antibiotics, while the 1:1 ratio achieved the best entrapment efficiency (CIP: 55.2±1.7%; TC: 46.0±1.4%) ($p < 0.05$). Release studies showed both composites exhibit slow and controlled release at pH 7.4. Antibacterial activity was assessed using agar well diffusion method, where MMT-CIP (1:2) showed significantly larger inhibition zones (*E. coli*: 21.3±1.2 mm; *S. aureus*: 19.8±0.9 mm; *P. aeruginosa*: 18.6±1.1 mm) compared to free CIP ($p < 0.05$). Biofilm formation was quantified by microtiter plate crystal violet staining, and anti-biofilm efficacy was evaluated by determining the minimum biofilm inhibitory concentration (MBIC) and minimum biofilm eradication concentration (MBEC). MMT-CIP composites inhibited biofilm formation at 16 µg mL^{-1} (MBIC for *E. coli* and *S. aureus*) and eradicated established biofilms at 32 µg mL^{-1} (MBEC), values significantly lower than free CIP (MBIC 64 µg mL^{-1}; MBEC 128 µg mL^{-1}) ($p < 0.05$). While, MMT-TC composites displayed moderate efficacy, with MBIC values of 64 – 128 µg mL^{-1} and MBEC value of 256 µg mL^{-1}, and particularly less effective against methicillin-resistant *S. aureus* and clinical isolates of *P. aeruginosa*. These findings highlight the potential of MMT as a carrier for antibiotics, offering enhanced efficacy, controlled release, and reduced resistance development.

Keywords: Antibiotic resistance, Biofilm, Ciprofloxacin, Montmorillonite, Tetracycline

RESCON 2025 LS 53

A PRELIMINARY STUDY TOWARDS DEVELOPMENT OF A FERMENTED COCONUT WATER BEVERAGE

S.A. Suriyaarachchi and K.N. Samarasekera*

Department of Botany, University of Sri Jayewardenepura, Nugegoda, Sri Lanka.
*kaumadi@sjp.ac.lk

Coconut water is a nutrient-rich natural beverage with significant potential in the functional beverage market. Although abundant in Sri Lanka, it remains underutilised in value-added applications. Due to its natural sugar content, minerals, and bioactive compounds, coconut water serves as an ideal substrate for fermentation. This study developed a new fermented coconut water beverage using commercial yeast, which is also known as baker's yeast (*Saccharomyces cerevisiae*) as the starter culture, with and without added table sugar, to enhance its nutritional value and ensure microbiological safety and shelf life. Fresh coconut water obtained from 8-month-old coconuts was used to produce three different fermented coconut water products: coconut water product; coconut water and 1% (v/v) commercial yeast product; and coconut water, 1% (v/v) commercial yeast, and 5% (w/v) added sugar product. Triplicates were prepared for each product. All fermentation products were incubated at room temperature with constant shaking at 120 rpm. The fermentation process was monitored daily by measuring changes in pH and Brix values. The coconut water alone required nine days to complete fermentation. In contrast, coconut water inoculated with yeast fermented within three days, while coconut water supplemented with both yeast and sugar took seven days to complete fermentation. At the end of fermentation, viable yeast and lactic acid bacteria counts were determined, along with nutritional parameters such as vitamin C and protein, and the alcohol content of each product. Based on nutritional values and other parameters mentioned above, the best product was the coconut water with the commercial yeast product. It had a final pH of 5.05±0.02, a Brix value of (1.90±0.06) ºBx, viable yeast count of $(5.60\pm0.57)\times10^{11}$ CFU mL^{-1}, viable lactic acid bacteria count of $(2.45\pm0.25)\times10^{7}$ CFU mL^{-1}, (20.90±0.28) mg per 100 mL vitamin C, (1001.73±3.08) µg mL^{-1} protein, and (4.40±0.14)% alcohol. The selected product showed no *Escherichia coli* growth. Shelf-life testing revealed ongoing fermentation under refrigeration, indicating the need for preservatives. This study demonstrates that fresh coconut water obtained from 8-month-old coconuts can be transformed into a safe and nutritious fermented beverage.

Keywords: Commercial yeast, Fermented coconut water, Functional beverage, Microbiological safety, Nutritional enhancement

RESCON 2025 LS 54

MOLECULAR DETECTION OF *Aeromonas* spp. IN MUNICIPAL TAP WATER FROM SMALL SCALE RESTAURANTS IN NUWARA ELIYA DISTRICT, SRI LANKA

Y.P. Thuduwage, R.M.P.A. Bandara and S.S.S. de S. Jagoda*

Centre for Aquatic Animal Disease Diagnosis and Research, Department of Veterinary Pathobiology, University of Peradeniya, Peradeniya, Sri Lanka.
*samanthika@vet.pdn.ac.lk

Aeromonas species, Gram-negative bacteria ubiquitous in aquatic environments, particularly in freshwater, are increasingly recognised as emerging waterborne pathogens implicated in both gastrointestinal and systemic infections in humans. The objective of this study was to detect the occurrence of *Aeromonas* spp. in municipal tap water in the Nuwara Eliya District, a highland region with distinctive climatic and hydrological features, potentially affecting water safety. Aseptically collected water samples were obtained from taps supplying drinking water to consumers at thirty-seven randomly selected small scale restaurants across various locations in Nuwara Eliya, during the period from December 2024 to February 2025. Typical colonies of *Aeromonas* spp. isolated on Glutamate Starch Phenol Red (GSP) agar were presumptively identified to the genus level through phenotypic characterisation, including Gram staining and a series of biochemical tests. Molecular confirmation of these presumptive *Aeromonas* isolates was performed using polymerase chain reaction (PCR) with *Aeromonas* genus-specific 16S rRNA primers. Out of thirty-seven processed water samples, eight (21.62%) tested positive for *Aeromonas*. Fourteen isolates were presumptively identified as *Aeromonas* spp. through biochemical tests. However, PCR analysis confirmed only thirteen isolates as *Aeromonas*, providing the first molecular evidence of the presence of these pathogens in treated municipal water within this region. The detection suggests possible inefficacies in current water treatment and distribution systems, raising concerns over microbial contamination and public health risks. These findings suggest the potential presence of *Aeromonas* in treated municipal water. Ongoing investigations into the species-level identification, virulence factors, and antimicrobial resistance profiles of *Aeromonas* isolates aim to provide a clearer understanding of their pathogenic potential and to inform future risk assessments.

Keywords: *Aeromonas spp*., Drinking water, Molecular detection, Phenotypic characterisation, Public health

RESCON 2025 LS 55

INVESTIGATION OF BIOFILM FORMATION IN THREE WARDS OF PERADENIYA TEACHING HOSPITAL AND COMPUTATIONAL PREDICTION OF ANTI-BIOFILM DRUGS

M.N.F. Ramsa[1], J.P.P.S. Rasangani[2] and W.R.P. Wijesinghe[1,3]*

[1]*Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Genetics and Molecular Biology Unit, University of Sri Jayewardenepura, Nugegoda, Sri Lanka.*
[3]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
*priyangaw@sci.pdn.ac.lk

Biofilm formation in healthcare settings presents a significant challenge due to its role in antibiotic resistance and persistent infections. This study investigated biofilm formation in clinical isolates from the surgical, medical, and psychiatric wards of the Peradeniya Teaching Hospital, employing three distinct detection methods: The Test Tube Method, Congo Red Agar (CRA) Method, and Tissue Culture Plate (TCP) Method. The Test Tube Method enabled qualitative assessment of biofilm production, while the CRA Method utilised Brain Heart Infusion (BHI) agar supplemented with Congo Red dye to differentiate biofilm producers visually, which formed characteristic black, dry colonies. The TCP Method provided a quantitative analysis of biofilm biomass using crystal violet staining and spectrophotometric absorbance at 630 nm. Scanning electron microscopy further confirmed the presence of dense biofilm matrices in high biofilm-forming samples, particularly from surgical and medical wards. In contrast, samples from the psychiatric ward showed significantly lower biofilm production. These differences correlated with variations in patient demographics, hygiene practices, and antibiotic exposure. In the computational component of the study, machine learning models, including Random Forest (RF), Support Vector Machine (SVM), and Artificial Neural Network (ANN), were implemented using KNIME software to predict biofilm-inhibitory potential among 200 antibiotics, based on a training dataset of 23 known inhibitors. All models identified ceftazidime as a promising anti-biofilm agent, demonstrating strong activity against single-species biofilms. However, its reduced efficacy in mixed-species communities highlighted the increased resistance and complexity of polymicrobial biofilms. The RF and SVM models achieved prediction accuracy of 86.04%, while the ANN model achieved 83.33%. This integrative study underscores the value of combining experimental assays with computational prediction to advance the discovery of effective anti-biofilm agents. It also emphasises the need for novel strategies tailored to overcome the resilience of complex, hospital-acquired biofilms.

Keywords: Antibiotic resistance, Biofilm, Drug prediction, KNIME, Machine learning

RESCON 2025 LS 56

COMPARATIVE EVALUATION OF MYCOBIOTA OF *Aedes albopictus* AND *Culex quinquefasciatus* LARAVE AND LARVICIDAL POTENTIAL OF ASSOCIATED ENTOMOPATHOGENIC FUNGI

K.P.W.C. Kavindi[1], W.M.S.H. Wijesundara[1], W.A.M. Daundasekera[2] and W.A.P.P. de Silva[1]*

[1]*Department of Zoology, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka.*
*depriyanka@sci.pdn.ac.lk

Fungi influence mosquito survival, development, and population dynamics through symbiotic to pathogenic interactions. This study aimed to characterise and compare the fungal communities associated with larvae of *Aedes* and *Culex* mosquitoes, and to evaluate the entomopathogenic potential of common fungal species isolated from both mosquito genera. *Aedes albopictus* and *Culex quinquefasciatus* larvae were collected from natural and artificial breeding sites from Kandy and Galle districts. Fungi associated with the external surfaces and the internal organs of the collected larvae (n = 240) were cultured using potato dextrose agar (PDA). Isolated fungi were identified morphologically. Three fungal species, (*Aspergillus fumigatus, A. niger, Cladosporium* sp), which were common to both larval species, were used to assess the entomopathogenicity. Larval bioassays were conducted with conidial suspensions of each fungus (1×10^7 – 1×10^3 conidia mL^{-1}), and mortalities were reported after 24 h to determine the lethal concentrations (LC_{50} and LC_{90}). Nine fungal species were isolated from *Aedes* larvae, with *Aspergillus fumigatus,* and *Cladosporium* sp. were the most prominent. Twenty fungal species were isolated from *Culex* larvae, with *A. fumigatus*, *Cladosporium* sp, and *Trichoderma* sp. being the most abundant. Six fungal species, *A. fumigatus*, *A. niger*, *Cladosporium* sp., *Curvularia* sp., *Fusarium* sp., and *Penicillium* sp. were common to both *Aedes* and *Culex* larvae, while *Rhizopus* sp., *Trichoderma* sp., and *Trichothecium* sp. were found only from *Culex* larvae. *Acremonium* sp. was found only from *Aedes* larvae. *Aspergillus niger* showed significantly higher larvicidal activity against *Cx. quinquefasciatus* larvae (LC_{50} = 3.47×10^5 conidia mL^{-1}) compared *Ae. albopictus* (LC_{50} = 7.94×10^5 conidia mL^{-1}) (p = 0.0495; H = 3.86). *Aspergillus fumigatus* (LC_{50} = 1.23×10^6 conidia mL^{-1}) and *Cladosporium* sp. (LC_{50} = 1.78×10^5 conidia mL^{-1}) showed larvicidal activity only against *Cx. quinquefasciatus.* The outcomes reported a difference in the number of fungal species and the composition between *Aedes* and *Culex* larvae, with *Aspergillus niger* showing the strongest larvicidal effect.

Keywords: *Aedes albopictus, Culex quinquefasciatus, Entomopathogenic potential,* Fungi, Mosquito microbiome

RESCON 2025 LS 57

GENOTYPIC DIVERSITY AND CARIOGENIC POTENTIAL OF *Candida albicans* ISOLATED FROM A COHORT OF CHILDREN WITH EARLY CHILDHOOD CARIES PRESENTED TO THE DENTAL TEACHING HOSPITAL, PERADENIYA, SRI LANKA

K.M.S. Bandara[1]*, D.P. Jayarathne[2], N.H. Senarath[3], M.P.C.S. Dhanapala[1] and M.P. Paranagama[2]

[1]*Department of Molecular Biology and Biotechnology, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Basic Sciences, Faculty of Dental Sciences, University of Peradeniya, Peradeniya, Sri Lanka.*
[3]*Department of Community Dental Health, University of Peradeniya, Peradeniya, Sri Lanka.*
*suranga23280@gmail.com

In recent years, studies have identified a strong link between *Candida albicans*, an opportunistic fungal pathogen in humans, and Early Childhood Caries (ECC), or tooth decay, a significant global health concern among preschool children. Based on 25S rDNA, strains of *C. albicans* are classified into multiple genotypes (A, B and C), which may vary in their prevalence and cariogenic potential. Hence, investigating the genotypic diversity and cariogenic potential of different genotypes is crucial for ECC prevention, although it has not been studied in Sri Lanka. Therefore, this study aimed to examine the genotypic diversity and cariogenic potential of *C. albicans* isolated from a cohort of Sri Lankan children with ECC. Dental biofilm samples were collected from 19 children with ECC. *C. albicans* was isolated using CHROMagar medium, followed by DNA extraction and PCR targeting the 25S rDNA to analyse the genotypes. The Cariogenic potential of different genotypes was evaluated with regard to acidogenicity and aciduricity. Out of 19 participants, 10 tested positive for *C. albicans*. Genotyping revealed that only a single genotype was present in each child, with the majority of children (70%) carrying genotype A, followed by 10% with genotype B, and 20% with genotype C. All three genotypes produced acids and lowered pH below the tooth demineralisation threshold of pH 5.5 within 24 hours. Notably, acidogenicity of genotype C was significantly lower than that of genotype A and B (n = 3; $p < 0.05$). According to the aciduricity test results, genotype A exhibited the highest growth at all tested pH values, suggesting its superior acid tolerance contributing to its high prevalence. In conclusion, genotype A has the highest prevalence in the selected cohort and exhibits greater cariogenic potential, suggesting its potential role in disease progression. Future studies are warranted to clarify its clinical relevance in the management of ECC.

Financial assistance from University of Peradeniya (Grant No. URG/2023/12/D) is acknowledged.

Keywords: ABC genotypes, Acidogenicity, Aciduricity, Cariogenicity, Dental caries

RESCON 2025 LS 58

PREVALENCE OF ANTIBIOTIC RESISTANCE GENES IN ORAL BIOFILMS COLLECTED FROM PATIENTS ATTENDING THE DENTAL (TEACHING) HOSPITAL, UNIVERSITY OF PERADENIYA, SRI LANKA

G.W.N. Kaushalya[1], R.G.S.C. Rajapakse[1] and J.A.M.S. Jayatilake[2]*

[1]*Department of Molecular Biology and Biotechnology, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Oral Medicine and Periodontology, University of Peradeniya, Peradeniya, Sri Lanka.*
*sumedhaj@dental.pdn.ac.lk

Oral biofilms are complex microbial ecosystems that can harbor opportunistic pathogens responsible for periodontal diseases, dental caries, and systemic infections. Antibiotic resistance in oral microorganisms poses a critical challenge to the management of both oral and systemic infections. While several studies worldwide have examined antibiotic resistance genes (ARGs), only a limited number of studies have focused on the prevalence of specific ARGs in oral biofilms, multidrug resistance, and factors influencing antibiotic resistance in Sri Lankan patients. This study aimed to investigate the prevalence of ARGs in oral biofilms collected from 70 patients (35 children and 35 adults) attending the Dental (Teaching) Hospital, University of Peradeniya, Sri Lanka. Total DNA was extracted from the biofilms using the NaOH boiling method and the presence of ARGs (*TetM, TetQ, ermB, blaTEM*) was detected using PCR. The overall prevalence of ARGs as well as prevalence within the children and adult groups was assessed and the difference between the two groups were compared using a chi-square test. The overall prevalence of ARGs was *TetM* (64.3%), *TetQ* (34.3%), *ermB* (67.1%), and *blaTEM* (74.3%). Multidrug resistance was observed in 71.4% of the sample and 95.71% carried at least one ARG. *TetM* ($p = 0.025$) and *ermB* ($p = 0.022$) were significantly associated with age, showing a higher prevalence in adults, whereas no significant association with age was found for *TetQ* ($p = 0.615$) or *blaTEM* ($p = 0.584$). In conclusion, this study indicates a high prevalence of ARGs and elevated multidrug resistance in oral biofilms among the study population with notable differences in resistance gene distribution among adults and children. However, future research is needed to confirm if these genes translate to clinical antibiotic resistance via phenotypic tests. These preliminary findings highlight the need for improved awareness regarding rational antibiotic prescription and use.

Keywords: Antibiotic resistance genes, Dental caries, Oral biofilm, Periodontal disease

RESCON 2025 LS 59

IDENTIFICATION OF GIBBERELLIN-SENSITIVE MUTATIONS PRESENT IN *OsGA20ox* GENE INVOLVED IN GIBBERELLIN BIOSYNTHESIS PATHWAY OF SRI LANKAN DWARF RICE VARIETIES

D.K.N.D. Pushpakumara and M.P.C.S. Dhanapala*

Department of Molecular Biology and Biotechnology, University of Peradeniya, Peradeniya, Sri Lanka.
*chandimasd@sci.pdn.ac.lk

Rice (*Oryza sativa* L.) sustains billions of people globally, including Sri Lankans, by being the world's second most consumed cereal. As a country located near the equator, Sri Lanka faces frequent climate variations such as heavy rain and wind, which lead to lodging, where the stem of the plant leans from its upright position, resulting in yield loss. To address this, breeding dwarf rice that has the potential to withstand lodging was introduced. Previous studies identified that mutations in the genes involved in the gibberellin (GA) biosynthesis pathway led to dwarfism. However, the occurrence of GA-related mutations in local rice varieties is little known. This study laid the groundwork for identifying mutations present in the Gibberellin 20 oxidase (*GA20ox*) gene, which encodes a key enzyme that facilitates the final steps in the biosynthesis pathway, and it has been found that alterations in this gene lead to dwarfism in rice. The main objective of the study was to identify nucleotide base changes in the 3rd exonic region of the respective gene. For that, two dwarf varieties, which are believed to have arisen due to spontaneous mutations, and a normal reference variety (*tikiri-kekulu*) were selected. Concerning that, genomic DNA was extracted by the cetyltrimethylammonium bromide (CTAB) method, and the targeted region was identified through PCR with a specific marker, followed by sequencing and alignment. Results showed single-nucleotide polymorphisms in coding regions, which led to amino acid changes that appeared to be missense mutations in black and white dwarf varieties. Reportedly, sites where these mutations occurred belong to conserved regions that remain unchanged in reference varieties but were altered in dwarf varieties, which may explain the reason for the dwarfing trait. After further analysis, these findings can be incorporated to enhance rice breeding and produce new variants that are capable of withstanding climatic changes.

Keywords: Dwarfism, Genetic variations, Gibberellin 20-oxidase, Lodging resistance, Sri Lankan rice

RESCON 2025 LS 60

TRACING THE INVISIBLE: FORENSIC DNA ANALYSIS FROM CIGARETTE BUTTS IN A MULTI-ASSAILANT SEXUAL ASSAULT CASE

R.A.B.S. Ranasinghe*, P.G. de Silva and V.J. Bandaranayake

Department of Government Analyst, Battaramulla, Sri Lanka.
*bhagya.subani90@gmail.com

In complex sexual assault investigations involving multiple perpetrators, identifying individual contributors can be challenging, especially when direct biological evidence such as semen or blood is absent or degraded. This case study highlights the successful application of forensic DNA analysis using secondary biological evidence specifically saliva and buccal epithelial cells recovered from cigarette butts collected at the crime scene of a gang rape. A total of 20 cigarette butts were analysed, out of which 18 yielded sufficient DNA profiles. Autosomal Short Tandem Repeat (STR) and Y-STR profiling enabled the identification of five distinct male DNA profiles, including a mixed profile. Comparative analysis showed that the DNA profiles obtained from reference blood samples provided by the suspects 1 and 2, matched with those obtained from the cigarette butts (number 2, 7, 8, and 13 and number 4 and 9, respectively). Mixed DNA profile revealed to be a mixture of two male contributors, one of whom matched to suspect-1 while the other remains unidentified. The analysis utilised standard forensic methodologies, including human DNA extraction and quantification, STR amplification, Polymerase Chain Reaction (PCR) and capillary electrophoresis. This case highlights the forensic value of secondary DNA evidence from non-traditional sources, the effectiveness of STR technologies in resolving mixed DNA samples, and the importance of careful evidence handling and preservation. The findings underscore how secondary evidence can play a critical role in criminal investigations, especially in the absence of direct biological evidence or eyewitness testimony.

Keywords: Forensic DNA analysis, Mixed DNA profiles, Secondary DNA evidence, STR profiling, Y-STR

RESCON 2025 LS 61

INVESTIGATION OF THE OCCURRENCE OF PROTEASES IN THE LATEX OF *Calotropis gigantea*

A.A.H.E. Amarasinghe and R.G.S.C. Rajapakse*

Department of Molecular Biology and Biotechnology, University of Peradeniya, Peradeniya, Sri Lanka.
*sanathr@sci.pdn.ac.lk

Proteases are ubiquitous biomolecules that play a crucial role in regulating protein activity in all living organisms. Dysregulation of protease functions gives rise to various pathological conditions, including cancer, neurodegenerative diseases, and cardiometabolic diseases. There is a growing interest in identifying proteases from latex-bearing plants, as they can be used in therapeutic and biotechnological applications. Giant milkweed, a medicinally important plant native to Sri Lanka, is utilised in Ayurvedic medicine for its antivenomous, antibacterial, and antifungal properties. Although previous studies suggest that giant milkweed latex contains proteases, detailed investigation into their occurrence and protease activity (PA) remains limited. This study aimed to investigate the presence of naturally occurring proteases in the latex of giant milkweed. Latex samples were collected from mature, flowering-stage plants, and a crude extract was obtained. A PA assay was successfully developed and optimised to achieve the maximum PA by varying different parameters, including temperature, pH, incubation time, substrate concentration, and crude concentration, using a one-factor-at-a-time approach. Subsequently, three different protease inhibitors were used to evaluate their inhibitory effects on the crude proteases. Inhibitors E-64, Pepstatin, and Leupeptin showed minimal, moderate, and strong inhibition, respectively. This suggests the presence of cysteine, aspartic, and serine proteases in the latex, with serine protease contributing more to the overall protease activity. Furthermore, the crude proteases were fractionated using ammonium sulfate precipitation, and a caseinolytic activity assay was performed. PA progressively increased from fraction 1 to 3 (0 – 60)%, followed by a decline from fraction 4 to 5 (60 – 90)%. Fraction 3 (45 – 60)% showed a peak activity, indicating that there is a significant protease enrichment in this fraction compared to other fractions. Further studies are required to determine the overall protease profile of the latex and the variation of the protease profile under different growth stages and climatic conditions.

Keywords: Ammonium sulfate precipitation, *Calotropis gigantea,* Latex proteases, Protease activity

RESCON 2025 LS 62

SEROTYPE- BASED CHARACTERISATION OF *Listeria monocytogenes* IN RAW MILK COLLECTED FROM COLOMBO DISTRICT, SRI LANKA

O.T. Weerasinghe[1,2], T.S. Thalpavila[1,2], D.A.D.V. De Silva[1], M.L.A.M.S. Munasinghe[1] and W.A.S. Wijendra[2]*

[1]*Department of Botany, University of Sri Jayewardenepura, Nugegoda, Sri Lanka.*
[2] *Medical Research Institute, Colombo, Sri Lanka.*
*wijendra@mri.gov.lk

Listeria monocytogenes is a foodborne pathogen responsible for listeriosis, a severe foodborne illness, that poses a significant public health risk due to its high mortality rate, particularly in immune compromised individuals. Raw milk is a potential substrate for this pathogen, as it can thrive under refrigeration and withstand harsh environmental conditions. This study aimed to evaluate the prevalence and characterisation of circulating serotypes of *L. monocytogenes* in raw milk samples collected from the Colombo district, Sri Lanka. A total of 50 raw milk samples were collected, and 63 bacterial isolates were obtained. Isolates were confirmed as *L. monocytogenes* using nested PCR, and serotyping was performed on positive isolates using multiplex PCR. Of 63 isolates, 39 (61.9%) were confirmed as *L. monocytogenes* through nested PCR. Among these, serotype 4b was dominant and identified in four samples (9.75%). One isolate (2.56%) was identified as serotype 1/2b, while three isolates (7.7%) were identified as serotype 1/2a, and two isolates (5.13%) as serotype 1/2c. Additionally, two isolates (5.13%) showed a combination of serotypes 4b and 1/2c, suggesting potential serotype variation or co-infection within raw milk samples. The detection of multiple serotypes including the highly virulent serotype 4b, underscores the potential public health risks associated with raw milk consumption. The occurrence of isolates displaying both 4b and 1/2c serotypes warrants further investigation through genetic characterisation. These findings provide preliminary data on the distribution of *L. monocytogenes* in Sri Lanka and emphasise the importance of integrating whole genome sequencing in future studies to guide risk assessment and policy development.

