# Postgraduate Institute of Science
University of Peradeniya

# PROCEEDINGS

PGIS RESCON
RESEARCH CONGRESS 2024

Volume 11

# POSTGRADUATE INSTITUTE OF SCIENCE

# UNIVERSITY OF PERADENIYA

# SRI LANKA

*"Breaking Boundaries: Collaborative Science for Global Challenge"*

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# Message from the Director, Postgraduate Institute of Science

The Postgraduate Institute of Science (PGIS) at the University of Peradeniya is dedicated to advancing science, technology, and societal development through its postgraduate programmes and impactful research initiatives. With a wide range of scientific disciplines represented across eleven Boards of Study, the Institute focuses on fostering innovative thinking and supports new postgraduates in launching their research careers at PGIS. Since its establishment, the Institute's research and development efforts have consistently grown, reinforcing its status as a leading national institution committed to advancing science.

The PGIS stands as a premier institution in Sri Lanka, dedicated to advancing scientific knowledge and research excellence. Since its inception, PGIS has offered diverse postgraduate programmes that foster critical thinking, innovation, and research skills across multiple scientific disciplines. Through its commitment to high-impact research and quality education, PGIS plays a vital role in shaping the next generation of scientists and contributing to the scientific and technological progress essential for societal development.

The RESCON of the PGIS encourages participation from both local and international researchers, fostering a vibrant academic community. In addition to presentations, RESCON often includes keynote speeches from prominent figures in the scientific community, workshops, and panel discussions, providing attendees with valuable insights and networking opportunities.

We warmly welcome you to RESCON 2024, our annual two-day research conference. We invite all participants to actively engage in the intellectual exchange by sharing their latest research, joining stimulating discussions, and networking with peers and experts across various scientific fields. I extend my sincere gratitude to the Organizing Committee of RESCON 2024, the editorial board of the conference proceedings, all the authors who entrusted their work to this conference, and the referees for their invaluable contributions to the success of this prestigious event. May this Congress inspire scientific progress and foster collaborative efforts toward a positive global impact.

I wish all participants a productive and insightful experience at the Research Congress.

**Prof. H.M.T.G.A. Pitawala**
*Director, Postgraduate Institute of Science (PGIS)*
*University of Peradeniya*
*Sri Lanka*

# Message from the Congress Chairperson

It is with great pleasure and honour that I welcome you to RESCON 2024, the Annual Research Congress of the Postgraduate Institute of Science (PGIS), University of Peradeniya, Sri Lanka. Now in its 11th consecutive year, this conference continues to be a vital platform for scholars and researchers across diverse scientific disciplines to exchange knowledge, drive innovation, and foster collaboration. Science has always been at the forefront of shaping our future, and this year, we aim to push the boundaries of discovery even further.

The theme of this year's conference, *Breaking Boundaries: Collaborative Science for Global Challenges*, highlights contemporary scientific issues while exploring transformative solutions that can impact society for the better. In response to the evolving landscape of education and research, we have introduced a new track on Artificial Intelligence in Biomedical Sciences, reflecting the growing importance of AI in addressing complex biomedical challenges. We are particularly honoured to have RESCON 2024 endorsed by Nobel Laureate Sir Paul M. Nurse, a globally renowned biomedical scientist.

Over the two dynamic days, November 1st and 2nd, 2024, nearly 250 abstracts will be presented across six key themes: Life Sciences, Physical Sciences, Earth and Environmental Sciences, ICT/Mathematics and Statistics, Science Education, and AI in Biomedical Sciences. These presentations represent the work of researchers from major state and private universities, research institutes, and industries, demonstrating the significance of this platform for both local and international scholars. On behalf of the organizing committee, I extend my deepest gratitude to the authors for entrusting us with their scientific breakthroughs and for contributing to the continuous success of this conference.

In the lead-up to the main event, we conducted three insightful pre-conference workshops: *Computer Programming with AI: Applications in Biological Sciences*, *Mastering the Art of Scientific Review: Techniques and Best Practices*, and *Encouraging International Collaborative Research*. These workshops provided participants with valuable tools to maximize their impact at RESCON 2024.