Keywords: Food safety, *Listeria monocytogenes*, Multiplex PCR, Public health, Raw milk

RESCON 2025 LS 63

SALIVARY DETECTION OF *Porphyromonas gingivalis* VIA PCR AND ITS ASSOCIATION WITH PERIODONTITIS IN SRI LANKA

Y. Branavi[1]*, T.V.M.T. Somarathna[2], D.P. Jayarathne[2], K.S.N.D. Gunawardhana[2], D. Leuke Bandara[3], M.P.C.S. Dhanapala[1] and M.P. Paranagama[2]

[1]*Department of Molecular Biology and Biotechnology, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Basic Sciences, Faculty of Dental Sciences, University of Peradeniya, Peradeniya, Sri Lanka.*
[3]*Department of Oral Medicine and Periodontology, University of Peradeniya, Peradeniya, Sri Lanka.*
* branaviyogeshwaran@gmail.com

Porphyromonas gingivalis, a keystone periodontal pathogen, drives oral microbial dysbiosis and tissue destruction in periodontitis. While current subgingival diagnostics for periodontitis are invasive and limited, saliva offers a potential alternative for microbe-based diagnosis for this disease. For the first time in a Sri Lankan cohort, this study emphasises the utilisation of PCR-based salivary detection of *P. gingivalis* and its association with periodontitis. In this study, unstimulated saliva from 102 subjects (80 periodontitis patients and 22 healthy controls) were collected at the Dental Teaching Hospital, Peradeniya. Using an optimised DNA extraction protocol followed by conventional PCR targeting the *16S rRNA* gene of *P. gingivalis*, pathogen detection was achieved with sequence validation using NCBI BLAST confirming specificity. Prevalence of *P. gingivalis* was 50.0% in periodontitis patients versus 22.7% in healthy controls (p = 0.026). This represents a 2.2-fold higher occurrence in periodontitis. Multivariate analysis revealed strong associations between salivary detection and periodontitis status (adjusted OR = 3.98, 95% CI: 1.25 – 14.90) and increasing age (OR = 1.14/year, 95% CI: 1.02 – 1.31). This analysis revealed a noteworthy pattern among middle-aged subjects, showing increased detection rates approaching significance (OR = 3.13, p = 0.068), which should be studied further. These findings demonstrate that salivary PCR effectively distinguishes periodontitis patients and correlates with established risk factors such as age. This work lays the foundation for the process of developing non-invasive diagnostic tools using *q*PCR or *FimA* genotyping. Thus, it establishes salivary PCR as a viable diagnostic strategy and reveals unique epidemiological trends that could inform targeted preventive care for the Sri Lankan population.

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Keywords: Gum disease, Molecular periodontology, Peradeniya, Salivary biomarkers, *16S rRNA* gene

RESCON 2025 LS 64

MOLECULAR DETECTION OF *Helicobacter pylori* IN SALIVA OF SRI LANKAN PERIODONTITIS PATIENTS WITH AND WITHOUT GASTRITIS

T.V.M.T. Somarathna[1], D. Leuke Bandara[2], K. Gunasekara[3], S. Wijetunge[4], A.D.S.N.P. Athukorala[5], L.S. Nawarathna[6], M.P. Paranagama[1] and K.S.N.D. Gunawardhana[1]*

[1]*Department of Basic Sciences, Faculty of Dental Sciences, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Oral Medicine and Periodontology, University of Peradeniya, Peradeniya, Sri Lanka.*
[3]*Department of Surgery, University of Peradeniya, Peradeniya, Sri Lanka.*
[4]*Department of Pathology, University of Peradeniya, Peradeniya, Sri Lanka.*
[5]*Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka.*
[6]*Department of Statistics and Computer Science, University of Peradeniya, Peradeniya, Sri Lanka.*
*ndg@dental.pdn.ac.lk

Helicobacter pylori, a gram-negative bacterium, colonises the gastric mucosa of more than half of the world's population. It can cause a range of diseases from gastritis to gastric cancer. Research indicates this pathogen may also inhabit the oral cavity, potentially serving as a bacterial reservoir. Moreover, periodontitis, a chronic immuno-inflammatory disease affecting the tooth-supporting structures, has been suggested to facilitate the colonisation of *H. pylori* in the oral cavity, potentially serving as a reservoir for gastric reinfection. Given the high prevalence of both periodontitis and gastritis in Sri Lanka and the limited local data on oral *H. pylori*, this study assessed whether oral *H. pylori* is associated with gastritis in Sri Lankan patients with periodontitis. This cross-sectional study involved 98 individuals with periodontitis (53 females and 45 males), recruited from the Teaching Hospital, Peradeniya, and the Dental Teaching Hospital, Peradeniya. Among them, 43 were diagnosed with gastritis, while the remaining 55 had no evidence of gastritis. Saliva samples were collected, genomic DNA was extracted, and PCR was performed to detect the *H. pylori* 16S rRNA gene. Out of the 98 saliva samples analysed, *H. pylori* was detected in 27 cases (27.55%), predominantly in females (20/27), with a statistically significant gender difference. Positivity was higher in gastritis patients (34.9%) than in those without gastritis (21.82%). However, there was no statistically significant difference between the detection rates of these two groups, suggesting that the presence of gastritis does not significantly influence oral *H. pylori* detection in patients with periodontitis ($p > 0.05$). These findings suggest that the oral cavity may serve as a reservoir for *H. pylori*, implying that oral *H. pylori* can colonise in periodontitis patients without the influence of gastritis. However, further studies are needed to elucidate the role of oral *H. pylori* in periodontitis and its potential contribution to the transmission of gastric diseases.

Financial assistance from University Research Council, University of Peradeniya (Grant No. MRG-500) is acknowledged.

Keywords: Gastritis, *Helicobacter pylori*, PCR, Periodontitis, Saliva

RESCON 2025 LS 65

PRELIMINARY ASSESSMENT OF CLIMBERS FOR ENHANCING URBAN ACOUSTIC COMFORT

A.M.S. Nethmini[1], K. Yakandawala[1]* and D.M.D. Yakandawala[2]

[1]Department of Horticulture and Landscape Gardening, Wayamba University of Sri Lanka, Kuliyapitiya, Sri Lanka.
[2]Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka.
*kapilay@wyb.ac.lk

Anthropogenic noise has become a significant concern for urban dwellers, primarily caused by road traffic, industrial activities, construction sites, and social activities, which affect human wellbeing. Vegetation with desirable morphological characters can mitigate noise through absorption, scattering, reflection, and ground effect. Climbers, a largely understudied plant group, show potential for noise attenuation when used in urban green infrastructure. This study analysed the quantitative and qualitative morphological traits of 19 climber species to assess their potential for noise reduction. Three randomly selected individuals per species were examined, and 12 morphological traits were measured from three mature twigs (30 cm) of each climber. Quantitative data was analysed using ANOVA in R Studio. Leaf area, leaf thickness, and hair density emerged as the primary traits associated with noise reduction, while hair length, petiole length, leaf margin shape, presence of hairs on the midrib and petiole, and surface texture were secondary factors. *Petrea volubilis*, *Thunbergia grandiflora*, and *Antigonon leptopus* exhibited significantly greater ($p < 0.05$) leaf area, leaf thickness, and hair density on both surfaces compared to other species. Leaf area ranged from 85.04 cm^2 to 1203.32 cm^2, thickness from 34.77 µm to 79.70 µm, and hair density from 1 – 198 (upper) and 2 – 246 (lower), as observed at ×100 magnification under a scanning electron microscope. Higher leaf area and hair density likely provide a greater surface for noise absorption, while thicker leaves may reduce transmission. Longer hairs in *P. volubilis* and *T. grandiflora* further enhanced surface area. Non-entire leaf margins, hairs on the midrib and petiole, and rough textures also contributed to noise absorption, while longer petioles of *T. grandiflora* and *A. leptopus* may promote leaf movement. Therefore, these three species may be considered for use in urban greening initiatives, as they could contribute to improving the acoustic comfort of city dwellers.

Keywords: Climbers, Green infrastructure, Morphological characters, Noise reduction, Urban areas

RESCON 2025 LS 66

SCREENING FOR DROUGHT TOLERANCE OF GROUND COVER SPECIES FOR URBAN GREEN SPACES

W.M.K.P. Wanninayake, K. Yakandawala* and J.K.W.N. Subashini

Department of Horticulture and Landscape Gardening, Wayamba University of Sri Lanka, Kuliyapitiya, Sri Lanka.
*kapilay@wyb.ac.lk

Urban green spaces provide recreation, aesthetic, and ecological benefits, but many local authorities face funding and water scarcity challenges. Drought-tolerant ground cover species offers a sustainable solution for improving water use efficiency. Hence, this study investigated the water stress tolerance capacity of three ground cover species *Zebrina pendula*, *Pellionia repens*, and *Hemigraphis alternata,* under four species-specific irrigation intervals as treatments. For each species, 20 plants were assigned to each treatment and *Z. pendula* was irrigated daily (control), every 6, 12, and 18 days; *P. repens* daily (control), every 4, 8, and 12 days; and *H. alternata* daily (control), every 2, 3, and 4 days. The experiment was arranged in a completely randomised design and general linear model followed by Tukey's pair-wise comparison was used to analyse data. Survival and growth parameters were recorded. Growth parameters differed significantly among the species-specific treatments ($p < 0.05$). *Zebrina pendula* recorded 100% and 95% survival in once every 6-day and 12-day interval irrigation schedules, and thereafter, it was reduced to 65% in an 18-day irrigation interval. *Pellionia repens* recorded 100% survival throughout, while in *H. alternata,* 100% survival was recorded once in every two-day irrigation schedule, and thereafter, it was reduced to 40% and 20% respectively. Irrigation every two days showed high mean growth parameters in *H. alternata,* every eight days in *P. repens* and every 12 days in *Z. pendula.* Hence, *P. repens* and *Z. pendula* have strong adaptive traits under water stress conditions, whereas *P. repens* is the most resilient, whereas *H. alternata* is not recommended for drought-tolerant designs in sustainable green spaces.

Keywords: Drought tolerance, Ground covers, Growth performance, *Pellionia repens,* Urban green spaces

RESCON 2025 LS 67

EDIBLE MINIATURE GARDENS FOR URBAN MICRO SPACES TO ENHANCE POLLINATOR SUPPORT

M.M.M.S. Adhikari[1], K. Yakandawala[1]* and W.A.I.P. Karunarathne[2]

[1]*Department of Horticulture and Landscape Gardening, Wayamba University of Sri Lanka, Kuliyapitiya, Sri Lanka.*
[2]*Department of Zoology, University of Peradeniya, Peradeniya, Sri Lanka.*
*kapilay@wyb.ac.lk

Urbanisation-driven environmental changes aggravate environmental issues, leading to the loss of habitats essential for pollinators. This study was conducted to investigate the potential of edible miniature gardens in semi-indoor and semi-outdoor spaces to support pollinating insects and to promote this concept as a strategy for enhancing environmental sustainability in urban micro spaces. Thirty clay pots were planted with a mix of edible and ornamental species, and nesting elements were integrated into each. Fifteen pots (miniature gardens) were arranged linearly during the dry season and pollinator visitation was recorded following a pollard walk. Data were subjected to the Mann-Whitney U test. A significant difference ($p < 0.001$) was recorded in pollinator visitation, with semi-indoor spaces recording higher visitation (30.4) than semi-outdoor spaces (21.4). Higher visitation throughout the day was also recorded in the semi-indoor space, with two peaks. Higher visitation in the semi-indoor area may have resulted from limited food and nesting resources, as it was surrounded by buildings. In contrast, the semi-outdoor area might have offered abundant resources, possibly diverting pollinators from the miniature gardens, as it was in a home garden. Bare ground and bamboo substrates were the most preferred nesting material. Three species of ground-nesting bees and six wasp species were recorded. These findings highlight the influence of spatial context and environmental structure on pollinator behaviour and garden effectiveness. They also emphasise the value of the edible miniature gardening concept in supporting pollinators, while providing food and aesthetic benefits in urban micro spaces.

Keywords: Ground nesting bees, Miniature gardening, Pollinator habitats, Urbanisation, Urban micro spaces

RESCON 2025 LS 68

PREVALENCE OF *Aedes aegypti* AND *Aedes albopictus* VECTORS IN SUB-REGIONAL AREAS WITHIN MATARA DISTRICT

A.P.S. Perera[1]*, M.W.M.K. Mediwaka[1], M.M.S.M.B. Marasinghe[2], S.H.J. Thilanke[1] and K.O. Bandaranayaka[2]

[1]*District Director of Health Services, Matara, Sri Lanka.*
[2]*Department of Zoology, The Open University of Sri Lanka, Nugegoda, Sri Lanka.*
*Paramikaperera90@gmail.com

Dengue remains Sri Lanka's most critical vector-borne disease, largely due to the lack of specific treatments or vaccines, making it essential to monitor the prevalence and distribution of its primary vector, *Aedes aegypti,* and secondary vector, *Aedes albopictus,* for effective control. This study aimed to determine the prevalence of *Ae. aegypti* and *Ae. albopictus* across all 17 MOH areas in the Matara District, from 2022 to 2024, using systematic monthly entomological larval surveillance. Standard collection methods were used to sample larvae from both permanent and temporary breeding habitats in indoor and outdoor areas. Third and fourth instar larvae were identified to the species level using morphological taxonomic keys. Over the study period, 58,745 wet containers were examined, of which 824 were positive for *Ae. aegypti* and 8,015 for *Ae. albopictus*. Both vectors were detected in 8 MOH areas (urban and peri-urban MOH regions), while the remaining 9 MOH areas (rural MOH regions) reported only *Ae. albopictus*. A Wilcoxon signed-rank test confirmed that all MOH areas had significantly higher counts of *Ae. albopictus*-positive containers compared to *Ae. aegypti* ($W = 153$, $p < 0.001$), indicating the dominance of *Ae. albopictus* across the district. Breeding site analysis revealed that discarded items (36.2%) were the predominant habitat type in urban MOH areas, while water storage containers (30.4%) were more common in peri-urban and rural areas. This study confirms that, *Ae. albopictus* is the predominant *Aedes* vector across all 17 MOH areas in the Matara District. In contrast, *Ae. aegypti* was confined primarily to urban MOH areas, indicating its typical habitat preference. The emergence of *Ae. aegypti* in peri-urban regions such as Kamburupitiya, Welipitiya and Athuraliya highlights a potential shift in vector distribution. This expansion of primary vector presence into previously low-risk areas poses a growing challenge for dengue control efforts and underscores the need for enhanced surveillance and targeted vector management strategies in both urban and peri-urban settings of the district.

Keywords: *Aedes aegypti*, *Aedes albopictus,* Larval survey, Vector prevalence

RESCON 2025 LS 75

OPTIMISATION OF MICRO PROPAGATION TECHNIQUE FOR THE PRODUCTION OF POMEGRANATE (*Punica granatum* L.) VARIETY 'MALEE PINK'

O.G.L. Prabhashani[1], L.G.I. Samanmalee[2], M.S.M. Farhan[3]*, H.M. Hunupolagama[1] and N.P.A. Rathnamali[4]

[1]*Department of Biosystem Technology, Eastern University, Chenkalady, Sri Lanka.*
[2]*Plant Tissue Culture Division, Plant Virus and Indexing Center, Homagama, Sri Lanka.*
[3]*Department of Physical Science, Trincomalee Campus, Eastern University, Nilaveli, Sri Lanka.*
[4]*Anu Agri and Biotech Private Limited, Ambeypussa, Mirigama, Sri Lanka.*
*lekhsoviti99@gmail.com

This study aimed to develop an optimised micropropagation protocol for the 'Malee Pink' pomegranate (*Punica granatum L.*) variety, addressing critical challenges in surface sterilisation and phenolic compound management. Pomegranate is a commercially valuable fruit crop, but its conventional propagation methods are limited by low multiplication rates and susceptibility to contamination. Effective *in vitro* propagation requires a robust sterilisation procedure to eliminate microbial contamination without damaging explants, alongside strategies to control phenolic exudation, which often leads to tissue browning and culture loss. In this study, shoot tip with nodal explants from healthy mother plants were subjected to different sterilising agents, including sodium hypochlorite, systemic fungicide, antibiotics, and mercuric chloride, at varying concentrations and exposure times to identify the most efficient sterilisation treatment. Additionally, ascorbic acid was incorporated into the culture medium to mitigate phenolic oxidation. Results indicated that a sterilization protocol combining 2% Clorox for 2 minutes, followed by washing with streptomycin sulfate and dipping the shoot tips in a citric acid and ascorbic acid solution before culturing, significantly reduced contamination rates while maintaining high explant viability. Incorporation of Ascorbic acid (0.025 g) into the Murashige and Skoog (MS) medium effectively minimised phenolic browning, promoting healthy shoot initiation and elongation. The optimised protocol achieved a contamination rate below 10%, and a shoot induction frequency exceeding 80%. This optimised micropropagation approach offers a reliable and reproducible technique for large-scale clonal propagation of the 'Malee Pink' pomegranate variety. It can support sustainable production and genetic conservation, facilitating the commercial cultivation of this variety with superior fruit quality and yield. Future work will focus on rooting and acclimatisation stages to complete the micropropagation cycle.

Keywords: Activated charcoal, Micropropagation, Phenolic exudation, *Punica granatum*, Surface sterilisation

RESCON 2025 LS 76

EVALUATING *Aedes* BITING PATTERN FOR TARGETED SPACE SPRAYING: A CASE STUDY FROM DENGUE HIGH RISK AREA, SRI LANKA

M.D.S. Janaki[1]*, A.P.S. Perera[2], S.N. Weerakoon[3], B.L. Hewagamage[1], G.A.T.A. Rajathilake[1], P.C. Samaraweera[1] and S. Samaraweera[1]

[1]*National Dengue Control Unit, Colombo, Sri Lanka.*
[2]*Office of the Regional Director of Health Services, Matara, Sri Lanka.*
[3]*Office of the Regional Director of Health Services, Badulla, Sri Lanka.*
*sakoo_j@yahoo.co.uk

Aedes aegypti and *Aedes albopictus* are two mosquito species that are recognised for their involvement in the transmission of diseases such as dengue and chikungunya. Due to the lack of specific drugs or vaccines for these diseases, vector control is essential. Therefore, identification of the peak biting periods for *Aedes* mosquitoes is vital for the prevention of diseases and the effective control of vectors. Targeted interventions, such as the timing of insecticide application and public health messaging, can then be implemented to mitigate human exposure to mosquito bites and the transmission of diseases. This study investigated *Aedes* mosquito biting patterns over a 24-hour period, monthly from May 2024 to April 2025, in Gothatuwa MOH area, Colombo district, using human-baited double net traps (HDN). Mosquito collections were conducted hourly. A total of 372 *Aedes* mosquitoes were collected during the study. *Aedes albopictus* was the predominant species (361, 97%) in the total collection, with 86% (316) females. In contrast, *Aedes aegypti* comprised a smaller proportion, with 11 (3%) mosquitoes, of which 9 (82%) were females. These findings confirm *Aedes albopictus* as the most prominent vector species in the study area. Further, it was observed that female *Aedes* mosquitoes preferably bite between 06:00 – 09:00 hours in the morning and 16:00 – 18:00 hours in the evening. It was found that biting activity during each hour within these periods was statistically significant ($p < 0.05$). Although, some increased biting activities of these *Aedes* mosquitoes could be observed during 03:00 – 06:00 hours, 10:00 hours, 16:00 hour and 18:00 – 19:00 hours, they were not statistically significant ($p > 0.05$). Our findings highlight that the preferred time intervals for conducting space spraying for *Aedes* vector control are 06:00 to 09:00 hours and late 16:00 to 18:00 hours.

Keywords: *Aedes* vector, Chikungunya, Dengue, Human baited double net trap (HDN), Peak biting time

Physical Sciences

RESCON 2025 PS 01

DEVELOPMENT OF SIMPLE AND LOW-COST PAPER FLUIDIC DEVICES COUPLED WITH AMPEROMETRY FOR SEPARATION AND DETECTION OF PHARMACEUTICAL COMPOUNDS

A.M.M.P. Wijerathne[1], H.P.G. Nawaruwan L.[2], D.M.L.R. Dissanayake[3] and M.B. Wijesinghe[1]*

[1]*Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Physics, University of Peradeniya, Peradeniya, Sri Lanka.*
[3]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
*manjulaw@sci.pdn.ac.lk

The advancement and characterisation of cellulose chromatography paper-based microfluidic devices mark a significant step forward in analytical chemistry, particularly for point-of-care diagnostics and environmental monitoring. Hydrophobic patterning on chromatography paper was used to define hydrophilic flow channels, directing the sample from an inlet to a defined location for subsequent analysis. This simple yet elegant development led many to recognise paper as a substrate material for applications where low-cost and portability are critically important. Carbon ink was used to fabricate the working electrode on the paper-based microfluidic device, and silver paste was used as the pseudo-reference electrode to keep the device simple and low-cost. A 350 V difference was applied along the paper channel to create the fluidic flow. As the electrolyte 10.00 mmol L^{-1} borate buffer solution at pH 9 was used. Amperometric analysis was carried out using a homemade instrumental setup. When subjected to amperometric analysis, the developed paper-based microfluidic device produced distinct peaks for ascorbic acid and acetaminophen. Migration times of 120 s and 85 s and peak currents of 0.28 µA and 0.31 µA for acetaminophen and ascorbic acid, respectively, were obtained for a separation distance of 1.5 cm. The R^2 value for the calibration curve of ascorbic acid was 0.94. Future efforts may focus on constructing calibration curves for acetaminophen based on the peak areas of amperograms and reducing the peak width for more accuracy. This study successfully demonstrated the detection and separation of two key electrochemically active analytes, ascorbic acid and acetaminophen. Further, instead of power-free fluid transport via capillary action, paper electrophoresis was used to obtain narrow peaks by increasing the fluid flow rate.

Keywords: Acetaminophen, Amperometry, Ascorbic Acid, Paper based microfluidic device

RESCON 2025 PS 02

BANANA PEEL POWDER AS A GREEN CORROSION INHIBITOR FOR STAINLESS STEEL GRADE 202 IN HYDROCHLORIC ACID MEDIUM

P.O. Alliyadde[1] and N. Priyantha[2]*

[1]*Department of Environmental and Industrial Sciences, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.*
*namalpriyantha@sci.pdn.ac.lk

Corrosion is a persistent issue in acidic environments, especially for stainless steel (SS) Grade 202, which is prone to localized attack in the presence of chloride ions. While synthetic corrosion inhibitors are widely used, their toxicity and environmental impact have prompted the need for green and sustainable alternatives. In this study, the corrosion inhibition potential of banana peel powder (BPP) was evaluated for SS Grade 202 in 0.50 mol L^{-1} HCl medium. BPP extract was prepared by mixing 10.0 g of dry powder with 80.0 mL of distilled water, followed by refluxing to enhance the release of active compounds, such as tannins, flavonoids and polyphenols, which are known for their surface-adsorbing and corrosion-inhibiting properties. Fourier transform infrared spectroscopy of the extract identified characteristic functional groups at 1700 cm^{-1} for C=O and 3300 – 3500 cm^{-1} for O-H involved in corrosion inhibition through surface adsorption, while verifying the refluxing process preserved the chemical integrity of the extract. Mass loss measurements demonstrate significant reduction in corrosion rate from 50% to 15% with increase in the extent of the BPP extract, where the addition of 2.0 – 4.0 mL extract to 40.0 mL of 0.5 mol L^{-1} HCl solution showed 70% inhibition efficiency. Electrochemical impedance spectroscopy revealed an increase in polarization resistance from 1.70 Ω cm^2 to 3.40 Ω cm^2, with the diameter of the semi-circle increasing proportionally, indicating the formation of a protective layer on the metal surface. Tafel slope analysis showed a decrease in corrosion current density from 20.80 $\mu A\ cm^{-2}$ to 6.20 $\mu A\ cm^{-2}$ along with modified slope values, confirming the ability to suppress both anodic metal dissolution and cathodic reactions through corrosion inhibition. Open circuit potential measurements displayed positive potential shifts, reflecting enhanced thermodynamic stability of the metal surface in BPP-containing solutions. Atomic absorption spectroscopy confirmed the release of metal ions into the corrosive medium during corrosion. Overall, the results establish BPP as an effective, biodegradable, and environmentally friendly corrosion inhibitor for SS Grade 202 in HCl medium.

Keywords: BPP, Corrosion inhibition, Electrochemical analysis, Extraction, SS Grade 202

RESCON 2025 PS 03

INVESTIGATION OF THE PRESENCE OF SO_4^{2-} IN HUMIC SUBSTANCES EXTRACTED FROM DRINKING WATER

A.M.G.R.D. Abeysinghe[1], A. Bandara[1]*, L. Jayarathne[2] and M. Makehelwala[3]

[1]Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.
[2] National Institute of Fundamental Studies, Kandy, Sri Lanka.
[3]China Sri Lanka Joint Research and Demonstration Centre for Water Technology, Peradeniya, Sri Lanka.
*athulab@sci.pdn.ac.lk

Humic substances (HS) are a fraction of dissolved organic carbon. There are two main fractions of HSs: humic acid (HA) and fulvic acid (FA). Recent research on HS in water indicates that they can bind with charged species, such as metals and ligands, leading to severe health problems. Further, recent studies have highlighted the increase of manganese (Mn^{2+}) levels in ground water in some areas in Sri Lanka, and it is hard to remove manganese by filtration. Therefore, this study focused on the investigation of the presence of SO_4^{2-} species bound to HAs in drinking water with and without Mn^{2+}. First, the presence of humic substances was confirmed by extracting HA from some selected well water samples in Sri Lanka and characterised using Fourier transform infrared (FTIR) spectroscopy by identifying major functional groups present in the most acceptable model structure of HAs and comparing them with authentic standards. To identify the potential interactions of SO_4^{2-} with HAs, two methods were followed: adding SO_4^{2-} directly from a SO_4^{2-} source and adding through a metal salt. By comparing the FTIR spectra and Raman spectra, the effective binding of SO_4^{2-} with HAs could be proven. Overall, this study was able to prove that SO_4^{2-} binding happens through an elimination/exchange reaction and electrostatic interaction with HAs, and SO_4^{2-} followed by metal binding causes sulphate to bind via the metal.

Keywords: Dissolved organic carbon, Humic acid, Humic substances, Sulphate

RESCON 2025 PS 04

ELECTROANALYTICAL DETECTION OF IMIDACLOPRID USING STEARIC ACID-NANO TiO_2 MODIFIED GLASSY CARBON ELECTRODE

J.M. Hewagampalage and A.N. Navaratne*

Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.
*ayanthin@sci.pdn.ac.lk

Imidacloprid, one of the world's most widely used insecticides, has emerged as a hidden environmental threat due to its long-term persistence in ground water and soil. In addition, contamination of food with imidacloprid residues can have serious impact on both human and animal health. Hence, its detection in environmental samples is important. Among different analytical techniques, electroanalytical techniques provide a simple and cost-effective method for imidacloprid detection. In this study, a simple, novel electrochemical method based on stearic acid and TiO_2 nanoparticles was developed for the detection of imidacloprid. TiO_2 nanoparticles were synthesised using the sol-gel method and characterised by scanning electron microscopy, Fourier transform infrared spectroscopy and powder X-ray diffraction, which indicated that TiO_2 nanoparticles with an average diameter of 24.46±1.32 nm were successfully synthesised. The glassy carbon electrode (GCE) was modified with stearic acid-nano TiO_2 suspension using simple drop casting method. The electrochemical behaviour of imidacloprid at the bare GCE and at the stearic acid-nanoTiO_2 modified GCE were studied using electroanalytical techniques, namely, cyclic voltammetry (CV) and steady state amperometry. CV analysis resulted in a single reduction peak at –1.2 V, indicating the electroactivity of imidacloprid. Electrode fouling observed in amperometric studies with the bare GCE was overcome with the stearic acid coating, while the sensitivity of the electrode was enhanced by incorporating TiO_2 nanoparticles. The modified electrode developed provides an amperometric sensor to detect imidacloprid with a linear dynamic range of 1.19×10^{-4} mol L^{-1} to 6.97×10^{-4} mol L^{-1}. It exhibited a minimum detection limit of 8.77×10^{-6} mol L^{-1}, which is closer in value for similar type of modified electrodes reported in literature, and a limit of quantification of 2.92×10^{-5} mol L^{-1}, offering a potential tool for imidacloprid detection in environmental samples.

Keywords: Amperometry, Cyclic voltammetry, Modified electrode, Nano TiO_2, Stearic acid

RESCON 2025 PS 05

DEVELOPMENT OF AN ELECTROANALYTICAL DETECTION SCHEME FOR FIPRONIL INSECTICIDE

B.G.W.M. Sriyananda, K.L.H.S. Perera and A.N. Navaratne*

Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.
*ayanthin@sci.pdn.ac.lk

Fipronil is a widely used insecticide with serious health hazards. This study aimed at comparatively evaluating the performance of glassy carbon electrode (GCE) and stearic acid-modified GCE (SAGCE), for rapid, inexpensive detection of Fipronil in aqueous samples. Electrochemical behaviour of Fipronil was studied using a GCE. Cyclic voltammogram (CV) for GCE was obtained under optimised conditions (0.5 mmol L^{-1} Fipronil in 0.1 mol L^{-1} $HClO_4$/acetone solution 50:50 v/v; scan rate 50 mV s^{-1}; potential range –0.1 V to +1.8 V), which peaked at 1.5 V. When the Fipronil concentration was gradually increased, the peak current (PC) of the CVs increased with a linear variation between 0.04 and 3.00 mM (slope = 6.695; R^2 = 0.979), where the slope corresponds to sensitivity. Scan rate dependence was assessed using the Randles-Sevcik relationship, and the slope of 0.5 of the log (peak current) vs. log (scan rate) plot indicated that the oxidation reaction was diffusion-controlled, permitting chronoamperometric analysis. Amperogram was obtained with 0.26 mM increments of Fipronil concentration at 60 s intervals for 10 times, resulting in 4 µA increments until six additions. To reduce the noise level and increase detection limits, SAGCE was designed. The above analyses were repeated, resulting in a linear variation in PC increment between 1.28 and 3.28 mM (slope = 3.521; R^2 = 0.988). Diffusion control of the oxidation reaction at SAGCE was confirmed by scan rate dependence analysis, which resulted in a slope of about 0.5 in the log (peak current) vs.log (scan rate) plot permitting chronoamperometry. An amperogram obtained under similar conditions showed 3 µA increments. The SAGCE reduced noise level; however, exhibited lower sensitivity compared to GCE. By optimising the thickness of the SA coating on the working electrode to leverage PC, this can potentially be developed into a method for low-cost pesticide monitoring in resource-limited settings.

Keywords: Amperogram, Cyclic voltammogram, Fipronil, Glassy carbon electrode, Stearic acid

RESCON 2025 PS 06

ELECTROCHEMICAL INVESTIGATION OF THIAMETHOXAM ON BARE AND STEARIC ACID/SILVER PARTICLES MODIFIED GLASSY CARBON ELECTRODE

J.H.L.K. Jayasinghe and A.N. Navaratne*

Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.
*ayanthin@sci.pdn.ac.lk

The intensive use of pesticides contributes to environmental contamination and potential health risks, requiring the development of sensitive detection methods. Thiamethoxam (TMX) is one of the most widely used neonicotinoid pesticides in modern agriculture. Among the existing analytical detection techniques, such as high-performance liquid chromatography and gas chromatography, electrochemical methodologies offer a promising alternative, due to their cost-effectiveness and efficiency. In this research, cyclic voltammetry, square wave voltammetry, and amperometry were employed to obtain electrochemical responses under various conditions. The results revealed an irreversible reduction peak at –1.24 V vs. the Ag/AgCl/KCl reference electrode, attributed to the characteristic reduction of the nitro group to hydroxylamine derivative of TMX, occurring via a diffusion-controlled process in pH 9.0 Britton-Robinson buffer according to the peak current-scan rate relationship. Although electrochemical sensors are a more effective method, electrode fouling can occur when pesticide molecules block the active surface of the bare electrode, resulting in a lower electrochemical signal, which suggests the necessity of electrode modification. Nanomaterials exhibit different properties with specific characteristics compared with the same materials with micrometer-scale dimensions. Undesirable characteristics of nanoparticles, such as the tendency to agglomerate, high surface energy, and attractive van der Waals forces between particles, which limit applications, can be overcome using stearic acid, which functions as a capping agent to maintain the stability of nanoparticles. Silver nanoparticles act as an electrocatalyst, which enhances the rate at which the electron transfer takes place at the electrode surface. The scanning electron microscopy images revealed that the synthesised particles are in an aggregated form, with a particle size of around 127 nm. The stearic acid/silver particles modified glassy carbon electrode shows a higher current response as well as lower background noise in comparison to the bare glassy carbon electrode.

Keywords: Cyclic voltammetry, Glassy carbon electrode, Silver particles, Stearic acid, Thiamethoxam

RESCON 2025 PS 07

DEVELOPMENT OF A DETECTOR FOR 3-NITRO-TYROSINE USING ELECTROGENERATED CHEMILUMINESCENCE WITH BIPOLAR ELECTROCHEMISTRY

S.M. Rajasinghe, N. Lakmina and M.B. Wijesinghe*

Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.
*manjulaw@sci.pdn.ac.lk

Biomarker 3-nitro-L-tyrosine (3-NT), associated with nitrosative stress, has been linked to various pathological conditions, including neurodegenerative and cardiovascular diseases. Therefore, its detection is important; however, traditional detection methods, such as mass spectrometry and chromatography, require expensive instrumentation and expertise. Electroanalytical techniques are of choice owing to their ability to detect in real-time and low-cost. However, it is usually susceptible to high noise. Translating the current signal to an optical signal, which exhibits simultaneous oxidation and reduction at the extremities of a bipolar electrode (BPE), may provide better detection limits, as optical signals are less susceptible to environmental noise. In this study, a novel electrochemiluminescence (ECL)-based detector utilising BPE was developed for the detection of 3-NT. The objective was to establish a cost-effective and highly sensitive detection method suitable for biomedical and environmental applications. The detector setup consisted of a BPE coupled with luminol-H_2O_2-based ECL reporting, where the reduction of 3-NT at the cathodic pole induced light emission at the anodic pole. The experiments optimised the luminol-to-H_2O_2 ratio of 2:13 and applied potential of 2.6 V to achieve maximum ECL intensity. The system was evaluated using image-based intensity analysis captured via a smartphone camera. Results demonstrated a linear correlation between 3-NT concentration and ECL intensity, with R^2 of 0.93, linear dynamic range of 1.00 μmol L^{-1} to 80.00 μmol L^{-1}, calibration sensitivity of 0.075 luminescence intensity per μmol L^{-1} and a detection limit of 1.00 μmol L^{-1}, significant improvement upon conventional methods such as cyclic voltammetry. The BPE-ECL platform developed has proven to be a robust, low-cost alternative to high-end detection techniques, offering advantages such as miniaturisation, portability, and potential integration with microfluidic devices for point-of-care diagnostics. Future improvements could include a continuous flow system at the anodic pole, coupled with an electrophoretic microchip at the cathodic pole, to detect multiple biomarkers separated by electrophoresis.

Keywords: Bipolar electrochemistry, Electrochemical sensor, Electrogenerated chemiluminescence, Luminol-H_2O_2, 3-nitro-L-tyrosine, Oxidative stress

RESCON 2025 PS 08

COMPUTATIONAL STUDY OF LINEAR AND NON-LINEAR OPTICAL PROPERTIES IN NOVEL HEPTAZINE DERIVATIVES

J.P.C.C. Jayaweera and M.S. Kodikara*

Department of Chemistry, University of Ruhuna, Matara, Sri Lanka.
*mskodikara@chem.ruh.ac.lk

The development of advanced optoelectronic and photonic technologies is critically dependent on the discovery of new materials with superior non-linear optical (NLO) properties. Heptazine, a highly efficient electron acceptor having a planar conjugated structure, presents a promising core structure for octupolar D_3A-type NLO systems. Symmetrical substitution of peripheral hydrogens by electron-donating groups considerably enhances the NLO response. Notably, organometallic s-hepatazine systems display exceptional multi-photon absorption activity. Surprisingly, there have been no experimental or theoretical second-order NLO studies on these organometallic heptazine derivatives. This study employed density functional theory (DFT) and time-dependent DFT (TD-DFT) at the CAM-B3LYP/6-31+G(d)/SDD level of theory, selected after testing various methods and basis sets, and led to results consistent with previously reported work. This approach was applied to explore novel heptazine derivatives bearing amino (NH_2) and dimethylamino [$N(CH_3)_2$] donor groups, and nitro (NO_2) acceptors, substituted at the 2,5, and 8 positions of the heptazine ring, either directly or indirectly attached, through linkers such as $–C_6H_4–$ and $–C_6H_4–C≡C–C_6H_4–$. Instead of organic donor groups, the Ru(dHpe)$_2$Cl unit was attached to the heptazine core in organometallic systems. Extending the π-conjugation in donor-substituted derivatives results in an increase in the first, second and third-order polarisabilities due to improved electron delocalisation, while the NO_2-substituted heptazine analogues show lower values. The replacement of the organic donor groups by the organometallic unit leads to a significant increase in the first and second-order polarisabilities. Natural bond orbital analysis confirms that the donor groups increase the negative charge on the core, enhancing delocalisation and polarisability. The efficacy of s-heptazine as the core structure was investigated for organometallic molecules. Heptazine derivatives showed the largest NLO coefficients compared to triazine and commonly used benzene core geometries. The lower HOMO-LUMO energy gap in heptazine can be attributed to this prediction. Based on the TDDFT calculations, 2,5,8-tri(donor)-s-heptazines show red-shifted bands. When NO_2 groups are substituted, the low-energy band is blue-shifted. Moreover, Ru complexes enhance NLO via metal-to-ligand charge transfer, with heptazine giving the highest response. Building on this, future work may explore frequency-dependent NLO behavior and conformational effects on organometallic systems.

Keywords: DFT, First hyperpolarisability, Heptazine, Metal alkynyls, Nonlinear optics

RESCON 2025 PS 09

COMPUTATIONAL STUDIES ON ANTIBACTERIAL ACTIVITIES OF 6*β*-HYDROXYBETUNOLIC ACID AND ITS DERIVATIVES

H.M.K.D. Herath, R.J.K.U. Ranatunga and S. Jayasinghe*

Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.
*susanthij@sci.pdn.ac.lk

Antibiotic resistance is a major global health threat. Developing novel antibacterial agents with enhanced mechanisms against specific strains, supported by computational drug design, offers a promising solution to this challenge. Previous studies have shown that 6*β*-hydroxy betulinic acid (6*β*-HBA) possessed strong antibiotic activity (16 mg L^{-1}) against methicillin-resistant *Staphylococcus aureus* (MRSA) which has limited antibiotic activity. However, its synthetically modified derivatives demonstrated reduced antibacterial activity. Therefore, in this study, *in-silico* investigations were conducted to elucidate the mechanism underlying the antibacterial effects of 6*β*-HBA. Lupane-type triterpenoids feature a hydroxyl group at the C-6 position. The synthesised derivatives involved modifications at the C3-OH to C3-OAc, C6-OH to C6-C=O, and C17-COOH group to C17-COOR. Preliminary computational investigation on ligand interactions with penicillin binding protein 2a (PBP2a) from MRSA was carried out, using molecular docking and molecular dynamics (MD) simulations. Molecular docking analyses revealed strong binding affinities (–8.3 kcal mol^{-1}) for 6*β*-HBA and the derivatives which had free C17-COOH group, with PBP2a. Further validation through MD simulations confirms the stability of the ligand-protein complexes of 6*β*-HBA and identified key interactions with active site residues, such as ASP665, TYR664, and ASN624, of PBP2a, which are essential for inhibiting bacterial cell wall synthesis. However, no such interactions were observed for the synthetic derivatives without free COOH at C17. These *in-silico* results directly support and explain previous findings, where modification of the C17-COOH group led to a dramatic increase in MIC values and a complete loss of antibacterial activity against Gram-positive bacteria, including MRSA. Moreover, C3-OAC protected compound showed promising interactions with the acetate group and protein residues, which is again corroborated with the strong antibacterial activity obtained in *in-vitro* studies. Thus, this study provides molecular-level evidence that C17-COOH and the C3-OAc groups are essential for effective protein binding and highlights their critical role in designing potent antibacterial agents.

Keywords: Antibiotic resistance, 6*β*-hydroxybetulinic acid, Molecular docking, MRSA, Penicillin-binding protein 2a

RESCON 2025 PS 10

CONTROLLED COMPLEXATION OF Zr(IV) AND Hf(IV) WITH AMINO-DERIVATIVES OF 2,6-PYRIDINEDICARBOXYLATES: A COMPUTATIONAL APPROACH FOR SEPARATION EFFICIENCY ENHANCEMENT

D.M. Adhikari[1], C.V. Hettiarchchi[2] and R.J.K.U. Ranatunga[2]*

[1]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.*
*udayana.ranatunga@sci.pdn.ac.lk

Extraction of ultra-pure zirconium and hafnium would be a value addition to the zircon ($ZrSiO_4$) ore available in Sri Lanka. However, extracting the ultra-pure Zr and Hf has become impossible to countries such as Sri Lanka due to the complexity, environmental impact and the cost of the currently available methods. Among them, fractional crystallisation is the simplest method with the least environmental impact, although its separation efficiency is low. In this study, a theoretical approach was taken to improve the separation efficiency of fractional crystallisation through complex formation with 2,6-pyridinedicarboxylate (PDA). Initially, the reaction energy for each ligation step during the formation of $[M(PDA)_3]^{2-}$ starting from $[M(H_2O)_9]^{4+}$ was calculated with density functional theory (DFT) using ORCA 5.0. However, based on the calculated reaction energies, it was not possible to separate Zr(IV) and Hf(IV) with the formation of $[M(PDA)_3]^{2-}$, due to similar reaction energies in the latter steps. However, in the initial step, there is a significant difference between Zr(IV) and Hf(IV) complex formations. Consequently, calculations were extended to determine the reaction energies with amino derivatives of PDA for the initial step. If one of the metals shows significant favorability to ligate with a particular amino derivative, it is possible to stoichiometrically drive the ligation toward a particular metal ion. Thereafter, the remaining complex substitutions can be performed with 2,6-PDA, leading to complexes with differing physical properties. The calculations, performed at the hybrid B3LYP functional, and def2-TZVP basis set, accounting for the basis-set superposition error, indicate that 4-amino-PDA show the highest favorability to ligate with Zr(IV) in the initial step among other amino derivatives of PDA. Therefore, it is possible to crystallize $[Hf(PDA)_3]^{2-}$, if a controlled amount of 4-amino-PDA is used in the initial step. It is expected that properties of dipole-moment and solubility be significantly different for the two complexes, allowing easier and more efficient separation.

Financial assistance from the Asian Office of Aerospace Research and Development (AOARD) (Grant No FA2386-23-1-4036) is acknowledged.

Keywords: DFT, Fractional crystallisation, Hafnium, 2,6-pyridinedicarboxylate, Zirconium

RESCON 2025 PS 11

APPLICATION OF FTIR SPECTROSCOPY AND MULTIVARIATE MODELING FOR IDENTIFYING SUGAR ADULTERATION IN BLACK TEA

G.N. Damayanthi[1,2]*, K.M. Binduhewa[1], B.A.T. Amalka[1], C.K. Dissanayake[1], A.G.A.W. Alakolanga[2] and V.P. Ellepola[2]

[1]*Sri Lanka Atomic Energy Board, Orugodawatta, Wellampitiya, Sri Lanka.*
[2]*Department of Export Agriculture, Uva Wellassa University of Sri Lanka, Badulla, Sri Lanka.*
*nadeekadamayanthi650@gmail.com

Sri Lankan tea is globally acknowledged as the "World's Cleanest Tea". However, adulteration, especially in black tea, remains a persistent challenge within the industry. It has recently been recognised that the intentional addition of sugar to processed teas is widespread. To the best of our knowledge, no prior studies have applied Fourier transformed infrared spectroscopy-Attenuated total reflectance (FTIR-ATR) spectroscopy for the detection of sugar adulteration in black tea. Therefore, this study aimed to develop a novel screening protocol for identifying sugar adulteration in black tea. Authentic orthodox black tea samples were collected covering all seven tea-growing regions in Sri Lanka. Adulterated samples were prepared by mixing tea with sugar at different concentration levels ($1-40\%$ w/w). The spectral data obtained from analyses of both adulterated and unadulterated samples were subjected to three pre-processing approaches; standard normal variate (SNV), multiplicative scatters correction, and first derivative filtering. Subsequently, principle component analysis was applied to pre-processed data separately and SNV pre-processed data resulted highest R^2 value (0.995). Using the SNV pre-processed data set, orthogonal partial least square discriminant analysis (OPLS-DA) showed a clear separation of adulterated and unadulterated tea. R^2 value explained 99% of the total variance, and the model showed strong predictive power with a Q^2 value of (0.953). The application of OPLS-DA proved the strong discriminative power of the model, achieving 100% classification accuracy with the independent test data set. These findings highlight the potential of FTIR-ATR spectroscopy, coupled with multivariate modelling, as a rapid and non-destructive approach for routine quality control and adulteration detection in black tea.

Keywords: Black tea adulteration, FTIR-ATR spectroscopy, Multivariate analysis, Non-destructive screening, Sugar detection

RESCON 2025 PS 12

EFFECT OF CALCINATION TEMPERATURE ON PHOTOCATALYTIC PERFORMANCE OF NATURALLY AVAILABLE ILMENITE

P.P.N.N. Wickramasinghe*, **S.H.R.T. Sooriyagoda and C.R. Munasinghe**

Department of Physics, University of Colombo, Colombo, Sri Lanka.
*2020s18254@stu.cmb.ac.lk

Photocatalytic degradation of organic pollutants is a key challenge in developing sustainable and efficient wastewater treatment technologies. However, many conventional photocatalysts are costly and exhibit low efficiency under visible light. In this study, the potential of natural ilmenite as a visible-light-active photocatalyst was investigated. To enhance its performance, ilmenite was milled and thermally treated (calcined) at various temperatures to induce structural transformations, followed by characterisation using X-ray diffraction (XRD), UV-visible diffuse reflectance spectroscopy (DRS), and scanning electron microscopy. XRD analysis revealed that calcination below 800 °C resulted in unreacted ilmenite. Higher temperatures above 1000 °C resulted in primarily Fe_2TiO_5 and TiO_2 (rutile). Calcination between 800 °C and 1000 °C led to the formation of mixed oxide phases such as α-Fe_2O_3, TiO_2 (rutile) and Fe_2TiO_5. These structural changes enhance light absorption and charge carrier mobility. The DRS analysis revealed a direct bandgap of 2.34 eV for milled ilmenite. When the calcinated temperature of milled ilmenite increased from 700 °C to 1000 °C, the direct bandgap energy narrowed down from 2.30 eV to 2.09 eV. Ilmenite samples calcined at 900 °C and 1000 °C achieved a notable degradation efficiency of approximately 17%, as determined by methylene blue, within 2.0 h under pH 7.0 conditions. Although the band structures of the calcined ilmenite sample are more preferable for lower recombination and active in visible light than TiO_2 (anatase), commercially available TiO_2 (anatase) exhibited a degradation efficiency of approximately 22% under 2.0 h of visible light irradiation at pH = 7.0, due to its high crystallinity and large surface area. Although its efficiency does not surpass that of commercial TiO_2, the enhanced activity of high-temperature-calcined ilmenite highlights the role of multiphase oxide structures in improving charge dynamics. Given its natural abundance and low cost, thermally modified ilmenite offers a compelling pathway toward affordable and sustainable photocatalysts for water purification.

Keywords: Calcination, Ilmenite, Photocatalytic activity, Visible-light conditions

RESCON 2025 PS 13

ELECTROCATALYTIC REDUCTION OF CO_2 USING N,N′-BIS(SALICYLALDEHYDE)ETHYLENEDIAMINE COPPER(II) COMPLEX

R.W.P.K.J.M.L.I.K. Thalgahagoda[1] and M.Y.U. Ganehenege[2]*

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.
[2]Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.
*myug@sci.pdn.ac.lk

Environmental pollution caused by emission of CO_2 is regarded as one of the biggest global issues in the 21st century. Electrochemical reduction of CO_2 using metal Schiff base complexes as catalysts to obtain required chemicals, such as oxalic and formic acids, has garnered attention among other methods. In this regard, the research presented here mainly focuses on the synthesis of efficient electrocatalysts to bind and reduce CO_2 into valuable products. This research details the electrocatalytic reduction of CO_2 using N,N′–bis(salicylaldehyde)ethylenediamine copper(II) complex [Cu^{2+}(Salen)] as the electrocatalyst. It exhibited a higher catalytic efficiency than the starting Cu(II) salt [$Cu(CH_3COO)_2.H_2O$], demonstrating the critical role of the ligand environment in tuning the catalytic activity. Cyclic voltammetric studies, carried out in DMSO using tetraethylammonium hexafluorophosphate as the electrolyte and the three electrode system comprising a glassy carbon working electrode, Ag/AgCl reference electrode and Pt wire auxiliary electrode, revealed that [(Cu^{2+}(Salen)]/[(Cu^{+}(Salen)] reduction takes place at –1.2 V and the reduced form of the [Cu(Salen)] complex is capable of catalysing CO_2 reduction around –0.9 V that is significantly lower than the potential required to reduce CO_2 in the absence of a catalyst. The efficiency of reduction in terms of $i(CO_2)/i(N_2)$ ratio is 1.63. The large difference in the reduction and oxidation peak potentials of the quasi-reversible cyclic voltammetric wave may be due to the overlapping multi-electron processes.

Keywords: Catalytic reduction, CO_2 reduction, Copper-Schiff base complexes, Cyclic voltammetry, Electrocatalyst

RESCON 2025 PS 14

SYNTHESIS AND STUDY OF STRUCTURE DIRECTING AGENTS ON STRUCTURAL PROPERTIES OF BORON MODIFIED ZEOLITES

M.A.K. Madhumekala[1]*, W.M.A.T. Bandara[2] and I.P.L. Jayarathne[1]

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka.*
[2]*Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
*kushanimadhumekala@gmail.com

The ability to tailor specific framework structures and morphologies during zeolite synthesis is critical for their effective application in various processes, including catalysis, adsorption and separation. This study advances the synthesis of boroalumino zeolites with Linde Type A (LTA) and Faujasite (FAU) frameworks by developing novel techniques and the incorporation of boron atoms into the zeolites frameworks to better understand the impact of a structure-directing agent (SDA) on porous network formation and zeolite crystallisation. Boron-modified LTA and FAU zeolites were successfully synthesised with the B:Al ratio varying from 100 to 0 using microwave-assisted methods, both in the absence and presence of SDAs. Synthesised materials were characterised by powder X-ray diffraction (PXRD), scanning electron microscopy (SEM), Raman microscopy, and Fourier transform infrared (FTIR) spectroscopy. Findings revealed that boron-modified LTA was formed in the absence of SDAs, whereas boron-modified FAU was produced when sodium dodecyl sulfate was used as the SDA. PXRD analyses revealed the formation of LTA and FAU zeolites in the synthesised materials. PXRD and SEM further revealed that increase in the B:Al ratio led to a reduction in crystallinity. However, further increasing this ratio did not favour the formation of pure LTA and FAU phases. Vibrational mode predictions via FTIR and Raman spectral studies revealed a prominent change, indicating the formation of 4-membered ring of LTA zeolite, while Faujasite's 6-membered ring was formed and the successful incorporation of boron was evidenced by corresponding shifts in the spectral bands. This study establishes foundational knowledge demonstrating that the presence or absence of SDAs, combined with increasing the B:Al ratio, leads to the formation of different zeolite types exhibiting low crystallinity.