We are privileged to have Ms. V.S. Saranya, Assistant High Commissioner of India to Sri Lanka, as our Chief Guest and Professor Jennifer Perera from the University of Colombo as our Keynote Speaker. I also wish to extend my heartfelt thanks to our plenary speakers, Prof. Nalini Ravishanker, Prof. Sakunthala Yatigammana, and Prof. Anjana Silva, whose expertise will tremendously enrich our intellectual discussions and subsequent science education of the public.

An event of this magnitude is the result of collective effort. I would like to express my sincere appreciation to Prof. H.M.T.G.A. Pitawala, Director of PGIS, for his unwavering support and guidance. Special thanks go to Dr. Sampath Alahakoon for his exemplary secretarial work and Prof. Priyanka De Silva for her impeccable editorial contributions. I am also deeply grateful to the conveners, subcommittee members, reviewers, session chairs, and the Young Researcher Forum for their invaluable contributions. A special mention must also go to Mr. Saumya Bandara for his outstanding work in assisting the editorial process and the CMT system.

On behalf of the organizing committee, I wish you all a productive and inspiring conference. I encourage every participant to actively engage in discussions, network with their peers, and seize this opportunity to contribute to the advancement of science. Thank you for being part of RESCON 2024 and I look forward to the exciting discoveries and ideas that will emerge from our time together.

**Prof. Priyanga Wijesinghe**
*Chairperson PGIS RESCON 2024*

# Message from the Editor-in-Chief PGIS RESCON 2024

It is my great honour to present the proceedings of the Postgraduate Institute of Science Research Congress (RESCON) 2024. This year's congress celebrates the outstanding contributions of authors from diverse fields, including Life Sciences, Physical Sciences, ICT, Mathematics & Statistics, and Science Education, as well as the special theme introduced this year: Artificial Intelligence in Biomedical Science. We sincerely thank all researchers from various geographic regions and scientific backgrounds for choosing RESCON 2024 as the platform to share their innovative work. This year, we received a total of 289 abstracts, of which 243 were meticulously selected through a rigorous editorial and review process. I extend my deepest gratitude to the reviewers from various institutions and universities, including our own, for their insightful feedback and constructive comments, which were essential in shaping these proceedings.

The past seven months have been an exciting and engaging journey, collaborating with a dedicated team who has given their all despite busy schedules. Their strong commitment has been instrumental in making RESCON 2024 a success. I would like to express my heartfelt gratitude to the entire Editorial Board, including all theme coordinators and members, for their crucial roles in the editorial process. Their efforts are deeply appreciated.

Special appreciation goes to the Assistant Editor, Mr. Saumya Bandara, for his exceptional support and commitment throughout the process. I also want to highlight the remarkable dedication of our young editorial assistants: Mr Kumudu Wijesooriya, Ms. Nirosha Dissanayake, Ms. Pavithra Basnayake, Dr. Nuwandi Pathirana, Mr. Rajitha Weerakoon, Ms. Lakmini Weligamage. For the first time, we aimed to index all abstracts submitted to RESCON, enhancing visibility and recognition for each contribution. This achievement was made possible with the invaluable support of the University of Peradeniya Library system, for which we are truly grateful. Notably, Mr. Kumudu Wijesooriya's leadership in indexing every abstract marks a significant milestone in RESCON history.

I would also like to acknowledge the strong leadership and support of the Chairperson, Prof. Priyanga Wijesinghe; Secretary, Dr. Sampath Alahakoon; and Director of the PGIS, Prof. H.G.M. Pitawala. Each member of the PGIS staff deserves our deepest appreciation for their assistance and support throughout.

This congress has provided an exceptional opportunity for both postgraduate and undergraduate students at the University of Peradeniya. By engaging with esteemed scientists and researchers, both locally and globally, students have gained valuable insights and inspiration that will undoubtedly enrich their academic pursuits.

To echo the wisdom of Marcel Proust, "The real voyage of discovery consists not in seeking new landscapes, but in having new eyes." As we explore these proceedings, may we embrace new perspectives and continue to push the boundaries of scientific inquiry.

Thank you to everyone who made RESCON 2024 a remarkable success. We look forward to many more years of providing this exceptional platform for great researchers to meet, share groundbreaking research, and initiate collaborations.

**Prof. Priyanka de Silva**
*Editor-in-Chief, PGIS RESCON 2024*

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**Professor Jennifer Perera**
**Keynote Speaker**

Jennifer Perera MBBS, MD (Col) PgDipMedEdu (Dundee), PgDipWomensStudies (Col), MBA (Wales), FNASSL, FSLCM is an Emeritus Professor in Medical Microbiology and former Dean of the Faculty of Medicine, University of Colombo, Sri Lanka. She has held the post of President of Sri Lanka Medical Association and Sri Lanka College of Microbiologists. Her research focuses on tropical infectious diseases, including tuberculosis and antibiotic resistance. She has supervised many research students while winning research awards and Presidential awards. She has other research interests, including womens health and their career development. Medical education is another area of interest and has conducted research on improving educational achievement of students. She is the current Chairperson of the Biotechnology Working Committee and The Research Committee of the National Science Foundation, Sri Lanka

**Keynote Speech Summary**

**"The Microbiome: unveiling and harnessing the power within"**
The microbiome, which inhabits various environments within and outside living organisms, is a fascinating topic that cuts across all scientific disciplines, from biology and ecology to medicine and environmental science. Its vast influence on health, ecosystems, and even global processes underscores its importance, offering insights that drive innovation in agriculture, climate research, and human health. The study of the microbiome has transformed our understanding of ecosystems and biological processes.

Microbes play crucial roles in maintaining the health of ecosystems, influencing soil fertility, plant growth, and nutrient cycling. In humans and animals, the microbiome contributes to immune function, digestion, and overall health, acting as a dynamic interface between the host and the environment. Modern research in microbiomics leverages genomics and bioinformatics to explore the diversity, functionality, and interactions of microbial communities, uncovering their potential for disease prevention, ecological balance, and biotechnological innovation. Integrating microbiome science with natural sciences enables a holistic approach to environmental conservation, agriculture, medicine, and climate change mitigation and needs to be explored vigorously.

**Professor N. K. Anjana Silva**
**Plenary Speaker**

Professor Anjana Silva is an internationally recognised toxinologist and a medical educator. He is the chair professor and head of the Department of Parasitology of the Faculty of Medicine, Rajarata University and an Adjunct Senior Research Fellow at Monash University, Australia. Prof. Silva obtained an MBBS and M.Phil from the University of Peradeniya and a PhD in toxinology from Monash University, Australia. He is a Fellow of the Royal College of Physicians Edinburgh and a Fellow of the National Academy of Sciences of Sri Lanka.

Prof. Silva initiated his research career as a young biodiversity explorer, leading to the discovery of eleven new species of fish and reptiles new to science. After obtaining his medical degree, his research interests developed on snake envenoming, venoms, and antivenoms. He combines experimental, clinical, and epidemiological research to answer real-life clinical problems of snakebite victims.

He is widely published and cited (h-index 24; 1690 citations) and has delivered four prestigious orations and over ten keynote addresses in local and international forums. He has received over 30 international and local research awards, including research awards from European, North American and Asia Pacific Associations of Clinical Toxicology, the TWAS/NSF Young Scientist Award in 2013 and the CVCD Excellence Award in 2020.

**Speech Summary**
**"Decoding the problem of snakebite: A complex public health problem due to a complex interaction between humans, venomous snakes, climate and the environment"**
Snakebite is a serious public health issue in the tropics that mostly affects impoverished, rural farming communities in South Asia, Southeast Asia, Sub-Saharan Africa and Latin America, with an estimated 2.5 million annual envenoings. Despite its impact, due to the poor political and economic voice of the affected communities, snakebite has long been neglected by researchers, policymakers, and the pharmaceutical industry, resulting in our understanding of all aspects of snake envenoming being very narrow.