Keywords: Crystallisation, Microwave-assisted synthesis, Morphology, Structure directing agents, Zeolite

RESCON 2025 PS 15

CONTROLLED RELEASE OF METFORMIN USING MIL-101(Fe): A PROMISING METAL ORGANIC FRAMEWORK FOR DRUG DELIVERY APPLICATIONS

J.P.I.U. Rathnayake[1] and C.V. Hettiarachchi[2]*

[1]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.*
*champikav@sci.pdn.ac.lk

Metal organic frameworks (MOFs) are emerging porous materials with great potential as drug delivery vehicles due to their tuneable porosity, high surface area, and large pore volume. Among them, the iron-terephthalate MOF, MIL-101(Fe) has great potential due to its large pore volume and wide pore windows. Despite its favourable characteristics, the application of MIL-101(Fe) in drug delivery remains relatively underutilised. This study investigated the use of MIL-101(Fe) for the controlled release of the antihyperglycemic drug metformin, which typically suffers from low bioavailability and potential side effects when administered directly. MIL-101(Fe) was synthesised via a modified solvothermal method to obtain a high-purity product. Metformin loading was performed in duplicate in ethanolic medium using 25 mg of the MOF in 50 mL of 500 mg L^{-1} metformin solution, and it was quantified at 231 nm with UV-visible spectrophotometry. Drug release was studied in duplicate in phosphate-buffered saline (PBS) at pH 7.4 and HCl at pH 4.0 at 37 °C over 48 h, mimicking intestinal and postprandial stomach environments, respectively. PXRD confirmed the expected MOF structure. UV-visible spectroscopy revealed a metformin loading capacity of 0.19 mg mg^{-1} of MOF and a loading efficiency of 19%. The release profiles demonstrated a gradual and sustained release, with no initial burst effect. After 48 h, release efficiencies were 72% in HCl and 61% in PBS, calculated using the UV-visible data. These findings not only highlight the potential of MIL-101(Fe) as a carrier for metformin but also emphasise the need for post-synthetic modifications to minimise the drug release under stomach conditions. Future work would focus on functionalising the MOF with negatively charged groups to enhance drug loading and broaden its applicability to other pharmaceutical agents.

Keywords: Controlled release, Drug delivery, Metal organic frameworks, Metformin, MIL-101(Fe)

RESCON 2025 PS 16

DEVELOPMENT OF LOW-COST, SUSTAINABLE COUNTER ELECTRODE FOR DYE-SENSITISED SOLAR CELLS USING ACTIVATED PALMYRA SHELL CHARCOAL/GRAPHENE COMPOSITE

D.M.N. Dissanayake[1,2], M.I.U. Weerasinghe[1], T. Senapathi[2] and G.R.A. Kumara[1]*

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka.*
[2]*Department of Chemistry, University of Sri Jayewardenepura, Nugegoda, Sri Lanka.*
*kumara.as@nifs.ac.lk

In recent years, significant research studies have focused on developing low-cost, alternative counter electrode (CE) materials for dye-sensitised solar cells (DSCs), due to the high-cost of conventional platinum counter electrodes. This study aimed to develop an alternative, low-cost CE material for DSCs by fabricating a composite based on activated palmyra shell charcoal (APSC) and graphene. In this project, APSC powder was produced in a carbonisation process under steam activation with reduced O_2 level, followed by grinding into a fine powder. Then, the counter electrodes were prepared using 0.5 g of APSC powder and 1-ethenylpyrrolidin-2-one (PVP) binder in a propan-2-ol solution. The resulting suspension was sprayed onto pre-heated FTO plates and sintered at 300 °C for 30 min. Composite counter electrodes were prepared according to the above method by incorporating trace amounts of graphene while maintaining a constant APSC amount. The mass ratio of graphene-to-APSC was subsequently optimised to obtain the maximum power conversion efficiency by enhancing the conductivity and catalytic activity of the composite counter electrodes. To assemble the DSCs, a N719 dye-coated photoanode with a 0.20 cm^2 mask and counter electrode was gently clipped, and the space between the photoanode and CE was filled with the liquid electrolyte I^-/I_3^- . Then, the solar cell performance was evaluated using SPD SS-25 LED solar simulator (simulated sunlight source), under AM 1.5 illumination of 100 mW cm^{-2}. The DSC fabricated with the APSC CE exhibited a power conversion efficiency of 5.16%, while a 14% graphene-incorporated composite CE exhibited a power conversion efficiency of 6.56%, significantly higher than APSC CE and slightly lower than the 7.65% power conversion efficiency of platinum-based DSCs. The resulting composite-based DSCs provide a sustainable, low-cost, eco-friendly alternative to platinum counter electrodes for dye-sensitised solar cells, thereby supporting the development of cost-effective solar energy technologies.

Keywords: Activated palmyra shell charcoal, Composite counter electrode, Dye-sensitised solar cell, Graphene

RESCON 2025 PS 17

LIGHT SOAKING EFFECT ON THE PERFORMANCE OF Sb_2S_3 BASED SOLAR CELLS UNDER LOW LIGHT INTENSITY

M. Sarathchandra[1,2]* and J. Bandara[1]

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka.*
[2]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
*madara.sa@nifs.ac.lk

Antimony sulphide (Sb_2S_3) solar cells have achieved the highest efficiency of 7.69% in practice; however, it is lower than theoretical predictions. The main drawback of Sb_2S_3 solar cells is the defects in the bulk, grain boundaries, and at interfaces. The light soaking effect (LSE) was observed in FTO/TiO_2/Sb_2S_3/P3HT/carbon solar cells, which were fabricated via a modified solar cell configuration utilising a novel spin coating approach. The solar cells were then characterised to identify the reasons behind LSE because improving the stability of Sb_2S_3 solar cells requires the suppression of LSE. Overall, the initial measurements of these solar cells resulted in efficiency of 0.1 – 0.5%, short circuit current density (J_{SC}) of 1 – 4 mA cm^{-2}, open circuit voltage (V_{OC}) of 0.1 – 0.5 V and fill factor of 0.25 – 0.30; however, with illumination, J_{SC} enhanced while V_{OC} decreased slightly. Even though the rate of change in J_{SC} with illumination time was similar, it can be improved by passivating the bulk Sb_2S_3 layer, enhancing charge transfer, and decreasing its thickness. Additionally, when solar cells were evaluated temporarily, improvement of 4.14 – 17.65% in J_{SC} was observed without any illumination. Therefore, it was suspected that defects in fabricated solar cells generate heat. At low intensities, solar cells demonstrated higher performance in *I-V* plots. When V_{OC} versus intensity plot was elucidated, these solar cells had trap-assisted recombination at the lower intensity ($\approx$ 20 mW cm^{-2}) and bimolecular recombination at the higher intensity. If these recombination processes could be minimised, it would be possible to achieve better performing Sb_2S_3 solar cells with minimum LSE. Moreover, the major suspected locations of defects in these solar cells are found to be in the grain boundaries and interfaces of the Sb_2S_3 layer.

Keywords: Bimolecular recombination, Illumination time, Light soaking effect, Low intensity, Trap-assisted recombination

RESCON 2025 PS 18

INVESTIGATION OF THE CORRELATION OF MODIFIED Al/B RATIO WITH STRUCTURAL DISTORTION AND Ni^{2+} INCORPORATION IN ZSM-5 ZEOLITES

J.G.J.I. Wickramasinghe, M.M.A.K. Mannapperuma and L. Jayarathne*

National Institute of Fundamental Studies, Kandy, Sri Lanka.
*lakmal.ja@nifs.ac.lk

ZSM-5 zeolite, an aluminosilicate having high silica content, is used in catalysis and adsorption. The framework is formed by connecting TO_4 tetrahedra (T = Si, Al), making intersected pores, with ten-member ring openings. B/ZSM-5 zeolites contain boron (B) atoms within the framework. Though the individual effects of Al/ZSM-5 and B/ZSM-5 zeolites have been investigated, the systematic influence of Al/B ratio on framework distortion, Bronsted acidity, and efficiency of Ni incorporation has not been comprehensively examined. This study aimed to synthesise Al/B modified ZSM-5 zeolites and determine the effect of compositional differences on structural order, Bronsted acidity, and Ni^{2+} addition. Five samples of ZSM-5 zeolites with varying Al/B ratios - 100% Al; 75% Al, 25% B; 50% Al, 50% B; 25% Al, 75% B; and 100% B were synthesised using a hydrothermal method with $NaAlO_2$, NaOH, tetraethylammonium bromide, colloidal silica, and H_3BO_4. The catalysts were made by impregnating each composition with nickel using $[Ni(H_2O)_6](NO_3)_2$. The characteristic ZSM-5 peak in Raman spectroscopy was located at 385 cm^{-1}; therefore, all the compositions exhibit a sharp peak around this value, indicating the presence of zeolite crystals. As the B content increased, this peak became sharper, suggesting a reduction of framework distortion. B reduces the lattice strain through its smaller ionic size, thereby minimising vibrational dephasing and inhomogeneous broadening. Other prominent peaks could be observed at 845 cm^{-1} and 1320 cm^{-1}, corresponding to the symmetric stretching of T-O vibrations within the framework. UV-visible spectroscopy was employed to confirm the incorporation of Ni. The absorbance values for Ni decreased gradually when the B content was increased. The incorporation of Ni^{2+} diminished with the increasing B content. This study demonstrates that the nature of the Bronsted acid sites within the crystal framework influences Ni^{2+} incorporation. Al-rich samples possess Al-OH-Si linkages within the framework, featuring highly acidic and polarizable O-H bonds that govern effective ion exchange. In contrast, B-substituted zeolites have weaker Bronsted acid sites, resulting in reduced ion exchange capacity and inefficient Ni incorporation.

Keywords: B/ZSM-5 zeolites, Bronsted acidity, Ion exchange, Ni incorporation

RESCON 2025 PS 19

RAPID SYNTHESIS OF 3-MERCAPTOPROPIONIC ACID CAPPED CdTe QUANTUM DOTS USING L-ASCORBIC ACID IN ATMOSPHERIC CONDITIONS

T.G.M. Mihidula, J.M.S.G.B. Navarathne and L. Jayarathne*

National Institute of Fundamental Studies, Kandy, Sri Lanka.
*lakmal.ja@nifs.ac.lk

The aqueous synthesis of cadmium telluride (CdTe) quantum dots (QDs) capped with thiolate ligands is a widely accepted approach for producing biocompatible, semiconducting nanomaterials for fluorescence imaging and detection. Conventional routes typically require over 6 h of reaction time and an inert atmosphere to prevent the growth of oxygen induced surface impurities and to ensure the formation of stable QDs by completing crystal growth. This work introduces an optimised, rapid, nitrogen-free method to produce brightly luminescent CdTe QDs under natural atmospheric conditions using L-ascorbic acid (AA) as a co-capping ligand. This employs a one-pot aqueous reflux system at 100 °C, with only the NaHTe precursor prepared under inert conditions. The main synthesis proceeds completely in ambient atmospheric conditions, with optimised Cd:Te:3-mercaptopropionic acid (3-MPA):AA molar ratios of 1.0:0.1:0.7:1.0 and a specific pH of 11.9±0.1 to accelerate nucleation and QD growth. Under these conditions, complete red shift of the QD emission from green to deep orange was observed within 120 min, reducing synthesis time by 67% compared to standard methods. The strong alkalinity promotes full deprotonation of 3-MPA-SH groups, which enhances thiolate binding to Cd^{2+} and monomer stability. AA effectively passivates the QD surface, preventing oxidation of Te^{2-} to Te^0 and surface defects. Absorption peak area (APA) was increased by 67.7% at higher pH, though excessively high pH (>12.9) compromised colloidal stability. APA was increased by 189.8% by doubling the Cd:AA ratio. Replacing toxic reductants such as N_2H_2 with AA and omitting nitrogen purging enhanced safety and reduced reagent cost by about 40%. The combination of these ligands renders the QDs biocompatible compared to hydrophobic ones. The COOH rich shell helps to reduce Cd^{2+} leaching, thereby lowering the toxicity. With their colloidal and chemical stability lasting up to several months, these functionalised QDs are currently being applied in on-going studies of microplastic detection in environmental samples.

Keywords: Ambient conditions, CdTe Quantum dots, L-ascorbic acid, Nitrogen free, Water soluble

RESCON 2025 PS 20

VALORISATION OF OKRA AND CITRUS WASTE FOR CELLULOSE EXTRACTION AND NANOCELLULOSE SYNTHESIS TOWARD SUSTAINABLE POST-HARVEST WASTE MANAGEMENT IN SRI LANKA

E.S.M. Silva, F.M. Fathayee, B.A.S.O. Perera, U.S.A. Gunathilaka, R.M.D.K. Rathnayake and M.D. Bandara*

Department of Food Technology, Rajarata University of Sri Lanka, Mihintale, Sri Lanka.
*mdbandar@tec.rjt.ac.lk

Sri Lanka generates approximately 270,000 metric tons (MT) of fruit and vegetable waste annually, primarily due to post-harvest losses accounting for 30 – 40% of total production. This study explored strategies to valorise such waste in economic centers. As high-crystalline, high-purity cellulose was increasingly valued across industries, cellulose yield from commonly discarded products was investigated. A market survey identified 15 frequently discarded fruits and vegetables for analysis. For cellulose extraction, defatted sample powders were subjected to sequential pre-treatments involving acid hydrolysis (1.0 mol L^{-1} and 0.5 mol L^{-1} HCl), delignification (1.0 mol L^{-1} NaOH), and bleaching (1.5% NaOCl, 95 °C), and the final products were freeze-dried. Fourier transform infrared (FTIR) spectroscopic analysis confirmed cellulose by characteristic bands of O–H stretching (~3330 cm^{-1}), C–H stretching (~2900 cm^{-1}), and β-(1→4)-glycosidic linkages (~895 cm^{-1}). Okra (*Abelmoschus esculentus*) yielded the highest cellulose content (28.58±2.24%), followed by citrus (*Citrus aurantium*) peel (23.31±2.87%), cucumber (*Cucumis sativus L.*) peel (17.36±2.24%), luffa (*Luffa acutangular L.*) peel (14.59±3.21%), and avocado (*Persea americana Mill.*) peel (12.13±0.33%). Okra and citrus were identified as the most promising sources. Based on national production and waste estimates, valorisation of okra waste (~28,134 MT $year^{-1}$) could yield ~1,407 MT of cellulose, while citrus peel by-products (~79,932 MT $year^{-1}$), considering peel fractions of ~40% for sour orange and ~20% for lime, could yield ~3,726 MT cellulose, offering a combined recovery of ~5,133 MT cellulose annually. Nanocellulose is important for its high mechanical strength, large surface area, and biodegradability, enabling applications in food, packaging, biomedical, and composite industries. Therefore, nanocellulose synthesis was explored via sulfuric acid hydrolysis (58% w/w, 65 °C, 3 h, 1:40 cellulose-to-acid ratio). The sedimented suspension (18 °C, 24 h) was ultrasonicated (75%, 10 min), and nanocellulose was separated and confirmed by field emission scanning electron microscopy. This study confirms the feasibility of extracting cellulose and synthesising nanocellulose from agro-waste, supporting sustainability and circular bioeconomy initiatives in Sri Lanka.

Financial assistance from Asian Development Bank through Ministry of Higher Education, Sri Lanka (Grant No. STHRD/CRG/R3RJ3) is acknowledged.

Keywords: Agro-waste valorisation, Cellulose extraction, Circular bioeconomy, FTIR characterisation, Nanocellulose

RESCON 2025 PS 21

PULSATIONAL MODE IDENTIFICATION OF DELTA-SCUTI STAR-SZ LYN USING HIGH-RESOLUTION SPECTROSCOPY

D.A.D.D. Dissanayake[1], M.L.C. Attygalle[1]* and J. Adassuriya[2]

[1]*Department of Physics, University of Sri Jayewardenepura, Nugegoda, Sri Lanka.*
[2]*Department of Physics, University of Colombo, Colombo, Sri Lanka.*
*lattygalle@sjp.ac.lk

SZ Lyn (HD 67390) is a high-amplitude δ-Scuti type pulsating star in the constellation Lynx. A high-resolution spectroscopic study was conducted to identify radial and non-radial pulsation modes of the star. The high-resolution spectra were obtained with a spectral resolution of about 85,000 using the high efficiency and resolution mercator echelle spectrograph (HERMES) mounted on the 1.2 m Mercator telescope at the Roque de los Muchachos Observatory, La Palma, Spain. Three unblended metallic spectral lines, Ti II 4501.28 Å, Fe I 4957.59 Å and Fe II 4508.29 Å, were analysed using the FAMIAS software. Multiple analysis techniques were applied, including Fourier transforms, based on pixel-by-pixel analysis, computation of line moments, and least-squares fitting of line profiles to extract the pulsational properties of the star. The mode identification techniques, the Fourier parameter fit (FPF) method, and the moment method were applied to identify the pulsation modes. The Fourier parameter fit method indicated that the dominant pulsation mode of SZ Lyn was radial, with spherical degree l = 0 and azimuthal order m = 0. The result, supported with chi-squares values for the l = 0 and m = 0 combination, was obtained as 20.8493 for Ti II 4501.28 Å, 264.756 for Fe I 4957.59 Å and 10.091 for Fe II 4508.29 Å. The pulsational behavior of SZ Lyn was represented by the radial velocity curves and radius variation over phase. The findings confirmed the primary pulsation of SZ Lyn as a radial mode and demonstrated the significance of high-resolution spectroscopy in determining properties of the interior of the star.

Keywords: δ-Scuti stars, Fourier parameter fit method, High-resolution spectroscopy, Moment method, Pulsation modes

RESCON 2025 PS 22

DEVELOPMENT OF A NOVEL OPTICAL DEVICE FOR RAPID DETECTION OF HEAVY METALS IN WATER USING CHARACTERISTIC ISO-PATHLENGTH POINT

R.B.C.S. Rajaguru, T.P. Ranawaka and C.P. Jayalath*

Department of Physics, University of Peradeniya, Peradeniya, Sri Lanka.
*jayalathcp@sci.pdn.ac.lk

It is essential for human health to have access to clean water. However, inorganic fertilisers such as triple superphosphate (TSP) that contain high quantities of Cd between 39 mg L^{-1} and 46 mg L^{-1} contaminate surface water bodies in Sri Lanka. Overuse of inorganic fertilisers has been associated with heavy metal concentrations, particularly Cd and Pb, higher than WHO-recommended values for surface water bodies. Real-time pollutant identification employing sensitive, quick, and economical detection techniques is thus required to guarantee water purity. Many current technologies are expensive, necessitating sophisticated pre-treatment procedures and skilled personnel, and further, they are not suitable for real-time monitoring. In this study, contaminated water samples were analysed using a newly developed optical instrument designed to measure the intensity-angular distribution of light scattering over 180° range and identify unique iso-pathlength (IPL) points associated with specific heavy metal species. An IPL point is defined as the scattering angle at which the measured intensity becomes independent of particle concentration, given a constant absorption coefficient in the medium. A phosphate buffer solution at pH 7.4 was employed to maintain a stable absorption coefficient, with its suitability verified through UV-visible spectroscopic analysis. Instrument calibration was performed using reference water samples contaminated with Fe, Cd, As, and Pb in the (5 – 50) mg L^{-1} range, representing the single-intermediate scattering regime, yielding calibrated IPL points at 5°, 8°, 17° 46', and 4° 36', respectively. The reproducibility of these IPL points was confirmed across repetitive independent trials for each metal under the same conditions. Application of this method to chemical waste sample that was composed with 1.0 mol L^{-1} $CdSO_4$ and saturated with TeO_2 successfully detected Cd through a distinct IPL point at 8°. However, when analysing samples containing combinations of heavy metals, the previously determined IPL points were not observed, indicating increased complexity and interference in multi-component systems. Future work will improve the device's reliability for detecting heavy metals in complex water samples, establishing a new, efficient methodology for accurate on-site monitoring in field applications.

Keywords: Contaminated, Detection, Heavy metals, IPL point, Scattering

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Not Presented at RESCON 2025

RESCON 2025 PS 24

STELLAR PARAMETER ESTIMATION AND FREQUENCY ANALYSIS OF KIC 11973705

J.A.D.M. Dharmathilaka[1,2]*, J. Adassuriya[2], K.P.S.C. Jayaratne[2] and J.L. Gutiérrez[3]

[1]*Department of Physical Sciences and Technology, Sabaragamuwa University of Sri Lanka, Beihuloya, Sri Lanka.*
[2]*Department of Physics, University of Colombo, Colombo, Sri Lanka.*
[3]*Department of Physics, Universitat Politècnica de Catalunya, Spain.*
*dinesha@appsc.sab.ac.lk

Delta (δ) Scuti stars are a class of pulsating variables located within the classical instability strip on the Hertzsprung-Russell diagram. These stars exhibit a complex internal structure, comprising a mixture of both radial and non-radial pressure modes oscillations. KIC 11973705 is a double mode pulsating star, observed in photometry at Quarter 9 by Kepler mission. However, the lack of observational constraints for KIC 11973705 target has limited the comprehensive study of stellar parameters. To overcome this issue, the study delivers a theoretical approach for the estimation of stellar parameters for KIC 11973705 with minimal observational inputs. The effective temperature (T_{eff}) and surface gravity (log g) were adopted from the literature. In addition, visual (V) band magnitude and parallax were obtained for the estimation of stellar parameters through established theoretical approaches, which mainly include the dustmaps python package, the distance modulus formula, the Stefan-Boltzmann law, relationship to the surface gravity, and the polynomial transformation equations. The absolute magnitude of V band, $M_{\mathrm{V}} = 2.83 \pm 0.02$ mag; Bolometric Correction, $BC_{\mathrm{V}} = 0.0348 \pm 0.0015$ mag; B-V color index = 0.2641 mag; and Bolometric Magnitude $M_{\mathrm{bol}} = 2.86 \pm 0.02$ mag were the newly estimated parameters for the KIC 11973705. In addition, a detailed frequency analysis was performed to identify the pulsation characteristics using Period04 software. The dominant fundamental frequency was found to be 2.9002 ± 0.0005 d^{-1} and derived minimum p mode threshold frequency for the KIC 11973705 was 2.1095 d^{-1} In summary, this study yields an estimation of new stellar parameters for the first time for KIC 11973705.

Keywords: Delta scuti star, Frequency analysis, Fundamental frequency, Polynomial transformation, Stellar parameters

RESCON 2025 PS 25

ELECTRONIC FITNESS TRAINING DEVICE: A SMART WEARABLE SYSTEM FOR REAL-TIME EXERCISE FORM CORRECTION

M.A.M. Kumanjana*, W.M.K.D. Wickramasinghe, A.T. Mihiranga, K.G.M. Weerakoon, G.K.E.A. Jayaweera, K.S. Manatunga and W.K.I.L. Wanniarachchi

Department of Physics, University of Sri Jayewardenepura, Nugegoda, Sri Lanka.
*mithilakumanjana1998@gmail.com

Incorrect exercise techniques continue to be a widespread issue in modern fitness culture with consequences ranging from mild muscle strains to serious spinal injuries. In this regard, a novel electronic fitness training device was proposed to offer real-time corrective feedback on physical exercises performed. The device consists of two units based on the ESP32 microcontroller and programmed as master and slave modules that communicate via WiFi. Each unit, which includes an MPU-6050 gyroscope-accelerometer sensor for activity monitoring, is coupled with a vibrotactile feedback mechanism enabled through a vibrating motor. The ESP32 cores utilize FreeRTOS, which supports multi-threading, enabling simultaneous data collection, processing, and communication. Both devices are intended to be worn on the wrist; the master device receives motion data from the slave device, enabling bilateral movement comparison during exercise. To improve measurement accuracy and minimise the sensor noise, a Kalman filter algorithm was embedded into the system firmware. By applying this filter to the raw gyroscope and accelerometer data, the angular uncertainty of the system was improved from ±4° to ±2°. The system performs real-time error calculations by comparing the positional data of both devices. When detected deviations exceed predetermined thresholds, the vibration motors activate continuously until the correct posture is restored. Performance evaluations were performed for bicep curls and shoulder press exercises, and the resulting errors were detected with a response time of less than 100 ms. In addition, the device is able to track the number of repetitions and the duration of exercises performed, and further, it provides feedback in real-time through an OLED display. The system highlights the potential for implementing affordable embedded systems technology for delivering real-time feedback on exercises performed. Therefore, minimising the risk of injury and enhancing the safety and effectiveness of fitness training would be possible.

Keywords: Exercise monitoring, Injury prevention, Kalman filter, Real-time feedback, Wearable technology

RESCON 2025 PS 26

EVALUATION OF DOSIMETRIC IMPACT OF LEAD BALL MARKER ARTIFACTS IN PELVIC EBRT TREATMENT PLANNING

T.A.G.K. Thenuwara [1], **S. Kandeepan** [1]*, **R.G.N. Meegama** [2] **and K.K.D.L. Ruvinda** [3]

[1]*Department of Physics, University of Sri Jayewardenepura, Nugegoda, Sri Lanka.*
[2]*Department of Computer Science, University of Sri Jayewardenepura, Nugegoda, Sri Lanka.*
[3]*Department of Radiotherapy and Radiology, National Cancer Institute, Maharagama, Sri Lanka.*
*ssivayini@sjp.ac.lk

Computed tomography (CT) imaging artifacts caused by the presence of high-density materials, such as lead ball fiducial markers, can introduce inaccuracies in Hounsfield unit (HU) values, which might lead to dose miscalculations in external beam radiation therapy (EBRT) planning. This study investigated the impact of these lead-marker-induced artifacts on dose calculations in pelvic EBRT plans. The pelvic region was chosen as the marker positioning was relatively uniform across patients, unlike in other regions. The primary aim was to quantify the differences in calculated dose distribution of artifact-included and artifact-removed CT datasets, and to compare matrices between them to assess whether the observed differences are significant both statistically and clinically. Ten pelvic CT datasets were obtained from the existing datasets, each containing an original image series with visible lead markers and existing treatment plans. Each CT series was manually edited, and appropriate HU values were assigned to create an artifact-free version. Identical EBRT plans were applied to both CT sets using the VARIAN ARIA treatment planning system with the anisotropic analytical algorithm. Then, a plan comparison dose-volume histogram was generated for the artifact region and compared visually. Differences in key dose matrices (maximum, mean, median percentages) for the artifact structure averaged approximately 0.13%, 0.13% and 0.20%, respectively, across the dataset. According to the paired *t*-test analysis, there was no statistical significance across these parameters. However, in special cases where the clinical target volume (CTV) overlapped with the artifact region, more noticeable differences were observed. This indicates the potential for clinical relevance, highlighting the need for further study. The results highlight the importance of recognising and addressing high-density CT artifacts, especially the lead-ball artifact during pelvic EBRT planning, and the need for larger datasets as well as automated removal methods to enhance treatment accuracy and consistency.

Keywords: CT artifacts, Dose distribution, Lead ball artifact, Medical imaging, Radiation therapy

RESCON 2025 PS 27

ENCAPSULATION OF BACTERIAL CELLS USING NOVEL FUSED DEPOSITION MODELING BASED 3D-PRINTED POLYLACTIC ACID MICROFLUIDIC DROPLET GENERATOR

D.M.C.T. Dissanayake[1], L.C. Menikarachchi[2], K.B. Wijayaratne[1]*, B.S. Nanayakkara[3] and L.K. Narangammana[1]

[1]*Department of Physics, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Pharmacy, University of Peradeniya, Peradeniya, Sri Lanka.*
[3]*Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka.*
*lahirukn@sci.pdn.ac.lk

This study presents the development and application of a novel fused deposition modeling (FDM) based 3D-printed microfluidic droplet generator with a flow-focusing geometry fabricated using poly(lactic acid) (PLA). The vertical channel design was printed using an "Ultimaker-2" with a resolution of 60 µm. The optimal flow rates were determined to be 20 mL h^{-1} for the continuous phase (paraffin oil) and 2 mL h^{-1} for the dispersed phase (water), based on preliminary droplet generation tests. Under these optimized conditions, the device was employed for the encapsulation of *Bacillus subtilis* bacterial cells, obtained under aseptic conditions. The bacterial concentration was first determined using the Breed counting method. Microscopic observations and calculations using the Breed method equation revealed a bacterial density of approximately 2.3×10^9 cells mL^{-1}. A 2.0 mL solution of this bacterial suspension was prepared, with the addition of crystal violet for enhanced visualisation. This solution served as the dispersed phase during encapsulation. Droplet formation and encapsulation were successfully conducted using the optimised microfluidic device. The process yielded stable droplets containing approximately 100 bacterial cells per droplet, with an average droplet diameter of ~160 µm. Microscopic images confirmed the integrity and uniformity of the encapsulated droplets. To preserve their structure for observation, the droplets were aseptically transferred onto a cavity slide, minimising deformation during analysis. These findings validate the capability of the PLA-based 3D-printed device to serve as a cost-effective and reliable platform for bacterial encapsulation. The success of this application highlights its potential utility in microbiology, biotechnology, and point-of-care diagnostics, especially in resource-limited settings where traditional cleanroom fabrication methods are inaccessible.

Keywords: Cell encapsulation, FDM 3D printing, Flow focusing, Microfluidic devices, PLA

RESCON 2025 PS 28

WASTE HEAT RECOVERY OF A RECHARGEABLE ELECTRIC VEHICLE BATTERY PACK USING THERMOELECTRIC GENERATORS

M.G.R. Shyamamala[1,2], T.M.W.J. Bandara[3] and N.D. Subasinghe[1]*

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka.*
[2]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[3]*Department of Physics, University of Peradeniya, Peradeniya, Sri Lanka.*
*deepal.su@nifs.ac.lk

With the rapid growth of electric vehicles (EVs), enhancing energy efficiency and thermal management of battery packs has become increasingly important. The heat generated during the operation of lithium-ion batteries in EVs is released as waste. The primary objective of this study was to investigate the feasibility of using thermoelectric generators (TEGs) to recover this waste heat from EV battery packs and convert it into electricity, thereby improving the overall energy efficiency of the system without compromising battery thermal management. The use of TEGs on EV battery packs to harvest energy while keeping the cooling rate within a safe range has not been attempted before. Addressing this, the power output of a TEG attached to a sample battery pack was evaluated and time-based efficiency gains were assessed. Experimental measurements were conducted to determine the TEG output power for temperature differences (ΔT) ranging from 1 °C to 20 °C, maintaining the safe range for EV batteries. The maximum output power of 0.0238 W was recorded at ΔT = 20 °C. These experimental measurements were then used to calculate the discharge-time based efficiency gains of the battery pack. The results show that the harvested energy could extend the battery discharge time by over 2.4%, demonstrating a meaningful improvement in efficiency. Our prior findings showed that the heat dissipation rate of the battery pack decreased from 2.8 J s^{-1} to 2.5 J s^{-1} after attaching TEGs. However, this slight decrease in cooling rate still maintains the battery temperature within safe limits. These findings suggest that integrating TEGs into battery packs can enhance overall system efficiency by harvesting waste heat, with minimal impact on cooling effectiveness and battery safety.

Freeway (Pvt.) Ltd. is acknowledged for providing the battery pack for this study.

Keywords: Discharge time-based efficiency gain, Rechargeable battery pack, Thermoelectric generator

RESCON 2025 PS 29

PRE-ESTERIFICATION OF USED COOKING OIL USING A LEWIS ACIDIC ZIRCONIUM-OXINE SOLID ACID CATALYST TO MINIMISE SAPONIFICATION IN BIODIESEL PRODUCTION

W.H.M.R.N. Pilapitiya and M.Y.U Ganehenege*

Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.
*myug@sci.pdn.ac.lk

Biodiesel production using used cooking oil is a great alternative for the global energy demand, although a major problem of used cooking oil is that it contains a high amount of free fatty acids (FFA) originating from heating during multiple cycles of cooking. In the presence of excess FFA, used cooking oil undergoes saponification during the conventional transesterification step, where the oil source is reacted with methanol in the presence of a base catalyst. Saponification significantly decreases the net yield of final biodiesel produced. Hence, FFA should be minimised to a level recommended by biodiesel production guidelines, before the transesterification step. This is achieved through the introduction of a pre-esterification step, where FFA are converted to their methyl esters using an acid catalyst. This research was focused on the synthesis of economically feasible, solid acidic transition metal catalysts, Zr-oxine and nitrated Zr-oxine, in an attempt to minimise saponification of biodiesel production. Two types of cooking oils, domestically used oil (DUO) and industrially used oil (IUO), were used for this study. Initial FFA content of both types, DUO and IUO was determined using a titrimetric method, which showed a significantly higher FFA content than recommended. Optimum pre-esterification reaction time, temperature, and catalytic dose were determined by reacting DUO in the presence of Zr-oxine and measuring the percentage FFA reduction. Thereafter, both DUO and IUO were pre-esterified under optimised conditions with nitrated Zr-oxine. The results revealed that the FFA content of DUO was reduced by 48.34% and 36.27% in the presence of nitrated Zr-oxine and Zr-oxine, respectively. The final FFA level after the pre-esterification in the presence of nitrated Zr-oxine was 0.43 mg KOH g^{-1}, well within the recommended standards for biodiesel production. More importantly, biodiesel produced by esterifying the DUO using nitrated Zr-oxine showed no saponification at all. This result encourages the potential applicability of Lewis acidic Zr-oxines in the utilisation of used cooking oil for biodiesel production.

Keywords: Biodiesel production, Pre-esterification, Saponification, Solid acid catalyst, Wasted cooking oil, Zr-oxine

RESCON 2025 PS 30

EXPLORING ELECTRONIC/SEMICONDUCTING PROPERTIES OF Co, Ni, Mg, Zn-MOF-74s UPON PYRIDINE AND 4-AMINOPYRIDINE ENCAPSULATION

P.D.T.S.N. Jayasundara[1]*, C.V. Hettiarachchi[1,2] and H.A.I.R. Perera[1,2]

[1]*Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
*thushanis.jayasundara@gmail.com

The rising global demand for sustainable energy has positioned dye-sensitised solar cells (DSCs) as a promising alternative due to low-cost fabrication, environmental friendliness, and adaptability for building-integrated and portable energy solutions. To address the inherent insulating nature of MOF-based materials, this study explores the enhancement of semiconducting properties of M-MOF-74 (M = Co, Ni, Zn, Mg) through vapor-phase encapsulation of electron-rich guest molecules, pyridine and 4-aminopyridine. The successful synthesis and crystallinity of the M-MOF-74s were confirmed by powder X-ray diffraction, which displayed characteristic peaks at 6.7° and 11.7°. Fourier transform infrared spectroscopy revealed blueshifts in the 1700 – 1300 cm^{-1} region, indicating non-covalent interactions and coordination between the guests and open metal sites. Following optical characterisation, these guests improved semiconducting behavior, reducing the band gap of pristine Co-MOF-74 from 2.72 eV to 1.62 eV with 4-aminopyridine and to 2.10 eV with pyridine. Similarly, initial band gaps of Ni-MOF-74 (2.75 eV), Mg (2.86 eV), and Zn (2.87 eV) based analogs demonstrated reductions, while the latter two showed minimal changes due to the closed-shell nature of their metal centres. Cyclic voltammetry (CV) and Mott-Schottky analysis confirmed increased carrier density and retained *n*-type conductivity even after guest encapsulation of all M-MOF-74s. It was found that 4-aminopyridine outperformed pyridine, owing to enhanced electron-donating capability and optimised interaction with the metal centres of MOF. Further, guest encapsulations significantly reduced interfacial resistance and improved electron mobility, thereby confirming the enhancement of interfacial charge transfer. Upon post-modification with pyridine and 4-aminopyridine, Ni-MOF-74 films demonstrated 39% and 7% of power conversion efficiencies (PCE), respectively. In contrast, pyridine and 4-aminopyridine@Mg-MOF-74 showed significant improvements in PCE from 0.25% to 13% along with 17% higher efficiency compared to Co and Zn counterparts in MOF-sensitised photovoltaic devices. This work underscores the potential of pyridine and 4-aminopyridine encapsulated M-MOF-74s, particularly Co- and Mg-MOF-74, as low-cost, tuneable, and efficient materials for next-generation solar energy applications.

Financial assistance from National Research Council (Grant No. 20-089) is acknowledged.

Keywords: Dye-sensitised solar cells, Encapsulation, Guest molecules, MOF

RESCON 2025 PS 31

PREPARATION OF $Cu/Cu_2O/CuO/SrTiO_3$ PHOTOCATHODE FOR ENHANCED PHOTOELECTROCHEMICAL WATER SPLITTING

W.M.M.D. Wickramasinghe, W.T. Abeysundara and J. Bandara*

National Institute of Fundamental Studies, Kandy, Sri Lanka.
*jayasundera.ba@nifs.ac.lk

Photoelectrochemical (PEC) water splitting offers a clean and sustainable approach for solar hydrogen production. However, the development of photocathodes that are simultaneously low-cost, efficient, and stable remains a major challenge. This study presents the fabrication and characterisation of a multilayered $Cu/Cu_2O/CuO/SrTiO_3$ photocathode to address these limitations by enhancing charge separation, light absorption, and interfacial stability. The photocathode was synthesised through sequential anodisation, thermal oxidation, and spin coating techniques. Copper foils were anodised in aqueous NaOH solution to form $Cu(OH)_2$, thermally reduced to Cu_2O under nitrogen, and partially oxidised in air to form CuO. A thin $SrTiO_3$ layer was deposited via spin coating and annealed under nitrogen to promote passivation and minimise interfacial recombination. The material system was strategically selected due to excellent conductivity of Cu acting as a substrate. Moreover, Cu_2O is a visible light absorbing *p*-type semiconductor, while CuO extends absorption deeper into the visible range, forming beneficial heterojunctions. On the other hand, the $SrTiO_3$ layer serves as a wide *n*-type bandgap that passivates the surface and improves charge separation. Stepwise PEC measurements showed negligible photocurrent for bare Cu and Cu/Cu_2O, while introducing CuO improved visible light absorption. Further enhancement was achieved with $SrTiO_3$, which resulted in a photocurrent density of -3.76 mA cm^{-2} at 0.05 V vs. reversible hydrogen electrode (RHE) and an applied bias photon-to-current efficiency (ABPE) of 4.44%. X-ray diffraction confirmed successful phase formation, UV-visible diffuse reflectance spectroscopy demonstrated band gap tuning and enhanced optical absorption, and Mott-Schottky analysis revealed favorable semiconductor properties and improved charge carrier density. The combination of Cu-based oxides and $SrTiO_3$ contributed to significant improvement in photoresponse and stability. This work highlights the novelty of employing a low-cost, multilayered $Cu/Cu_2O/CuO/SrTiO_3$ photocathode architecture to simultaneously improve efficiency and stability, providing a promising pathway for the future development of solar fuel technologies.

Keywords: Band gap tunning, Charge carrier, Cu based photocathode, Photoelectrochemical water splitting

RESCON 2025 PS 32

PHYSICAL PROPERTIES OF SEMICONDUCTOR BASED REGENERATED CELLULOSE NANOCOMPOSITES

P.R.D. Weerasooriya[1]*, Md. Sohrab Hossain[2] and M.K.M. Haafiz[3]

[1]*Department of Mechanical and Manufacturing Engineering, University of Ruhuna, Matara, Sri Lanka.*
[2]*Department of Applied Sciences, Universiti Teknologi PETRONAS, Perak Darul Ridzuan, Malaysia.*
[3]*Division of Bioresource Technology, School of Industrial Technology, Universiti Sains Malaysia, Pulau Pinang, Malaysia.*
*dinesh@mme.ruh.ac.lk

As a photocatalyst, bismuth ferrite ($BiFeO_3$) was selected due to its less band gap energy (2.2 – 2.7 eV) to evaluate the degradation of methyl orange (MO) as an anionic dye. The regenerated cellulose films were derived from microcrystalline cellulose (MCC) sourced from empty fruit bunches of oil palm and prepared through a solution casting technique. During this process, varying amounts of $BiFeO_3$ (0 – 5 wt%) were incorporated into the MCC solution using the ionic liquid 1-butyl-3-methylimidazolium chloride. The photocatalytic activity of the resulting films was assessed by exposing the dye-catalyst mixture to direct sunlight until attaining a notable decolorisation of the dye. Specifically in this study, mechanical properties, thermal stability and water absorption were considered as the important application related physical properties. Tensile strength of the photocatalytic films lies around 10 MPa and the identified optimum film sample has a strain energy density of 2.8 MJ m^{-3} which indicates a capability to withstand mechanical forces. According to thermogravimetry analysis results, the weight loss of photocatalytic films is less than 5 wt% at possible extreme temperature environments. As a favorable phenomenon for photocatalytic degradation, water absorption was evaluated for the synthesised films. The photocatalyst shows 60% of water absorption after 2 h of immersion in water and it was identified as a favorable practical condition to facilitate photocatalytic degradation of MO.

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Keywords: Methyl orange, Photocatalyst, Physical properties, Tensile strength

RESCON 2025 PS 33

ECO-FRIENDLY CORROSION PROTECTION OF STAINLESS-STEEL GRADE 202 USING CHITOSAN-BASED FORMULATIONS

M.H.N. Revon and N. Priyantha*

Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.
*namalpriyntha@sci.pdn.ac.lk

Stainless steel (SS) Grade 202 possesses high corrosion resistance towards mild acidic environments, because of the interference caused by forming a passive film of chromium oxide on the surface of SS. Nevertheless, the corrosion stability of SS Grade 202 in certain acidic environments, especially under aggressive conditions is questionable. On the other hand, although the corrosion inhibitory action of certain species such as phosphate on SS Grade 202 has been well documented, the effect of various chemical constituents under moderate and aggressive acidic conditions has not been given due attention despite the wide use of SS Grade 202 in industrial applications. As such, variation of corrosion inhibition efficiency of SS Grade 202 at different concentrations of HCl, and the impact of these acid solutions with added chloride ions along with the effect of chitosan, a corrosion inhibitor, was investigated in this study. Fourier transform infrared spectroscopy analysis depicts the characteristic functional groups of chitosan, a wide band at 3249 cm^{-1} (O-H and N-H stretching vibration) and strong bands at 1365 cm^{-1} (C-N stretching) and 1217 cm^{-1} (C-O-C glycosidic linkage), verifying its chemical structure for corrosion inhibition of SS Grade 202. Mass loss measurements depict that SS Grade 202 exhibits 50% reduction in mass loss as compared to the uninhibited system, when 5.0 mL of 1.0% (w/v) chitosan prepared in 0.17 mol L^{-1} acetic acid is added to 0.25 mol L^{-1} HCl solution. Further study reveals that the increase in the dosage of the inhibitor significantly enhances the corrosion inhibition efficiency. In the presence of 10 mL of 5.0% chitosan/acetic acid solution, the corrosion rate decreases by 90.8% when compared to the uninhibited system. It is suggested that chitosan composites be synergistically combined with polymers to form future-generation green coatings taking advantage of the inherent greenness and corrosion inhibitive properties of chitosan.

Keywords: Chitosan, Corrosion rate, Inhibition, Stainless steel

RESCON 2025 PS 34

PREPARATION AND CHARACTERISATION OF CASSAVA STARCH BASED ELECTROSPUN NANOFIBRES

M.K.W. Sucharitha[1], W.S.S. Gunathilake[2]* and I.M.D.D.K.B. Ilankoon[3]

[1]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.*
[3]*Department of Physics, University of Peradeniya, Peradeniya, Sri Lanka.*
*subhashinig@sci.pdn.ac.lk

This work reports the preparation and characterisation of electrospun nanofibre mats using cassava starch blended with poly(ethylene oxide) (PEO) as a sustainable alternative to conventional petroleum-derived polymers. The environmental concerns regarding the non-biodegradable plastic waste and the urgent need for biodegradable materials such as starch-based nanofibres are particularly attractive for sustainable material development. Cassava starch is an abundant, renewable and biodegradable polysaccharide with limited spinnability for electrospinning applications. It was extracted from fresh tubers and PEO was added to enhance the spinnability of starch solutions. Cassava starch and PEO solutions were blended in various ratios (3:1, 1:1 and 1:3) and electrospun. Water was used as the solvent to dissolve both cassava starch and PEO polymers. The electrospinning process was optimised by changing polymer concentrations and instrumental parameters to obtain bead-free nanofibre mats. According to scanning electron microscopic images, nanofibre mats with smooth surfaces and minimum beads were obtained when cassava starch:PEO ratio was 1:3. Average fibre diameter was determined to be 112 nm. Fourier transform infrared spectroscopic studies revealed molecular interactions between cassava starch and PEO via hydrogen bonding. The mechanical property testing showed cassava starch/PEO nanofibre mats had a higher value for Young's modulus (31.06 MPa) compared to pure PEO nanofibre mats (7.15 MPa) indicating significant improvement in stiffness for cassava starch/PEO mats. These findings highlight that mixing cassava starch with PEO enhances spinnability, fibre morphology and mechanical strength. This offers a promising route for developing sustainable, biodegradable materials for potential applications in filtration, packaging and biomedical fields.

Keywords: Biopolymers, Cassava starch, Electrospinning, Nanofibres, PEO

RESCON 2025 PS 35

UTILISATION OF BIOCOMPATIBLE MIL-101(Fe) FOR THE DELIVERY OF FERULIC ACID

G.H. Walalawela* and C.V. Hettiarachchi

Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.
*gimhanihw@gmail.com

Drug delivery systems are engineered technologies that have been designed to transport pharmaceutical compounds into their intended sites of action in the body, optimising the therapeutic effects. Sustained drug delivery is important to maintain constant drug levels in blood and tissue for extended periods of time improving patient compliance and efficacy. This research investigated the development of a biocompatible iron(III) based metal organic framework: MIL-101 for the controlled release of ferulic acid, a naturally occurring phenolic compound with antimicrobial, anti-inflammatory, antioxidant and anticancer properties. However, the treatment is limited due to its low water solubility and bioavailability. Thus, this study aimed to obtain sustained delivery of ferulic acid by incorporation into a biocompatible metal organic framework (MOF). The synthesised MOF: MIL-101(Fe) containing terephthalic acid as the organic linker and iron(III) as the inorganic node, was characterised by powder X-ray diffraction, Fourier transform infrared spectroscopy and scanning electron microscopy techniques. In this study, drug loading was carried out in 2.6×10^{-3} mol L^{-1} solution of ferulic acid in a 50:50 (v/v) mixture of distilled water:ethanol. Drug loading data suggest that the maximum loading capacity of MIL-101(Fe) be obtained at 6 h as 44.63%. The release of ferulic acid from the drug loaded MIL-101 was carried out using dialysis bags dipped in phosphate buffer saline media at a pH of 7.4 to simulate *in-vitro* conditions for a period of 24 h and UV-visible absorbance spectra were obtained by withdrawing samples at predetermined time intervals. The spectra thus obtained show an increase in absorbance with time at 309 nm due to ferulic acid indicating that slow release of the drug was achieved with a percentage of 72.60% after 24 h. Further studies can be carried out to determine the release profiles of ferulic acid from MIL-101(Fe) using advanced techniques such as high-performance liquid chromatography.

Keywords: Drug delivery, Ferulic acid, MIL-101(Fe), Sustained release

RESCON 2025 PS 36

ADSORPTIVE REMOVAL OF METHYLENE BLUE FROM AQUEOUS SOLUTIONS BY POST-CONSUMER POLY(ETHYLENE TEREPHTHALATE)/CASSAVA STARCH BASED MICROBEADS

G.A.A.P. Darshani, L.D.C.T. Wickramasinghe and W.S.S. Gunathilake*

Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.
*subhashinig@sci.pdn.ac.lk

Plastic pollution represents a significant environmental challenge. As global demand for plastic rises, poly(ethylene terephthalate) (PET), a widely used synthetic polymer, has been identified as a major contributor to this issue. Recycling and reuse of post-consumer PET was attempted as a solution for this issue in this study. Microbeads from post-consumer PET were prepared by inotropic gelation method by dissolving it in a mixture of trichloroacetic acid:dichloromethane (1:1). The PET microbeads prepared were tested as an adsorbent to remove methylene blue (MB) dye from aqueous solutions. To increase biodegradability and low adsorption, a biopolymer cassava starch was introduced to the PET microbeads. The PET/cassava starch microbeads were synthesised using inotropic gelation method by mixing PET solution with cassava starch dissolved in trichloroacetic acid. The microbeads were characterised using Fourier transform infrared (FTIR) spectroscopy and scanning electron microscopy (SEM). Batch experiments were carried out to optimise parameters for the adsorption of MB on PET/cassava starch microbeads, and the remaining dye concentrations after adsorption were determined using UV-visible spectrophotometer. All measurements were taken in three replicates. The results of FTIR indicated the presence of O-H stretch around 3293 cm^{-1} and C=O stretch around 1730 cm^{-1} responsible for cassava starch and PET, respectively. The morphology of microbeads showed a rough surface before and after adsorption as revealed by SEM analysis. The optimised parameters for methylene blue adsorption on PET/cassava starch microbeads were recorded as 20 mg L^{-1} initial dye concentration, pH of 6.0, 75.0 min of shaking time, 11.0 min of settling time and 0.040 g of dosage. The extent of dye removal with PET/cassava-based microbeads was calculated as 41.83%, while it was 38.75% with PET only microbeads. The data fit well to the pseudo-second order kinetics model indicating that the rate determining step is chemisorption. Adsorption data fit to the Langmuir adsorption isotherm revealing that monolayer adsorption takes place. Regeneration of PET/cassava starch microbeads was carried out using 1.0 mol L^{-1} HCl and desorption efficiency was found to be 25.33%. The results indicate that post-consumer PET bottles and cassava starch are good sources for microbeads synthesis for adsorptive removal of methylene blue from aqueous solutions.

Keywords: Cassava starch, Methylene blue, Microbeads, Poly(ethylene terephthalate)

RESCON 2025 PS 37

POST-CONSUMER POLY(ETHYLENE TEREPHTHALATE)/CASSAVA STARCH-BASED ELECTROSPUN FIBRE MATS FOR REMOVAL OF METHYL VIOLET FROM AQUEOUS SOLUTIONS

L.D.C.T. Wickramasinghe, G.A.A.P. Darshani and W.S.S. Gunathilake*

Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.
*subhashinig@sci.pdn.ac.lk

Poly(ethylene terephthalate) (PET) products are a common waste material and have low biodegradability. This study focused on the development and characterisation of electrospun fibre mats from post-consumer PET and cassava starch for the removal of methyl violet from aqueous solutions. The research addresses the low adsorption capacity of methyl violet onto conventional PET fibre mats and its biodegradability by incorporating with a biopolymer, cassava starch. The study presents a systematic approach that includes extracting cassava starch, optimising the composition of solvents to dissolve cassava starch and PET, preparing PET/cassava starch-based fibre mats using the electrospinning technique, and conducting batch adsorption studies for removal of methyl violet by fiber mats prepared. Experimental results revealed that PET was completely dissolved in 1:1 ratio of trichloroacetic acid and dichloromethane, while cassava starch was completely dissolved in trichloroacetic acid alone. The optimised instrumental and solution parameters to prepare fibre mats were 3.5 mL h^{-1} of flow rate, 700 – 702 rps of drum speed, 10.0 cm of distance between the needle tip and the collector, 23 – 24 kV of applied voltage and 34% (w/v) of total polymer concentration respectively. The FTIR data revealed the presence of absorption bands corresponding to functional groups present in PET and cassava starch. The SEM images confirmed the fibrous nature of the mats. Optimised parameters of methyl violet adsorption from water using fibre mats were found as follows. A shaking time of 90 min, 13 min of settling time, pH 9 and adsorbent dosage of 2.0×10^{-2} g. Adsorption kinetics data confirmed the pseudo-second order model (R^2 = 0.98) and equilibrium data were consistent with the Langmuir isotherm model (R^2 = 0.98) indicating that monolayer adsorption of methyl violet occurs on the fibre surface. Further, fibre mat showed a removal efficiency of 35.22 % under gravity filtration.

Keywords: Cassava starch, Electrospinning, Methyl violet, Poly(ethylene terephthalate)

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MICROBEADS DERIVED FROM POST-CONSUMER POLY(ETHYLENE TEREPHTHALATE) BOTTLES FOR ADSORPTIVE REMOVAL OF HEAVY METAL IONS FROM AQUEOUS SOLUTIONS

N.D.W.Y. Ananda and W.S.S. Gunathilake*

Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.
*subhashinig@sci.pdn.ac.lk

Plastic pollution is a significant environmental challenge, with serious consequences for ecosystems and human health. Among synthetic polymers, poly(ethylene terephthalate) (PET) is a major contributor due to its durability and moisture resistance, making it widely used in packaging industry, particularly PET bottles. The objective of this study was to synthesise microbeads from post-consumer PET bottles to evaluate their efficacy in heavy metal ion removal, with bead formation specifically intended to increase surface area. To synthesise microbeads, PET flakes were dissolved in a 1:5 solvent system of trifluoroacetic acid (TFA) and dichloromethane (DCM), using an optimised PET concentration of 15% (w/v). Resulting microbeads with an average diameter of 744.9±38.6 µm were characterised using Fourier transform infrared (FTIR) spectroscopy, thermogravimetric analysis and X-ray fluorescence spectroscopy. The adsorption capacity was evaluated for Cu^{2+}, Cd^{2+} and Pb^{2+}, with residual concentrations quantified using atomic absorption spectroscopy. As Cu^{2+} ions exhibited the highest adsorption among tested ions, subsequent studies were conducted using Cu^{2+} ions. FTIR confirmed interactions between Cu^{2+} ions and oxygen bearing functional groups of PET during adsorption. Batch experiments conducted, in triplicate, to optimise adsorption parameters revealed that most effective removal occurred at an initial Cu^{2+} concentration of 10 mg L^{-1}, pH of 7, and a contact time of 12 min, achieving a maximum removal efficiency of 45%. Regeneration studies with 1 mol L^{-1} HCl achieved a desorption efficiency of 21% via an ion-exchange mechanism. Kinetics studies revealed pseudo-second order behavior, indicating chemisorption as the rate-limiting step. Further, the adsorption data fit well with the Langmuir isotherm model, suggesting monolayer adsorption of Cu^{2+}. These results highlight the potential of recycled PET bottles in microbeads form as low-cost functional materials for environmental remediation, offering a sustainable solution to address both plastic and heavy metal pollution.

Keywords: Heavy metals, Microbeads, Plastic pollution, Poly(ethylene terephthalate)

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DYE DEGRADATION CAPACITY OF GREEN SYNTHESISED IRON OXIDE NANOPARTICLES

T. Kailaivasan, S.B. Alahakoon and M.Y.U. Ganehenege*

Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.
*myug@sci.pdn.ac.lk

Synthetic dyes, once released as waste, pose a huge threat to the environment and the living organisms. Nanoparticles offer a cheaper, environmentally friendly and less energy consuming way to remove synthetic dyes by degrading these organic molecules. This research utilised papaya peel extract to green synthesise iron oxide nanoparticles (IONP) and to study their possible degrading capacity of methyl orange (MO) and methylene blue (MB) dyes. Papaya peel, a waste material available throughout the year, consists of antioxidants that can reduce and act as capping agents during the formation of nanoparticles. IONP were synthesised by adding the papaya peel extract to a heated solution of $FeCl_3$ while stirring. Effect of $FeCl_3$ concentration on nanoparticle formation and their corresponding dye degradation capacity were studied using $FeCl_3$ solutions of 10 mM, 20 mM and 30 mM concentrations. Powder X-ray diffraction data confirmed the presence of α-Fe_2O_3, high crystallinity of the calcined, synthesised samples, and the presence of small amounts γ-Fe_2O_3 and Fe_3O_4 as well. The scanning electron microscopic images revealed that the particles were in nanoscale, and their shapes were roughly spherical. The Fourier transform infrared bands appearing at 428, 524 and 628 cm^{-1} confirmed the formation of Fe-O bonds. The ability of IONP to decolorise both MO and MB were studied by UV-visible spectrophotometry. The intensities of the MO bands decreased over 1.5 h of stirring and that of MB bands decreased over 4 h of stirring when the solutions were exposed to sunlight. The study revealed that the synthesised IONPs remove 92.0% of MO and 74.7% of MB. The dye removal process may include degradation of dye molecules and adsorption of dye onto the IONP. The net reduction in color intensity, either due to degradation, adsorption or both, is higher for the synthesised IONP than with the commercially available iron oxide powder.

Keywords: Degradation, Green synthesis, Iron oxide nanoparticles, Methyl orange, Methylene blue

RESCON 2025 PS 40

CORROSION INHIBITION OF GRADE 202 STAINLESS STEEL BY $NaHCO_3$ IN HCl MEDIUM

P.D.T.A. Dewappriya, M.H.N. Revon and N. Priyantha*

Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.
*namalpriyantha@sci.pdn.ac.lk

Corrosion, the degradation of metals due to electrochemical or chemical interaction with the environment, has been a problem since the beginning of metal usage. Corrosion of metals adversely affects many operations, such as water supplies, energy production systems and construction of metallic structures, owing to the requirement of the use of metals and alloys having long lifetimes. Despite stainless steel (SS) facing corrosion challenges in harsh conditions, it exhibits excellent corrosion resistance in mild environments when compared to other alloys, primarily because of the chromium oxide barrier that is formed through oxidation of chromium present in SS. To enhance the longevity of SS, eco-friendly corrosion inhibitors made from cost-effective material have been utilised. Nevertheless, there has been limited exploration into the effects of different dissolved salts on the corrosion inhibition properties of Grade 202 SS. This study thus focused on the application of a multi-technique approach for the investigation of corrosion inhibition of Grade 202 SS in acidified $NaHCO_3$ systems. Gravimetric measurements indicate superior corrosion inhibition in aqueous 0.50 mol L^{-1} $NaHCO_3$ solutions prepared in HCl acid solutions, and further, increase in the concentration of $NaHCO_3$ is found to improve the inhibition efficiency. Electrochemical impedance spectroscopy (EIS), through Nyquist plots, demonstrates that the polarisation resistance, which is inversely proportional to corrosion rate and directly proportional to the extent of corrosion inhibition, significantly increases in aqueous $NaHCO_3$ systems in the presence of HCl, a corrosion promoter. Linear polarisation studies, leading to diminished corrosion rates in aqueous $NaHCO_3$, further support the findings of EIS. Introduction of $NaHCO_3$ solutions to minimise corrosion of stainless-steel objects in industrial applications which use HCl acid is thus convinced.

Keywords: Corrosion, Impedance, Linear polarisation, Mass loss measurements, $NaHCO_3$

RESCON 2025 PS 41

CRYSTALLOGRAPHIC EVOLUTION AND PHASE INTERACTIONS IN ZSM-5-MODIFIED ZnO NANORODS: A POWDER X-RAY DIFFRACTION STUDY

R.M.H.M. Rathnayake[1], J.M.S.G.B. Navarathne[1], M.D.R. Perera[1], A. Bandara[2] and L. Jayarathne[1]*

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka.*
[2]*Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.*
*lakmal.ja@nifs.ac.lk

Zinc oxide (ZnO) nanorods possess promising semiconducting, piezoelectric, and gas-responsive properties, making them attractive for sensing, catalysis, and environmental remediation. However, their structural stability and performance are often hindered by surface reactivity, structural imperfections, and aggregation under operational conditions. This study investigated the effect of incorporating Zeolite Socony Mobile-5 (ZSM-5) in different weight ratios on the crystal structure of ZnO nanorods, using powder X-ray diffraction (PXRD) to analyse phase interactions, crystallite size, and peak positions. PXRD analysis revealed that increasing ZSM-5 content in ZnO nanorods (ZnO:ZSM-5 = 10:1, 7:1, 4:1, 1:1, 1:4 and 1:7) leads to weakened, broadened, and shifted ZnO peaks, indicating reduced crystallinity, increased lattice strain, and structural confinement. In contrast, ZSM-5 peaks became sharper and more dominant. To determine whether ZnO peak broadening is due to crystallite size reduction, lattice strain, or both, the crystallite size was estimated using the Scherrer equation. Pristine ZnO nanorods exhibited a large crystallite size of 481±10 nm, indicating unrestricted growth. With ZSM-5 addition, the crystallite size gradually decreased due to zeolite-induced confinement and surface interactions. The smallest crystallite size, about 222±10 nm, was observed at a ZnO:ZSM-5 ratio of 1:4. Beyond this ratio, crystallite size slightly increased again, likely due to particle agglomeration or structural rearrangement. These findings show the effect of ZSM-5 incorporation on the ZnO nanorods' crystal structure. As ZSM-5 content increases, ZnO peaks weaken and broaden, suggesting increased strain and reduced structural order, while crystallite sizes decrease at moderate ratios due to constrained growth. Slight size increases at higher ZSM-5 content may result from aggregation. This study highlights how zeolite loading modulates ZnO nanostructures and provides a basis for optimizing hybrid materials. Future studies should employ Rietveld refinement and high-resolution transmission electron microscopy to better understand strain effects and guide the development of more stable, high-performance materials.

Keywords: Crystallite size, Nanorods, Zeolite, Zinc oxide

RESCON 2025 PS 42

BAND GAP INVESTIGATION OF NOVEL Hf(IV)-SCHIFF BASE COMPLEXES SYNTHESISED FROM SALICYLALDEHYDE DERIVATIVES AND HEXAMETHYLENEDIAMINE

S. Lilachjini and C.V. Hettiarachchi*

Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.
*champikav@sci.pdn.ac.lk

Band gap energy is a fundamental concept in solid-state physics and materials chemistry, referring to the energy difference between the valence band and the conduction band in a material. This energy gap determines a material's electrical conductivity and optical properties. The importance of band gap energy lies in its ability to predict and control the behavior of materials in various applications, particularly in electronics, photovoltaics, and photocatalysis. By analysing how the structure of the ligand or the metal center influences the band gap, electronic properties of these complexes can be tailored. The purpose of studying band gap energy in Schiff base complexes of Hf(IV) was to understand their potential as functional materials. A series of novel Hf(IV)-Schiff base complexes were synthesised using salicylaldehyde derivatives (5-bromosalicylaldehyde and 5-chlorosalicylaldehyde) and hexamethylenediamine as the coordinating ligands. The Schiff base ligands were prepared via condensation reactions and subsequently complexed with Hf(IV) to yield stable coordination compounds. The resulting complexes were characterised by Fourier transform infrared spectroscopy and electronic spectra to confirm their structural integrity and coordination behavior. Special emphasis was placed on evaluating the optical properties of the complexes by employing UV-visible diffuse reflectance spectroscopy. Tauc plots were constructed to determine the optical band gap energies, which provide insight into the potential semiconducting and photocatalytic behavior of the materials. The band gap values of the Hf(IV) complexes synthesised were found to vary depending on the nature of the salicylaldehyde derivatives, indicating the possibility of tuning electronic properties through ligand modification. In conclusion, the 5-chloro-substituted complex exhibits the lowest band gap energy (2.07 eV), followed by the 5-bromo derivative (2.37 eV), while the complex derived from unsubstituted salicylaldehyde displays the highest band gap (2.40 eV) among the series. Overall, these results demonstrate that tuning the substituent on the ligand framework is an effective strategy to modulate the band gap energy of the Hf(IV)-Schiff base complexes.

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Keywords: Bandgap, Hafnium, Photocatalysis, Salicylaldehyde, Schiff base, Tauc plot

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PHYTOCHEMICAL SCREENING AND BIOACTIVITY EVALUATION OF METHANOL BARK EXTRACT OF *Garcinia quaesita*

D.M.S.W.K. Dissanayake[1], **T.M.T.D. Thennakoon**[2] **and J.M.S. Jayasinghe**[1]*

[1]*Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
*susanthij@sci.pdn.ac.lk

Plant-based pharmaceuticals are progressively replacing synthetic treatments due to their fewer adverse effects and improved biocompatibility. Initial investigations revealed that hexane and methanol extracts of *Garcinia quaesita* bark exhibited notable bioactive properties. Garcinol was recognised as the active compound in the hexane extract. This study aimed to identify the phytochemicals responsible for unexpected and unreported bioactivity of the bark methanol extract. The air-dried and ground bark pieces were sequentially extracted with hexane, ethyl acetate, and methanol. The extracts were evaluated for their anti-obesity, antidiabetic, and antioxidant properties using pancreatic lipase, α-amylase, and 2,2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging assays, respectively. Ascorbic acid (IC_{50} 7.30±0.28 mg L^{-1}), acarbose (IC_{50} 11.021±0.232 mg L^{-1}) and orlistat (IC_{50} 9.869±0.686 mg L^{-1}) served as positive controls for DPPH, α-amylase, and pancreatic lipase assays, respectively. When compared to positive controls, the methanol extract showed strong antioxidant and antidiabetic activities with IC_{50} values of 9.43±0.14 mg L^{-1} for DPPH and 43.65±2.23 mg L^{-1} for α-amylase inhibition and exhibited low anti-obesity activity of 357.14±8.48 mg L^{-1}. The presence of tannins (black precipitate with $FeCl_3$ and light-yellow precipitate with $Pb(CH_3COO)_2$, steroids (dark blue colour with Liberman-Burchard test), and saponins (formation of stable emulsion with olive oil) was detected in the methanol extract. The presence of tannins in the methanol extract was supported by the high total phenolic content of 337.80±21.01 mg GAE g^{-1}. The alkaline ethanol precipitation method was used to extract tannins, yielding brown-coloured tannin salt that tested positive with $FeCl_3$ and $Pb(CH_3COO)_2$ tests. This tannin fraction exhibited significant antidiabetic and antioxidant properties, with IC_{50} values of 60.30±1.58 mg L^{-1} and 18.41±0.31 mg L^{-1} for each, respectively, but low anti-obesity activity (IC_{50} 186.51±11.60 mg L^{-1}). The non-tannin fraction showed low antidiabetic (IC_{50} 214.76±5.91 mg L^{-1}), anti-obesity (IC_{50} 117.92±0.70 mg L^{-1}) and antioxidant (IC_{50} 252.46±2.65 mg L^{-1}) properties. According to the quantification, tannins accounted for 94.29% of the total mass of methanol extract. These results conclude that the primary contributors to the observed bioactivities of *Garcinia quaesita* bark methanol extract are tannins. Further studies are required to isolate and characterise individual tannin compounds responsible for bioactivity.

Keywords: Antidiabetic, Antioxidant, Bioactivity, *Garcinia quaesita*, Tannins

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ANTAGONISM IN PASSIVE TRANSLOCATION OF CELL-PENETRATING PEPTIDES

M.S.F. Musna and R.J.K.U. Ranatunga*

Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.
*udayana.ranatunga@sci.pdn.ac.lk

Cell-penetrating peptides (CPPs) have emerged as promising tools for the delivery of macromolecular cargo, utilising either energy-dependent (endocytic) or energy-independent (direct) translocation mechanisms. Understanding the mechanism leading to internalisation is crucial for the design and optimisation of CPPs as efficient drug delivery agents as these mechanisms reveal the extent of their impact on the cell membrane and help evaluate their safety and efficiency as delivery vectors. The study analysed the free energy profiles associated with the passive translocation of different types of CPPs, including cationic, hydrophobic, and amphipathic peptides, with a particular focus on the peptides penetratin, K-FGF, transportan, and CADY. The free energy profiles for peptide translocation across a model cell membrane were generated employing the GROMACS software, Martini 3 coarse-grained force field, and umbrella sampling molecular dynamics simulations, varying the nominal surface concentration of the peptides. The Martini 3 coarse-grained force field was chosen for accurate peptide-lipid modeling with efficient and biologically relevant time scales. The cell membrane was composed of dioleoylphosphatidylcholine, and the temperature and pressure were maintained at 300 K and 1.0 atm. The results show that the peptides investigated show unfavorable free energy profiles for direct membrane translocation, and the presence of multiple peptides does not facilitate translocation. Instead, an increase in the free energy barrier suggests the absence of a synergistic effect when multiple peptides interact with the membrane. These results provide valuable insights into the complex biophysical behavior of CPPs, as it underscores the need to consider peptide density and potentially the membrane heterogeneity when evaluating direct entry mechanisms of CPPs and highlights the importance of further studies to fully elucidate complex mechanisms underlying the process. This work contributes to the broader understanding of CPP mechanisms and offers a foundation for future research aimed at improving peptide-based drug delivery systems.

Keywords: Antagonism, Cell-penetrating peptides, Free energy profiles, Molecular dynamics, Translocation

RESCON 2025 PS 45

BIOACTIVITY STUDIES OF ENDOPHYTIC FUNGI *Phyllosticta capitalensis* ISOLATED FROM *Syngonium angustatum* LEAVES

S.A.D. Chathurangi, N.P. Piyasena, N.K.B. Adikaram and L. Jayasinghe*

National Institute of Fundamental Studies, Kandy, Sri Lanka.
*Lalith.ja@nifs.ac.lk

Endophytes represent an intricate collection of microorganisms which inhibit asymptomatically internal tissues of higher plants. Endophytes directly produce bioactive secondary metabolites that increase the robustness of their host plant by defending them against pathogens. Moreover, endophytes can biosynthesise phytochemicals which were previously thought to be produced exclusively by their host plants. The objective of this study was to identify bioactive substances including antioxidants, enzyme inhibitors, phytotoxic and cytotoxic substances from the endophytic fungi, *Phyllosticta capitalensis.* It was isolated from leaves of the medicinal and phytoremediation plant, *Syngonium angustatum* based on the sequence of ITS region of rDNA and microscopic examination. Ethyl acetate extract of fungal strain was subjected to *in vitro* bioassays including DPPH radical scavenging activity, FRAP assay, α-glucosidase enzyme inhibitory assay, acetylcholinesterase enzyme inhibitory assay, brine shrimp (*Artemia salina*) lethality assay and lettuce (*Lactuca sativa*) seed germination inhibition assay. Ethyl acetate extract showed weak antioxidant activity in DPPH radical scavenging (IC_{50} 476.43±34.72 mg L^{-1}) when compared with the positive control ascorbic acid (IC_{50} 7.90±0.10 mg L^{-1}) and 3-tert-butyl-4-hydroxy-anisol (IC_{50} 10.03±0.31 mg L^{-1}). Similarly, the FRAP value of the crude extract (0.56±0.01 mmol Fe^{2+} g^{-1}) also indicated weak antioxidant activity contrast to the FRAP value of Trolox (1.26±0.01 mmol Fe^{2+} g^{-1}). Furthermore, the fungal extract showed lower percentage inhibition (27.68±2.12)% of acetylcholinesterase enzyme than the donepezil hydrochloride (99.29±0.04)% in 1000 mg L^{-1}. The inhibitory percentage of α-glucosidase enzyme (87.87±1.92)% in 1000 mg L^{-1} was equivalent to that of acarbose (88.97±0.22)% at the same concentration indicating the strong potential of crude extract to inhibit α-glucosidase enzyme. The LC_{50} value of the extract (624.85±46.77 mg L^{-1}) was significantly higher compared to that of the positive control $K_2Cr_2O_7$ (7.97±0.97 mg L^{-1}), indicating weak cytotoxicity. Phytotoxicity studies revealed that the MIC value for root and shoot inhibition of > 500 mg L^{-1} was greater than that of ascorbic acid (> 5 mg L^{-1}). These findings imply that ethyl acetate extract of the fungal strain has significantly high activity in α-glucosidase enzyme inhibitory assay, and further investigation is required to explore possible applications in pharmaceutical industries.

Keywords: Acetylcholinesterase, Bioactive substances, *Phyllosticta capitalensis, Syngonium angustatum*

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TWO NOVEL BREAD SPREAD FORMULATIONS PREPARED WITH *Terminalia catappa* L. KERNEL AND JUMBO PEANUT: PROXIMATE COMPOSITION AND FATTY ACID PROFILE

H.F. Fahmidha[1,2]*, J.J. Natasha[1,3], J.M.N. Marikkar[1] and K.M. Somawathie[3]

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka.*
[2]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[3]*Department of Food Science and Technology, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka.*
*fahmidha.ha@nifs.ac.lk

The increasing demand for plant-based food products has motivated exploration of underutilized crops for innovative formulations. This study evaluated the proximate compositions and fatty acid (FA) profiles of two novel plant-based bread spreads (BS) developed using seed kernels of tropical almond (*Terminalia catappa* L.) yellow cultivar and jumbo peanut (*Arachis hypogaea*) (JP). In this study, tropical almond kernels with seed coat and without seed coat were separately blended with JP in varying proportions (w/w, 100, 80, 60, 40) to prepare two series of blends. These two blends were then used to prepare two types of BS. The BS developed were applied on the surface of sliced bread to assess their sensory attributes by employing a 30-member panel of volunteers. The best BS formulations selected based on sensory assessment from each type of BS were subsequently analysed for proximate composition (according to AOAC methods) and FA profile. Based on the appearance, colour, aroma, flavour, texture, and overall acceptability, BS formulation of 60% yellow tropical almond with seed coat and 40% JP and BS formulation of 80% yellow tropical almond without seed coat and 20% JP were selected as the best. The best BS formulations were found to contain moisture (5.40 – 5.59)%, fat (47.5 – 58.57)%, and protein (26.44 – 27.34)% contents within the appreciable range, indicating the nutritional richness of the formulations. Out of the twelve FA detected in the samples, palmitic acid (30.96 – 33.53)% was the major saturated FA while oleic (34.40 – 36.02)% and linoleic (25.33 – 26.21)% acids were dominant unsaturated FAs. These results suggest that the formulated spreads are not only rich in energy and essential nutrients but also exhibit a favorable FA profile.

Keywords: Fatty acid profile, Jumbo peanut, Plant-based bread spread, Proximate analysis, Sensory evaluation

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EFFECT OF INCORPORATING VITAL WHEAT GLUTEN AS A NON-MEAT PROTEIN BINDER ON THE QUALITY CHARACTERISTICS OF EMULSIFIED CHICKEN SAUSAGES

J.H.S. Jayasekara[1]*, M.C.N. Jayasooriya[1] and S. Walimuni[2]

[1]*Department of Food Science and Technology, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka.*
[2]*Gills International (Pvt) Ltd, Katunayake, Sri Lanka.*
*hansijayasekara97@gmail.com

Protein binders in sausage mixtures act as functional ingredients which act as glue, binding structural elements together and forming a coherent sausage matrix. The vital wheat gluten (VWG), a by-product of wheat flour with ~80% protein, consists of gliadins, glutenins and residuals of cysteine. Upon heating, cysteine residues form the disulphide cross-linking between glutenin and gliadin and create a protein network, which traps components in the sausage mixture and influences the final quality of the sausage. This study evaluated the impact on physicochemical, textural, and sensory acceptance of emulsified chicken sausages formulated with added VWG. Treatments were formulated as follows: adding 1% VWG (VWG1), adding 2% VWG (VWG2), and adding 3% VWG (VWG3). Commercially available emulsified chicken sausages were used as a control, which did not contain VWG. A significant difference ($p < 0.05$) was observed in the pH values, with the control showing a higher pH than VWG1, VWG2, and VWG3, observed as 6.73±0.03, 6.56±0.07, 6.30±0.09, and 6.36±0.05, respectively. There was no significant difference ($p > 0.05$) in colour values among samples. Water holding capacity (WHC) was not significantly different ($p > 0.05$). Cooking loss varied among the treatments, control, VWG1, VWG2, and VWG3, observed as 2.11±0.77, 0.44±0.18, 2.50±1.23, and 2.68±0.31, respectively. Emulsion stability was not significantly different ($p > 0.05$). There was no significant difference ($p > 0.05$) observed in sensory acceptance among treatments. There were no significant differences ($p > 0.05$) observed in textural properties between samples except for hardness. Hardness of the sausages was significantly different when compared to the control, which had a lower value of 618.00±288.00. The cooking loss and hardness may have resulted from inconsistencies in cooking conditions. According to these results, VWG did not change pH, colour, or WHC; the emulsion stability and sensory acceptance of emulsified chicken sausages were not significantly different.

Financial assistance from Sabaragamuwa University of Sri Lanka and Gills International (Pvt) Ltd, Katunayake is acknowledged.

Keywords: Emulsified chicken sausages, Non-meat protein binder, Quality characteristics, Texture profile, Vital wheat gluten

RESCON 2025 PS 48

NOVEL METHOD FOR DIFFERENTIATION OF REFINED FRESH AND USED COCONUT OIL BASED ON MALAPRADE OXIDATION MECHANISM

D.D. Sakalasuriya*, **N. Jayathilaka and K.N. Seneviratne**

Department of Chemistry, University of Kelaniya, Kelaniya, Sri Lanka.
*dinithisakalasuriya@gmail.com

Coconut oil is widely used for cooking. The refining, bleaching, and deodorization (RBD) process transforms crude coconut oil into a colorless, odorless, and tasteless refined coconut oil favoured in culinary applications. However, the unethical practice of refining used coconut oil, which was previously exposed to high-temperature cooking, and marketing it as refined fresh oil raises concerns over consumer safety. Used oil undergoes oxidative degradation and polymerisation, generating carcinogenic lipid compounds. Long-term consumption of such adulterated oil poses significant health risks, including oxidative stress, hypertension, inflammation, and genetic mutations. Current quality control parameters fail to distinguish between refined fresh coconut oil and refined used coconut oil. This study presents a novel quality assurance method to differentiate these two types of oil based on their monoglyceride content. During repeated heating, oils accumulate monoglycerides due to triglyceride breakdown. The refining process does not eliminate glycerides. Therefore, monoglyceride content is a potential marker of used oil. Using sodium periodate as the oxidising agent, 1-monoglycerides were selectively oxidised by Malaprade oxidation to generate aldehydes, which were then quantified spectrophotometrically and evaluated qualitatively using a reference colour chart for 75 refined fresh and used oil samples. Refined used oil showed a significantly higher level of monoglycerides (1.58±1.05 at $p \leq 0.05$) than that of refined fresh oil (0.16±0.03). Logistic regression analysis demonstrated high diagnostic accuracy of 1.00, with a receiver operating characteristic area under the curve. The method yielded 100% sensitivity, specificity, positive predictive value and negative predictive value at an absorbance cut-off of 0.31. This novel, cost-effective technique enables regulatory authorities and manufacturers to assess the quality of coconut oil and authenticate the source of refined oil to ensure consumer safety.

Financial assistance from University of Kelaniya (Grant No. RP/03/02/06/01/2023) is acknowledged.

Keywords: 1-Monoglyceride, Malaprade oxidation, Refined coconut oil, Used oil

RESCON 2025 PS 49

AGAR-BASED BIOPOLYMER GEL ELECTROLYTES FOR POSSIBLE APPLICATIONS IN CdS QUANTUM DOT SENSITISED SOLAR CELLS

N.T. Widanage[1]*, T.M.W.J. Bandara[1], K.B. Wijayaratne[1] and G.R.A. Kumara[2]

[1]*Department of Physics, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*National Institute of Fundamental Studies, Kandy, Sri Lanka.*
*tharudya23@gmail.com

Quantum dot-sensitised solar cells (QDSCs) with liquid electrolytes suffer from poor long-term stability and leakage issues. This study focused on developing a sustainable, agar-based biopolymer gel electrolyte (GPE) optimised for CdS QDSCs. Agar is a biodegradable polymer derived from red algae, as an eco-friendly alternative to synthetic polymer electrolytes. To synthesise the photoanode, TiO_2 nanocrystalline films were deposited on transparent fluorine-doped tin oxide (FTO) conductive substrates using a combination of spray pyrolysis and spin coating methods, followed by CdS quantum dot deposition through the successive ionic layer adsorption and reaction (SILAR) approach. Agar-based GPEs with concentrations of 0.5 mol L^{-1} and 1.0 mol L^{-1} were synthesised, and QDSCs were fabricated in glass/FTO/TiO_2/CdS/electrolyte/Pt/glass configuration. The samples were characterised using electrochemical impedance spectroscopy to measure the ionic conductivity of the GPE, and the photovoltaic performance of the solar cells were tested under standard illumination conditions, using simulated sunlight at an intensity of 1000 W m^{-2}. The ionic conductivity of the gel electrolytes was evaluated over a temperature range from 24 °C to 70 °C. The study reveals that conductivity increased with temperature following the Vogel-Tammann-Fulcher behaviour. In comparison of the performance in 0.5 mol L^{-1} and 1.0 mol L^{-1} electrolytes, the 1.0 mol L^{-1} agar-based GPE recorded the highest room-temperature conductivity of 29.16 mS cm^{-1} at 24 °C Additionally, it exhibited the lowest activation energy of 0.018 eV, indicating enhanced ion mobility. However, the highest efficiency of 0.11%, a fill factor of 27%, an open-circuit voltage of 369 mV and short-circuit current of 1.12 mA cm^{-2} were exhibited for the solar cell fabricated using a 0.5 mol L^{-1} agar-based polysulfide gel polymer electrolyte with two TiO_2 layers in the photoanode. The study reveals that the number of TiO_2 layers has a significant impact on device performance, suggesting the need for future studies and highlighting the suitability of biopolymer gel electrolytes for developing sustainable QDSCs.

Keywords: Agar, Cadmium sulfide, Gel polymer electrolytes, Quantum dot, Quantum dot sensitised solar cells

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INVESTIGATION AND CHARACTERIZATION OF A SOLID POLYMER ELECTROLYTE BASED ON METHYL GRAFTED SRI LANKAN NATURAL RUBBER (MG49) AND LiBOB FOR LITHIUM-ION CONDUCTIVITY

H.M.P.N. Madubashini*, L.R.A.K. Bandara and T.M.W.J. Bandara

Department of Physics, University of Peradeniya, Peradeniya, Sri Lanka.
*nirashamadubashini09@gmail.com

The growing global demand for sustainable and efficient energy storage solutions has intensified interest in solid polymer electrolytes (SPEs) as safer and cost-effective alternatives to conventional liquid electrolytes used in lithium-ion batteries. This study focused on the preparation and characterisation of an SPE based on methyl-grafted natural rubber (MGNR) and lithium bis(oxalato)borate [LiBOB, $LiB(C_2O_4)_2$]. MGNR, derived through methyl methacrylate grafting onto natural rubber, was selected for its improved mechanical properties and compatibility. SPE samples were prepared using the solvent casting method, resulting in thin, mechanically stable, brownish-white films. The temperature dependence of conductivity followed Vogel-Tamman-Fulcher behaviour, indicating ion transport facilitated by polymer chain segmental motion. An optimum ionic conductivity of 9.29×10^{-5} S cm^{-1} was achieved for the composition containing 0.25 g MGNR and 0.25 g of salt at 27 °C. It was increased to 2.05×10^{-4} S cm^{-1} when the temperature was increased from 27 °C to 55 °C. This is a good value for natural rubber-based electrolyte and is suitable to be used in electrochemical storage devices. At low salt concentrations, the conductivities of the samples are low irrespective of the temperature. When increasing LiBOB concentration, from 40%/w to 50%/w, the conductivity increases, while it decreases when the concentration is further increased to 80%/w. The initial increase in conductivity with LiBOB concentration could be due to the increase in density of ions provided by the dissociation of salt, which eventually increases conductivity. A further increase in salt concentration may create a highly dense charge region, reducing ion mobility due to blocking effects. Additionally, the salt may reach its dissociation limit, beyond which further increase in concentration does not contribute to a higher ion density in the electrolyte. The findings of this study highlight several novel aspects, including the value addition to Sri Lankan natural raw materials, low production cost, and environmental friendliness. These features position this material system as a promising candidate for future energy storage applications.

Keywords: Electrochemical storage devices, Ionic conductivity, LiBOB, Natural rubber, Solid polymer electrolytes

RESCON 2025 PS 51

ENHANCING ELECTRON EXTRACTION IN DYE-SENSITISED SOLAR CELLS VIA REDUCED GRAPHENE OXIDE INTERFACIAL LAYER INTRODUCED TO SEMICONDUCTOR PHOTOELECTRODE

T.M.P.N. Thennakoon[1]*, R.T. Sooriyagoda[1], D.R. Jayasundara[1], V.P.S. Perera[2], G.C. Wickramasinghe[1] and S. Davisan[2]

[1]*Department of Physics, University of Colombo, Colombo, Sri Lanka.*
[2]*Department of Physics, The Open University of Sri Lanka, Nugegoda, Sri Lanka.*
*pamudithanaween2020@gmail.com

Dye-sensitised solar cells (DSCs) have emerged as a promising low-cost and efficient photovoltaic device for solar energy conversion. However, the high electron recombination that occurs in the semiconductor photoelectrode remains one of the major problems limiting the performance of DSCs. The objective of this study was to effectively extract electrons from the conduction band of the semiconductor to minimise recombination losses and enhance the current generation of the cell. This was achieved by introducing a reduced graphene oxide (RGO) interfacial layer between two titanium dioxide (TiO_2) layers as a sandwich-type structure (TiO_2/RGO/TiO_2) for the photoelectrode. The first TiO_2 layer was deposited by spin coating to get a uniform layer, followed by the graphene oxide (GO) layer using the same method. The final TiO_2 layer was applied via spray coating. The reduction of GO was carried out in an N_2 atmosphere. Subsequently, the concentration of RGO in the intermediate layer was optimised, identifying 5 mg mL^{-1} as the optimal value. The optimal cell exhibited a significant increase in short-circuit current density (J_{sc}) 14.01 mA cm^{-2}, compared to 9.73 mA cm^{-2} obtained from the conventional photoelectrode without the RGO layer. However, the open-circuit voltage (V_{oc}) decreases from 770 mV with the conventional photoelectrode (TiO_2) to 650 mV with the 5 mg mL^{-1} concentrated photoelectrode, attributing to a down shift in the TiO_2 quasi-Fermi level due to efficient electron extraction. The equivalent circuit of electrochemical impedance spectroscopy reveals an increase in charge transfer resistance at the TiO_2/electrolyte interface from 25.3 Ω to 118.7 Ω, indicating suppressed recombination. The electron lifetime obtained from the Bode-phase plot increases, confirming improved charge carrier dynamics. The series resistance (R_s) decreases from 35.5 Ω to 24.1 Ω (electrode surface area 0.49 cm^2), indicating improved electrical contact through the RGO layer. The development of the layer-by-layer structured photoelectrode has proved that the RGO conductive interfacial layer effectively balances electron extraction and recombination suppression, offering a promising strategy to overcome recombination losses and improve the performance of DSC.

Keywords: Dye-sensitised solar cells, Electrochemical impedance spectroscopy, Electron recombination, Reduced graphene oxide

RESCON 2025 PS 52

EFFECT OF SINTERING TEMPERATURE OF ACTIVATED CARBON/GRAPHITE/PLATINUM NANOPARTICLE COMPOSITE COUNTER ELECTRODES ON THE PERFORMANCE OF DYE-SENSITIZED SOLAR CELLS

P.U. Sandunika[1,2]*, **M.A.K.L. Dissanayake**[1], **G.K.R. Senadheera**[1,3] **and J.M.K.W. Kumari**[1]

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka.*
[2]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[3]*Department of Physics, The Open University of Sri Lanka, Nugegoda, Sri Lanka.*
*ushanisandunika78@gmail.com

The development of efficient and low-cost counter electrodes (CEs) is essential for improving the performance of dye-sensitised solar cells (DSCs) as well as their commercialisation. Platinum (Pt) sputtered electrodes are widely used as counter electrodes, despite their high-cost, limited abundance, and susceptibility to corrosion by the electrolyte. In order to address this problem associated with Pt, alternative counter electrode materials have been developed in the recent past. In this study, a novel composite counter electrode composed of platinum nanoparticles (Pt NPs), activated carbon (AC), and Sri Lankan vein graphite (GR) was developed. The composition of AC:GR:PtNPs composite counter electrode used was 0.50 g of AC, 0.50 g of GR, and 1.00 mL of 1.0 mM of the solution prepared by dispersing 8.19 µL of H_2PtCl_4 in 1.00 mL of ethanol. To study the effect of sintering temperature, CEs were subjected to sintering at temperatures ranging from 250 °C to 500 °C at 50 °C intervals, each for 30 min. The highest efficiency of 5.09% was achieved under the irradiance of 100 mW cm^{-2} (AM 1.5), with the composite CEs compared to the 6.54% efficiency of the DSCs made with Pt sputtered CE. Electrochemical impedance spectroscopic and cyclic voltammetric analyses of the CE at the optimum sintered temperature of 400 °C showed enhanced electro-catalytic activity, reduced charge transfer resistance, and improved electrochemical stability.

Keywords: Composite counter electrode, Dye-sensitised solar cells, Platinum nanoparticles, Sri Lankan vein graphite

RESCON 2025 PS 53

LABORATORY-LEVEL FEASIBILITY OF MILD OXIDATION METHOD SCALE-UP FOR BATTERY-GRADE SRI LANKAN VEIN GRAPHITE

H.M.H.D.K. Naranpanawa[1]*, T.H.N.G. Amaraweera[1,2], S.M.M.U. Sivirathna[1], N.W.B. Balasooriya[1,3], D.G.P.P. Karunaratne[4] and H.W.M.A.C. Wijayasinghe[1]

[1]National Centre for Advanced Battery Research, National Institute of Fundamental Studies, Kandy, Sri Lanka.
[2]Department of Applied Earth Sciences, Uva Wellassa University, Badulla, Sri Lanka.
[3]Department of Geology, University of Peradeniya, Peradeniya, Sri Lanka.
[4]Department of Chemical and Process Engineering, University of Peradeniya, Peradeniya, Sri Lanka.
*himashee.na@nifs.ac.lk

The demand for renewable energy storage is critical for achieving sustainable development, especially in countries such as Sri Lanka. One promising approach in this regard is to value addition to local mineral resources. Sri Lankan vein graphite, known for its high purity and crystallinity, is a promising candidate for lithium-ion battery (LIB) anodes. However, surface imperfections of vein graphite can lead to excessive formation of the solid electrolyte interphase, which limits the lithium-ion intercalation. Although chemically mild oxidation using HNO_3 acid (NO method) was previously developed and optimised to improve surface properties, its scalability, reproducibility and suitability for commercial-level processing remain unexplored. This study aimed to address this research gap by evaluating the feasibility of scaling up the NO method at the laboratory level, emphasising the process reproducibility and in-depth analysis of material characterisation. A graphite batch purified by HCl acid leaching, scaled-up to nine times the initial sample size, was subsequently treated under the optimised conditions (50.0 mL of 69% HNO_3). The modified graphite samples were then characterised using X-ray diffractometer (XRD), Fourier transform infrared (FTIR) spectroscopy, Raman spectroscopy, scanning electron microscopy (SEM) and simultaneous thermal analysis (TGA/DTA). The results showed that the scaled-up samples retained the structural characteristics and introduced functional groups consistent with the initial laboratory sample, as indicated by FTIR and Raman spectra. XRD and SEM results revealed that the graphite structure was preserved. TGA revealed distinct decomposition patterns corresponding to surface functional groups, and DTA provided insight into the enthalpy changes during oxidation. Furthermore, replicated carbon content measurements (n = 3) confirmed the high purity of the treated graphite (99.90±0.03)%, demonstrating batch-to-batch consistency and overall reliability of the NO method at the laboratory level. These findings confirmed that the NO method is structurally scalable and reproducible for modifying Sri Lankan vein graphite. Ongoing electrochemical studies will further evaluate its potential as an anode material in LIB. This work provides a strong foundation for future pilot-scale processing and commercialisation of Sri Lankan vein graphite for energy storage applications.

Keywords: Laboratory level, Mild oxidation, Scale up, Vein graphite

RESCON 2025 PS 54

OPTIMISING Na_2SO_4 ELECTROLYTE CONCENTRATION FOR SUPERCAPACITORS FABRICATED WITH ACTIVATED CARBON DERIVED FROM WASTEWATER FILTERS

D.J.D.S. Gamage[1,2], T.M.W.J. Bandara[2,3] and G.R.A. Kumara[1]*

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka.*
[2]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[3]*Department of Physics, University of Peradeniya, Peradeniya, Sri Lanka.*
*grakumara2000@yahoo.com

The current demand for energy storage technologies has provoked significant interest in supercapacitors, mainly due to their rapid charge-discharge capabilities, long cycle life, and high-power density compared to commercially available batteries and fuel cells. In electric double-layer capacitors, the electrode material and the electrolyte directly affect the performance of the device. Biomass-derived activated carbon materials have been extensively studied due to their low-cost, high surface area, and favourable electrochemical properties. However, the suitability of activated carbon obtained from wastewater filter residues remains underexplored. This study investigated the electrochemical performance of supercapacitors fabricated using activated filter carbon (AFC) derived from wastewater filters, with a focus on optimising the concentration of aqueous Na_2SO_4 electrolyte. The waste filters were cleaned and then thermally treated at 900 °C for 20 min in a low oxygen environment and activated via water quenching. The resulting carbon was then processed into electrodes and assembled into symmetric supercapacitor cells. Thereafter, electrochemical characterisation was conducted using cyclic voltammetry and galvanostatic charge-discharge techniques using various concentrations of Na_2SO_4 (1.5 – 3.5 mol L^{-1}) as the electrolyte. The results show that the optimum electrolyte concentration was 2.0 mol L^{-1} of Na_2SO_4, yielding the highest specific capacitance of 17.06 F g^{-1}, with an energy density of 12.45 W h kg^{-1} and a power density of 800.21 W kg^{-1}. A decrease in specific capacitance at higher concentrations is attributed to increased electrolyte viscosity, which reduces ion transport, as observed in previous studies. This work highlights the suitability of using waste-derived AFC for sustainable energy storage and shows the importance of electrolyte optimisation in supercapacitor design.

Keywords: Activated carbon, Electrolyte concentration optimisation, Supercapacitors, Wastewater filter recycling

RESCON 2025 PS 55

SUSTAINABLE SUPERCAPACITOR FABRICATION USING BIOWASTE-DERIVED ACTIVATED CARBON FROM *Mimosa pigra*

U.B.G.S. Ruwanthika*, T.M.W.J. Bandara, L.R.A.K. Bandara and K.B. Wijayaratne

Department of Physics, University of Peradeniya, Peradeniya, Sri Lanka.
*ruwanthika71s@gmail.com

The global energy crisis, driven by the rising demand and dependence on non-renewable sources, has intensified the search for sustainable energy storage technologies. Among these, electric double-layer capacitors (EDLCs) have gained considerable attention due to their high-power density, long cycle life, and rapid charge-discharge capabilities. In this study, activated carbon derived from *Mimosa pigra* (*Yodha Nidikumba*; YN), a highly invasive and carbon-rich biowaste, was investigated as a low-cost and eco-friendly electrode material for EDLC applications. The raw material was carbonised at 400 °C, chemically activated using 2.5 mol L^{-1} KOH, and further treated at 750 °C to produce porous *Mimosa pigra* derived activated carbon (YN-AC). The synthesised material was mixed with poly(vinylidene difluoride) binder to fabricate carbon ink, which was drop-casted onto current collectors. Symmetric EDLCs were then assembled using YN-AC electrodes and 6.0 mol L^{-1} KOH as the liquid electrolyte. Material characterisation revealed that YN-AC exhibited significantly enhanced adsorption properties and porosity compared to its non-activated form. The methylene blue adsorption capacity increased from 48.50 mg g^{-1} to 70.13 mg g^{-1}, and Raman spectroscopy showed a higher I_D/I_G ratio of 0.94 indicating increased structural disorder. Scanning electron microscopic analysis confirmed the development of well-distributed micropores and mesopores, improving ion accessibility. Cyclic voltammetric measurements demonstrated a maximum specific capacitance of 44.86 F g^{-1} at a scan rate of 2 mV s^{-1}. Galvanostatic charge-discharge (GCD) tests showed stable performance, achieving an energy density of 0.17 W h kg^{-1} and a power density of 8.53 W kg^{-1} at 1.0 mA cm^{-2}. Long-term cycling tests exhibited strong capacitance retention with 110% retention after 1000 cycles, confirming its durability and reliability. These findings highlight the potential of YN-AC as an electrode material for sustainable supercapacitors, with its excellent cycling stability and high capacitance retention demonstrating its viability and contributing to both energy storage and the management of an invasive species.

Keywords: Activated carbon, Electrode material, *Mimosa pigra*, Specific capacitance, Supercapacitors

RESCON 2025 PS 75

ENHANCED REMOVAL OF Cr(VI) FROM WASTEWATER USING CHEMICALLY MODIFIED *Eichhornia crassipes* BIOSORBENT

A.M.S.R. Abeysinghe[1] and N. Priyantha[2]*

[1]*Department of Environmental and Industrial Sciences, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.*
*namalpriyantha@sci.pdn.ac.lk

Water found in nature is heavily contaminated by pollutants discharged from industrial effluents. Among various pollutants, heavy metals and their compounds are considered the most hazardous substances causing water pollution. The use of plant-based materials has recently gained interest as a viable alternative to existing chemical methods for heavy metal removal. This study focuses on investigating the adsorption characteristics and effectiveness of *Eichhornia crassipes* (EC) as a biosorbent for Cr(VI) removal from contaminated water. This plant was selected due to its abundance as an invasive aquatic weed, low-cost, and the presence of functional groups in its roots and leaves, enhancing its potential for heavy metal adsorption. EC plants were collected, separated into roots and leaves, followed by air-drying and oven-drying to remove any remaining moisture. The dried material was ground and sieved to prepare particles of uniform size for adsorption experiments. Although raw leaf and root particles of EC result in less than 10% removal of Cr(VI), the biosorbents modified with 0.10 mol L^{-1} HCl demonstrate a significant improvement in their adsorption capacity, showing 76% and 84% removal by HCl-modified root and leaf of EC, respectively, under the optimum conditions of 1.50 g dosage and 500 – 710 μm particle size. Higher concentrations of HCl are not suitable for modification, as the adsorbent surface would be denatured. On the other hand, smaller particle sizes do not interact effectively with the solution due to their floating behaviour; hence, particles of less than 200 μm are not recommended. The protonation of active sites on the biosorbent through acid modification is responsible for binding with negatively charged Cr(VI) species, $Cr_2O_7^{2-}$, thereby enhancing the adsorption characteristics. Furthermore, the biosorbent is positively charged at the ambient pH, at which the experiments are performed, which is lower than the pH at the point of zero charge, providing further evidence of Coulombic attraction between the adsorbate and the adsorbent. These findings demonstrate that HCl-modified EC has potential for removing Cr(VI) from aqueous solutions, making it a sustainable option in wastewater treatment.

Keywords: Adsorption, Biosorption, Cr(VI), *Eichhornia crassipes*, Wastewater

RESCON 2025 PS 76

INFLUENCE OF COPPER(II) ION CONCENTRATION ON STRUCTURE AND MORPHOLOGY OF GREEN SYNTHESISED COPPER NANOPARTICLES USING *Coccinia grandis* LEAF EXTRACT

D.S. Pallegama and M.Y.U. Ganehenege*

Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.
*myug@sci.pdn.ac.lk

Nanomaterials are emerging and have gained significant attention in areas such as medicine, energy, materials and environmental industries. Among them, copper nanoparticles stand out, due to their biocompatibility, easy synthesis and low-cost of production. Various secondary metabolites in plant extracts can be used to reduce metal ions into nanoparticles in a single step, known as green synthesis. This study investigated a simple, eco-friendly and cost-effective method to synthesise copper nanoparticles using copper sulfate pentahydrate, as the precursor salt, and an aqueous leaf extract of *Coccinia grandis* that is rich in phytochemicals as a reducing, capping and stabilising agent. The synthesis of four different nanoparticle formulations was carried out by varying the concentration of the precursor solutions at 20 mM, 30 mM, 60 mM and 100 mM. The synthesised products were characterised using powder X-ray diffraction (PXRD), scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FTIR) and particle size analyser (PSA). PXRD data confirmed a highly pure crystalline, face-centred cubic structure of Cu nanoparticles with mean crystallite sizes of 10.59, 11.43, 13.72 and 17.43 nm for the four types synthesised (CuNP-1, CuNP-2, CuNP-3, CuNP-4) in four different concentrations, respectively. The FTIR spectra of the products confirmed the presence of functional groups of various biomolecules involved in capping and stabilising the CuNPs. Spherical nanoparticles of average sizes for CuNP-2 and CuNP-4 were found to be 16 nm and 72 nm, respectively, as identified from SEM imaging and by ImageJ analysis. The results of dynamic light scattering analysis by PSA showed that the average hydrodynamic diameters were 19, 71, 201 and 95 nm, respectively, for the four synthesised products. This study demonstrates that precursor concentration is a crucial factor for controlling nanoparticle properties. A detailed study to reveal their antimicrobial activity is currently underway.

Keywords: Characterisation, *Coccinia grandis*, Green synthesis, Nanotechnology, Phytochemicals

RESCON 2025 PS 77

CONSTRUCTION OF RADIATION DETECTING DEVICES TO IDENTIFY RADIOACTIVE MATERIALS

W.M.E.G.P.B. Elliyadda[1] **and R.M.G. Rajapakse**[2*]

[1]*CodeGen QBITS Laboratory, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.*
*rmgr@sci.pdn.ac.lk

Radioactivity, discovered during the golden era of science, marks the decay of unstable atoms or particles, into lighter particles and nuclei. It has significant scientific and industrial applications; improper handling of radioactive substances could pose serious health and environmental risks. Radioactive emissions are invisible to the naked eye and detection requires specialised instruments. However, many individuals unknowingly use radioactive materials, which shows the importance of raising awareness and accessible detection methods. This study examined three detection techniques: cloud chambers, ionisation chambers and Geiger Muller counters, meanwhile emphasising their affordability and accessibility within Sri Lanka. Conventional instruments are often expensive and unavailable; therefore, this research focused on developing qualitative and quantitative radiation detection methods using locally obtainable materials. The constructed devices were applied to detect radioactivity in gas mantles and tungsten electrodes. The particle tracks were successfully visualised in the cloud chamber, while the Geiger Muller counter provided audible pulses to detect radioactive particles. These detections were later turned into counts per minute as measurable outputs. Background radiation was recorded at 3 counts in 10 min, which was increased to 48 counts when exposed to gas mantle ash, confirming its high radioactivity. The findings demonstrate simple, low-cost devices which can effectively detect radiation, providing practical tools for education and research, and encourage to explore fundamental aspects of nuclear, particle physics and subatomic world.

Keywords: Adiabatic cooling, Cloud chamber, Geiger counter, Radioactivity, Thoriated tungsten.

Science Education

RESCON 2025 SE 01

INFLUENCE OF STUDENT-RELATED FACTORS ON THE EFFICIENCY OF MATHEMATICS TEACHERS

T. Luxan[1]* and R. Sarveswara[2]

[1]*Faculty of Graduate Studies, University of Jaffna, Jaffna, Sri Lanka.*
[2]*Department of Education, University of Jaffna, Jaffna, Sri Lanka.*
*lachchu5@gmail.com

This study examined how student related factors: moral values, motivation, and domestic settings influence the efficiency of mathematics teachers as reflected in student engagement, instructional strategies, and classroom management. The study was a cross-sectional quantitative study, which was carried out in 23 Type II schools, 11 Type 1C schools, and 10 Type 1AB schools under the Kilinochchi-South Zonal Education Office. A total of 80 secondary-level teachers, teaching Grades 6 to 11, participated in the study. Among them, 33 were male and 47 were female. Sixty-six teachers were selected through simple random sampling, based on the sample size table provided by Krejci and Morgan. Data were collected using structured questionnaires and analysed using SPSS version 25.0. The overall mean score for teacher efficiency was 4.07±0.52 while the mean score for student psychological factors was 3.74±0.50. The mean scores for student engagement, instructional strategies, and classroom management were 4.07±0.55, 4.10±0.59 and 4.03±0.60, respectively. Regarding student psychological factors, the mean scores for domestic settings, moral values, and motivation were 4.15±0.74, 3.50±0.66 and 3.57±0.58, respectively. Spearman's rho revealed a moderate, positive, and statistically significant correlation between overall student psychological factors and teacher efficiency (ρ = 0.343, p = 0.005), suggesting that students' psychological conditions contribute to how effectively teachers perceive and perform their roles. These findings emphasise the importance of understanding student psychology in enhancing teaching efficacy. The study recommends targeted teacher training programmes focused on student psychological development, improved communication with parents, and supportive policies to enhance classroom environments. Professional development and resource allocation should prioritise strategies that enable teachers to respond effectively to students' psychological needs, thereby improving instructional quality and the overall school performance in the Kilinochchi District.

Keywords: Kilinochchi-South Zonal Education Office, Secondary education, Spearman's rho, Student psychological factors, Teacher efficiency

RESCON 2025 SE 02

LEVEL OF INTEREST AND ENGAGEMENT IN ASTROPHYSICS AMONG UNDERGRADUATE STUDENTS IN SRI LANKA

N. Vithushan[1]*, C.M. Niranjan[2] and T.P. Ranawaka[1]

[1]*Department of Physics, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka.*
*nallanathanvithushan2000@gmail.com

Astrophysics is the branch of astronomy which uses physics and mathematics to study and understand how the objects in the Universe form, behave and evolve. In Sri Lanka, astrophysics remains in its early stages but is progressing steadily. However, due to limited facilities and resources, the interest and knowledge about astrophysics are questionable among the student community. This study investigated the interest and exposure to astrophysics among undergraduate students across Sri Lanka. A nationwide survey was conducted using structured questionnaires, and responses were collected from 309 undergraduate students, selected from 28 universities with a margin of error of ±5.5% at the 95% confidence level. According to the study, 12% respondents had studied an astrophysics-related course. The other 88% had no formal exposure. Nevertheless, participants expressed moderate to high attitude towards studying the subject, with an average interest level of 3.37±0.12 on a 5-point Likert scale. However, their knowledge level is significantly low in advanced topics compared to basic topics. This study also investigated the possibility for offering a certificate course for undergraduate students. About 52% students indicated that they would enroll if a course was offered free-of-charge, while 40% said they might consider enrolling even with payment. Only 8% expressed no interest. In terms of preferred delivery modes, the majority favored online learning, with 158 responses, followed by hybrid formats, and fully on-site programmes. These findings show strong latent interest in astrophysics among Sri Lankan undergraduates, with limited formal engagement. It highlights the need for improved academic and outreach programmes to support students' growing curiosity about astrophysics. Focused curricular expansions, and adaptive, flexible and informal learning platforms preeminently online and short-term certificate courses can unlock the interest and enable the growth of space-science education in the country.

Keywords: Astronomy outreach in Sri Lanka, Astrophysics education, Cosmology, Informal science education, Undergraduate interest

RESCON 2025 SE 03

EFFECT OF USING A NEW PRACTICAL COMPONENT ON STUDENTS' SELF-CONCEPT, MOTIVATION AND ACHIEVEMENT IN GRADE 13 CHEMICAL KINETICS: A CASE STUDY AT A SCHOOL IN KURUNEGALA

J.K.A. Jayatissa[1] and M.Y.U. Ganehenege[2]*

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.
[2]Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.
*myug@sci.pdn.ac.lk

Although students would like to achieve the best results in chemistry, many of them cannot reach their target due to poor understanding of the basic concepts of the subject and a lack of motivation. It has become an issue in chemistry education affecting the number of university admissions in science and mathematics streams. This study was carried out with the objective of studying the effectiveness of using practical components on students' self-concept, motivation and achievement in the unit on chemical kinetics taught in Grade 13. A sample of 60 Grade 13 students in a mixed school in Kurunegala was selected. Students were divided into two similar groups by using average marks of two pre-tests with 10 multiple-choice questions based on prior knowledge at ordinary level. Two lesson plans in chemical kinetics were taught separately with and without introducing a new practical component. As the new practical component, the practical component in Unit 12: Principles of chemical kinetics, Grade 12 Science for Technology syllabus was selected considering its relevance to understand the basic concepts taught in chemical kinetics in Grade 13. Questionnaires were used to collect quantitative data regarding students 'motivation, self-concept and focus group interview schedules were used to collect qualitative data. Students' motivation after teaching the principles of chemical kinetics (Unit 11) was evaluated using a questionnaire containing 18 questions. Self-concept was evaluated using a questionnaire with 15 questions. The academic performance was evaluated by a post-test that contained 10 multiple-choice questions. Quantitative data were analysed by Microsoft Excel, MINITAB 14, IBM SPSS 22.0 and qualitative data were analysed by thematic analysis. The generated themes in qualitative analysis were self-esteem and improvement of ideas towards academic achievement. The study revealed a significant difference (p = 0.01) in the post-test of two groups, and students' motivation, self- concept, and their achievements imply the higher effectiveness in the group of students who were taught chemical kinetics in Grade 13 with new practical component. The study reveals that teaching learning process becomes very effective if the teaching of the theoretical component of the unit is done soon after introducing a relevant practical component.

Keywords: Academic achievement, Motivation, Kinetics, Self-concept

RESCON 2025 SE 04

USE OF CONCEPT MAPS IN TEACHING ATOMIC CONCEPTS FOR GRADE 10 STUDENTS: A CASE STUDY IN A SELECTED SCHOOL IN COLOMBO, SRI LANKA

H.T.P.M.P. Chandrathissa[1], **A.M.P.S. Chathuranga**[2]* **and W.D. Chandrasena**[3]

[1]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.*
[3]*Science Education Unit, University of Peradeniya, Peradeniya, Sri Lanka.*
*sasitha@sci.pdn.ac.lk

Understanding and memorising science concepts are commonly recognised as challenging tasks among ordinary-level students. More studies would be beneficial to evaluate and recognise scientific approaches to promote science education. This study investigated the use of concept maps as a teaching strategy to enhance students' understanding of atomic concepts in Grade 10 classroom in a selected school in Colombo. Concept maps were used as the fundamental strategy in this study to help visualise relationships between key ideas, promote meaningful learning, and improve the teaching and learning process compared to the traditional teaching method for Grade 10 students. Mixed methods were used as the methodological approach in this study. The sample consisted of one hundred and forty students in Grade 10, aged 14 – 15 years, of both sexes in the selected school. Thirty-three boys and thirty-seven girls were included in the control group, and thirty-four boys and thirty-six girls were selected for the experimental group. Pre-tests were conducted among the sample. The unit "Atomic Structure" was taught to the experimental group using concept mapping, while the traditional lecture method was used for the control group. Qualitative data were collected using structured interviews, field notes, photographs, and videos. Pre-tests and post-tests were conducted to obtain quantitative data which were analysed using MS Excel and SPSS software. The results show that the experimental group demonstrated improved performance in teaching and learning process compared to the control group. In terms of standard deviation (SD), the control group had a value of 1.77, and the experimental group had a value of 1.82. There were no significant differences in the SD between the control group and experimental group for the pre-test. In the post-test, the experimental group outperformed the control group. Thus, it can be concluded that the concept map approach to teaching the "Atomic Structure" unit influenced the improvement of students' understanding of science concepts. Moreover, the effectiveness of concept maps in science education supports their suitability for enhancing current teaching and learning processes of chemistry concepts for the young generation.

Keywords: Atomic structure, Concept maps, Science education, Teaching and learning approaches

RESCON 2025 SE 05

IMPACT OF PRIVATE TUITION ON G.C.E. ADVANCED LEVEL PHYSICS LEARNING IN MATALE EDUCATIONAL ZONE, SRI LANKA

F.S.N. Mohamed[1] and P.R.K.A. Vitharana[1,2]*

[1]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Education, University of Peradeniya, Peradeniya, Sri Lanka.*
*pushpa.vitharana@yahoo.com

Private tuition has become increasingly common in Sri Lanka's secondary education system, even though free education is available. This study investigated the impact of private physics tuition on G.C.E. Advanced Level students in the Matale Educational Zone. A mixed-methods explanatory sequential design was used, beginning with questionnaires and followed by focus group interviews with students and structured interviews with teachers. A total of 332 Advanced Level physics students and 12 teachers from five selected schools were chosen using simple random sampling. The questionnaires included Likert scale, checkbox, and short-answer questions appropriately. Quantitative data were analysed descriptively using SPSS, while qualitative data were examined through thematic analysis. The quantitative findings showed that 99.4% of students attend private physics classes, with about 85.0% believing that these classes are more supportive than school lessons. Similarly, 91.7% of teachers agreed that students depend on private tuition for physics learning. Students appreciated private classes for their engaging teaching methods (51.8%), individual attention (32.5%), timely syllabus coverage (42.2%), and doubt clarification (29.5%). Additionally, 44.0% of students mentioned that regular assessments conducted in tuition classes helped track progress, while 52.1% felt that missing classes negatively affected their understanding. However, practical learning in tuition settings was limited, as only 16.6% of students experienced real experiments, while 71.7% reported relying mainly on theoretical explanations. Qualitative insights revealed that private tuition has become a central part of students' academic lives, with a noticeable shift toward private classes after the COVID-19 pandemic, which appears to have reduced engagement in school activities. Both students and teachers suggested that a balanced combination of private tuition and school-based instruction is essential for a comprehensive understanding of physics. This study highlights the strong influence of private tuition on learning behavior and raises concerns about its long-term impact on student engagement, equity, and the sustainability of the national education system.

Keywords: Academic performance, Advanced level, Physics, Private tuition, Student engagement

RESCON 2025 SE 06

INVOLVEMENT OF SRI LANKAN SECONDARY SCHOOL TEACHERS WITH ARTIFICIAL INTELLIGENCE: A CLUSTER-BASED APPROACH

R.M.B.I. Rathnayake*, T.M.S.S.K.Y. Ekanayake, V. Dishankan and M.R.V.S. Samarathunga

Department of Information Technology, University of Peradeniya, Peradeniya, Sri Lanka.
*binushirathnayake@gmail.com

This study examined the engagement of Sri Lankan secondary school teachers with Artificial Intelligence (AI) in education and aimed to assess how their educational and professional qualifications, along with demographic factors, relate to this engagement. Data were collected from 86 teachers (Grades 6 – 11) nationwide using a questionnaire. Out of 20 AI-related variables in the dataset, 13 were pre-grouped into three thematic groups based on: usage and experience, knowledge and awareness, and attitudes and perceptions. *K*-means cluster analysis ($k = 3$) was separately conducted for each group to identify distinct teacher profiles based on the above AI-related variables. Cluster assignments were analysed with seven additional variables, including educational and professional qualifications (highest educational qualification, highest professional qualification, entry qualification, and years of teaching experience) and demographic factors (gender, province, and district). Fisher's exact test was used to test the statistical association of these seven variables with every thematic group. The analysis showed no significant association among any of the three groups and the demographic variables used. No significant association was observed between the two groups: usage and experience, and knowledge and awareness, and any of the educational and professional qualification variables ($p > 0.05$). However, there was an association between the attitudes and perceptions group and the highest professional qualification variable ($p = 0.0136$), which indicated that professional development could be a key element in influencing teachers' perceptions of AI in teaching. The remaining three qualification variables have no significant association with the attitudes and perceptions group. These findings emphasise the importance of implementing targeted professional development programmes that highlight the pedagogical applications of AI. Additionally, since demographic factors showed no significant influence ($p > 0.05$), awareness and training initiatives should be designed to be inclusive and uniformly accessible across regions and genders. These findings offer valuable guidance for developing targeted training programs to enhance teachers' readiness for AI integration in Sri Lankan education.

Keywords: AI awareness, AI in education, K-Means clustering, Professional development, Teacher perceptions

RESCON 2025 SE 07

IMPROVING STUDENTS' GENERIC SKILLS THROUGH SKILL-ORIENTED TEACHING: AN EXPERIMENTAL STUDY IN CENTRAL PROVINCE, SRI LANKA

K. Balasritharan[1]* and T.M.S.S.K.Y. Ekanayake [2]

[1]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Education, University of Peradeniya, Peradeniya, Sri Lanka.*
*balasritharan@gmail.com

In today's education system, especially in Sri Lanka, teaching and assessment are mostly examination-focused, often leaving less space to develop essential life skills. This study aimed to compare traditional teaching methods with skills-oriented instruction to find out which approach better supports the development of generic skills in junior secondary science students. An experimental research design was used in nine government schools in the Central Province. The sample included 320 Grade 7 students and 20 science teachers. Two science lessons Domestic Chemicals and Earth Resources were selected from the syllabus. In each school, one class was taught using the traditional method, while another class was taught using a skill-oriented approach that encouraged communication, collaboration, creativity, and problem-solving. Later, the methods were switched between the classes for the second lesson. Students' performances were assessed using scoring rubrics, and data were analysed using SPSS software. Pre-tests confirmed that both groups were at similar levels before the intervention. Post-tests showed significant improvement in the group taught with the skill-oriented method. The *t*-test results showed a statistically significant difference in post-test scores between the two groups ($t = 4.87$, $p < 0.01$), favouring the skill-oriented group. Observations using rubrics also confirmed higher scores in generic skills for this group. Additionally, focus group discussions with 20 students and 20 teachers were held. Thematic analysis of these discussions showed strong support for the skill-based approach. Students reported better understanding and more engagement, while teachers observed improved classroom participation and real-world thinking. Overall, the study concludes that skill-oriented teaching methods are more effective in enhancing generic skills and should be integrated into science instruction in Sri Lankan junior secondary schools.

Keywords: Experimental research, Generic skills, Science education, Skill-oriented teaching, Sri Lanka

RESCON 2025 SE 08

THIRD SPACE ACTIVITIES OF ACADEMIC STAFF MEMBERS: A PRELIMINARY STUDY FROM A FACULTY OF SCIENCE AT A STATE UNIVERSITY IN SRI LANKA

A.M.R.S. Bandara[1] **and S. Perera**[2]*

[1]*Science Education Unit, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*College of Arts and Social Sciences, Australian National University, Canberra, Australia.*
*sean.perera@anu.edu.au

The traditional roles of staff in higher education institutions have become increasingly blurred over time. This has led to a new form of work referred to as the third space in higher education institutions. The primary role of academic staff has focused on teaching and research. However, multiple reasons, such as increasing regulations of higher education and performance evaluations, have resulted in a gradual expansion of the primary academic duties. While there is a fair understanding of the blurring boundaries between academic and professional staff in the international context, there is limited understanding of the identities of academic and professional staff in Sri Lankan higher education institutions. Hence, this study aimed to provide insights from a preliminary study conducted on the role of academic staff members in universities in Sri Lanka. Data on participation in selected activities in 2024 were collected from 23 academic staff members of a Faculty of Science, at a state university in Sri Lanka, through an online questionnaire and analysed. The majority of respondents were female (55%), and the participants included professors (20%), senior lecturers (60%), and probationary lecturers (20%). Respondents reported weekly engagement in lectures, tutorials, or laboratory sessions (100%), course coordination (73.9%), student administration (73.9%), and research project management (91.3%). At least once a month, 47.8% were involved in student counselling, 56.5% in research dissemination, 56.5% in student welfare and grievance resolution, 47.8% in faculty committee membership, 60.9% in university committee membership, and 43.5% in career guidance for students. Respondents reported rare participation in outreach activities (69.6%), science-industry interactions (56.5%), financial delegations for example serving as senior treasurer (34.8%), and academic and professional quality assurance (39.1%). The results indicate strong engagement with teaching, research, and academic administration; moderate involvement in student support and well-being; and limited participation in outreach activities and institutional development and governance among the respondents. It was concluded that the respondents are primarily engaged in their core academic responsibilities while extending their contributions to third space activities. An emerging recommendation from this study is to strengthen faculty support and recognition for third space roles of the academic staff.

Keywords: Academic, Boundaries, Higher education, Third space, Traditional

RESCON 2025 SE 09

IMPACT OF BREAKFAST ON SCHOOL CHILDREN: ACADEMIC, BEHAVIORAL AND HEALTH PERSPECTIVES

M.M.N.D. Mapa

Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.
nilumapa2021@gmail.com

Breakfast is often considered the most important meal of the day for school children, as it breaks the overnight fast and provides essential energy for learning and daily activities. However, skipping of breakfast has become a global concern with significant implications for children's health, behavior, and educational outcomes. This review evaluates the effects of breakfast consumption on students' academic performance, cognitive functions, behavior, and well-being. It also examines factors influencing breakfast habits and the role of school breakfast programmes in promoting academic success of students. The review synthesises findings from 35 peer-reviewed academic sources published between 2015 and 2025, retrieved from Google Scholar, PubMed, and ResearchGate. These include 20 original research articles and 15 reviews conducted in the USA, China, Ethiopia, Abu Dhabi, Saudi Arabia, and Sri Lanka. Participants ranged from 6 to 19 years old, with sample sizes from 22 to over 54,000. Methods included cognitive tests, surveys, interviews, academic record analysis, and, for this review, thematic analysis, content analysis, and descriptive summarisation. Over 76% of the reviewed studies reported a strong positive link between regular breakfast consumption and improved academic performance, especially in mathematics, science, languages, and creative arts. Cognitive functions such as memory, attention, and problem-solving were enhanced in 40% of the studies. Low-glycemic, nutrient-rich breakfasts improved attention and mental clarity in 22.9% of studies. Breakfast consumption positively influenced motivation (8.6%), emotional regulation (14.3%), classroom behaviour (17.1%), school attendance (22.9%), and physical health (17.1%). In contrast, skipping of breakfast was associated with poor concentration (20%), emotional instability and anxiety (17.1%), and increased risks of obesity and chronic diseases (11.4%). Sociodemographic factors such as gender (8.6%), parental education (5.7%), and socioeconomic status (5.7%) influenced breakfast habits. School-based nutrition programmes were highlighted in 25.7% of studies as effective in promoting academic engagement and reducing inequality worldwide. These findings support the need for inclusive, evidence-based breakfast policies in the world.

Keywords: Academic performance, Attitude, Breakfast, Health, School children

RESCON 2025 SE 10

A STUDY ON CONCEPTUAL UNDERSTANDING OF NEWTON'S LAWS OF MOTION IN ADVANCED LEVEL PHYSICS: A CASE STUDY IN THE MATALE EDUCATIONAL ZONE SRI LANKA

F.S.N. Mohamed[1] and P.R.K.A. Vitharana[1,2]*

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.
[2]Department of Education, University of Peradeniya, Peradeniya, Sri Lanka.
*pushpa.vitharana@yahoo.com

This study investigated the conceptual understanding of Newton's Laws of Motion among General Certificate of Education (G.C.E) Advanced Level Physics students in the Matale Zone of Education, Sri Lanka. A mixed-methods explanatory sequential design was employed, incorporating diagnostic tests, focus group interviews with students, and structured interviews with teachers. A total of 334 students and five physics teachers from five selected schools were chosen using simple random sampling. Quantitative data were analysed descriptively using statistical package for social sciences (SPSS), and qualitative data were analysed thematically. According to the findings, 24.9% believed a continuous force is needed to maintain motion, 76.2% were confused about action-reaction pairs of Newton's Third Law, on the other hand 56.5% misunderstood inertia, and 48.0% struggled with reference frames. Qualitative data supported these findings and revealed six key themes: limited use of student-centered teaching methods, infrequent practical demonstrations, challenges in applying Newton's Second Law, poor recognition of action-reaction pairs, vague understanding of inertia, and weak diagram interpretation skills. Teacher interviews confirmed that instruction remains largely teacher-centered, with limited focus on building conceptual understanding. Results revealed that while many students could recall basic concepts, a large number held persistent misconceptions. The study concludes that although students possess surface-level knowledge of Newton's Laws, deeper comprehension is lacking. It is recommended that more interactive, inquiry-based teaching methods, real-world applications, and hands-on experiments be incorporated. Furthermore, continuous professional development for teachers is essential to improve instructional strategies and foster meaningful student engagement. Enhancing these areas would strengthen students' understanding on Newtonian mechanics and lead to improved outcomes in Physics education.

Keywords: G.C.E. Advanced Level, Instructional strategies, Misconceptions, Newtonian mechanics

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MARTIAN TO BE: A MULTI-PLATFORM SCIENCE COMMUNICATION INITIATIVE FOR SPACE EDUCATION AND INTERDISCIPLINARY RESEARCH AWARENESS

W.C.S. Senarath[1]* and R.M.I.M. Nandasena[2]

[1]*Institute of Biochemistry, Molecular Biology & Biotechnology, University of Colombo, Colombo, Sri Lanka.*
[2]*Department of Chemistry, The Open University of Sri Lanka, Nugegoda, Sri Lanka.*
*chathukisenarath@gmail.com

The exponential growth of space science research has created significant communication barriers between scientific communities and the general public, particularly in underrepresented regions, such as South Asia, where access to specialised space education remains limited. This study presents "Martian To Be," a comprehensive digital science communication initiative which was initiated on 20th June 2023 with the launch of a dedicated Facebook page, later expanded into a WordPress-based website (martiantobe.com) and integrated across seven additional platforms, including YouTube, LinkedIn, Instagram, TikTok, Pinterest, and X. Developed by a graduate student with an academic background in bioinformatics and an active research focus on space medicine, the project addresses the critical need for authentic, research informed communication in digital spaces. The methodology combined evidence-based communication strategies with systematic data collection and SPSS supported analysis of multi-platform engagement between June 2023 and April 2025. Facebook insights provided metrics across three phases (Launch, Growth, and Maturation) covering follower growth (–1.2% to 50.4%), interactions (0 – 163), views (0 – 828), and link clicks (6 – 23), while YouTube Analytics captured performance of 43 videos across topics such as space medicine, astrobiology, radiation shielding, Mars colonization, robotics, and UFO fact checking. Quantitative analysis included descriptive statistics, ANOVA, correlation testing, and cross tabulations, while audience demographics were examined by age and geographic distribution with emphasis on South Asia (Sri Lanka, Pakistan, and India). Results showed high engagement variability but consistent thematic interest, with YouTube videos achieving 89 – 99% retention for science topics, Facebook link-based content outperforming other formats, and South Asian audiences showing significant but developing engagement. Strong positive correlations were found between follower growth and link clicks (r = 0.989, p < 0.001), while non-follower engagement averaged 51.5%, indicating successful external reach. The initiative effectively counters misinformation and demonstrates how active researchers can leverage digital platforms for scalable, evidence driven science education.

Keywords: Astrobiology, Digital education, Science communication, Space medicine, Technology-enhanced learning

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Not Presented at RESCON 2025

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VERBAL, VISUAL AND DIGITAL CLASSROOM COMMUNICATION FOR EFFECTIVE SCIENCE LEARNING: INSIGHTS FROM INTERNATIONAL STUDIES

H.V.A.K.K. Dissanayaka

Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.
Shadowzash88@gmail.com

Classroom communication plays a vital role in shaping effective learning environments, particularly in science education. Conceptual understanding in science refers to a student's ability to grasp scientific ideas thoroughly, express them using their own language, use them to solve unfamiliar challenges, and relate this understanding to everyday situations. The objective of this review is to understand how effective classroom communication supports students in making sense of science concepts, especially in improving their learning experiences at the secondary school level. A total of 45 peer-reviewed articles published after 2015 were selected from academic databases such as Google Scholar and ResearchGate. This review considered studies conducted in both developing countries (India, Malaysia, Indonesia, Uganda, Iraq, Iran, and Sri Lanka) and developed countries (USA, UK, Australia, Sweden, Germany, China, Netherlands, Finland and Cyprus). The articles were analysed using a narrative synthesis approach, involving the summarisation of research methods and key findings, and the identification of patterns across different contexts to understand how communication influences effective science learning. Among the research articles reviewed, 58% focused on effective communication in learning, 18% examined verbal communication, and 4% addressed non-verbal communication. Additionally, 9% of the studies focused on digital communication, while 7% explored the integration of visual aids into instructional communication. The analysis revealed that both verbal and non-verbal communication significantly influence student achievement. Furthermore, integrating visual aids with verbal and non-verbal communication, as well as incorporating digital communication into science education, was found to be effective for enhancing science learning. The reviewed literature emphasised how incorporating multiple modes such as visuals, text, audio, and video can enhance students' conceptual understanding of science.

Keywords: Conceptual understanding, Digital communication, Instructional communication, Non-verbal communication, Verbal communication

RESCON 2025 SE 78

HEALTH MISTAKES OF SCHOOL STUDENT'S LEADING TO NON-COMMUNICABLE DISEASES (NCDs)

S.P.A.S.S. Gunasinghe

Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.
sisaragunasinghe@gmail.com

Non-communicable diseases (NCDs) are a significant health burden hindering the achievement of sustainable development goals. NCDs are a result of modifiable risk factors, and unmodifiable risk factors like age, sex, and genetics. This review considers modifiable risk factors that can be changed with the person's behaviours, especially focusing on school students (age 5 – 17y). NCD has significant threat to school-aged children and many NCD roots are in childhood. Hence, the objectives of this review were to identify health mistakes done by school-age children and the contribution of such mistakes to NCDs later in their lives, to distinguish main behavioural risk factors that may affect school children and identify high risk NCD among school students. Google Scholar, PubMed, and Research Gate online resources were searched with keywords. Fifteen articles reviewed quantitatively and qualitatively for content analysis. Eleven out of 15 articles revealed that unhealthy diets are the most prevalent behaviour and health mistakes among school students. Unhealthy diet (11/15). Physical inactivity (7/11), smoking (2/15), and mental stress (3/15) were identified as four main risk factors. Diabetes showed a stronger association with school children’s dietary mistakes. Cardiovascular diseases, cancers, and respiratory diseases also identified as diseases likely to affect most school children. A key finding is that risk factors have unique underlying causes, such as high sugar intake, which are often health mistakes made by school children. The causes may differ across various socioeconomic groups worldwide. For instance, while junk food consumption is a global issue, certain mistakes like reusing cooking oil and experiencing mental stress may be country-specific. Therefore, this study recommends that identifying the health mistakes of school students in country-wise is crucial to prevent NCD and to take early intervention, since school students represent the health of the country.

Keywords: Behaviour, Health mistakes, Non-communicable diseases, School children

AUTHOR INDEX

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