Snake venom is a functional trait evolved in venomous snakes, to serve an ecological purpose. Snake venoms are complex cocktails of diverse toxins with various pharmacological properties that coevolved with the physiology of the prey animals of snakes. Actions of snake venom toxins result in a range of life-threatening acute envenoming effects such as bleeding, paralysis, kidney injury and muscle cell damage as well as tissue death at the bite site. In addition, there are a range of long-term effects, such as disability due to amputations, chronic kidney disease, and psychological effects that deprive the quality of life of snakebite survivors. Some who survive snakebites end up with long-term disabilities that significantly lower the quality of the rest of their lives.

There is a remarkable diversity of toxin composition within and between snake species and a considerable prey-specificity of some venom toxin groups. Humans are not included among the natural prey animals of snakes; hence, there are differences between the pathophysiological processes in prey animals and humans after snake envenoming. However, several animal models, including rodents such as mice and rats, which are natural prey species of snakes, are still used in snake venom and antivenom research related to human envenoming. The complex interaction between human behaviour, snake behaviour, snake venom, climate, and the environment makes snakebite a complex problem. Understanding these complex interactions is key to reducing morbidity and mortality due to snake envenoming.

**Professor Nalini Ravishanker**
**Plenary Speaker**

Nalini Ravishanker is a Professor in the Department of Statistics at the University of Connecticut (UConn). She has been a faculty member at UConn since 1989. She has a PhD in Statistics and Operations Research from the Stern School of Business, New York University, and a B.Sc. in Statistics from Presidency College, Madras. She currently serves on UConn's Steering Committee for the MS in Data Science Programme.

Nalini has over three decades of academic experience and is passionate about research, teaching and mentoring students in statistics and data science. Her research productivity includes over 140 publications, two books, and one edited volume-on various topics in methodological and applied statistics and interdisciplinary domains. She has taught statistical theory, methods, computing, and applications at various levels. She has received many honours such as Fellow of ASA, AAAS, CASE, and elected member of ISI. She has held many editorial positions over the years (currently EIC of Applied Stochastic Models in Business and Industry). She is committed to enhancing the role of statistics and data science in scientific investigations in different domains such as civil and transportation engineering, climate, ecology, environment, finance, marine science, marketing, etc.

**Speech Summary**
**"Ensemble Hindcasting of Coastal Wave Heights for Coastal Protection"**
The development of strategies to reduce the impact of coastal erosion and flooding must be informed by quantitative estimates of the wave heights that a site is likely to experience. Where long records of observations are available, the methods of extreme value analysis are often used by marine scientists to estimate, for instance, the wave height that has a 1% probability of exceedance in a year, and these values are used in the design of coastal structures. Unfortunately, even the longest data records seldom exceed twenty years, so the 1% wave exceedance height estimates are generally based on an extrapolation of a statistical model chosen to fit the observed frequency of much more likely events. These results are, therefore, sensitive to the model selected. Observations of wind velocity and direction have been recorded at many more locations for longer time periods. Recently, physics-based mathematical models of the mechanisms of wave growth, propagation, and decay have been used to synthesize long-time series of wave statistics at locations where design parameters are required.

We leverage the predictive power of wave height history and correlations with wind speed and direction to build statistical models for time series of wave heights to develop a method to fill data gaps and extend the record length of coastal wave observations. We build a threshold regression model where the threshold parameter, based on lagged wind speed, explains the nonlinear associations and the lagged predictors in the model are based on a well-established empirical wind-wave relationship. The predictive model is completed by addressing the residual conditional heteroscedasticity using a nonlinear time series model (generalized autoregressive conditionally heteroscedastic (GARCH)) model. This comprehensive model is trained on time series data from 2005 to 2013, using wave height and wind data, both observed from a buoy in the Long Island Sound. Subsequently, replacing wind data with observations from a nearby coastal station provides a similar level of predictive accuracy. This approach can be used to hindcast wave heights for past decades given only wind information at a coastal station. These hindcasts are used as a representative of the unobserved past to carry out extreme value analysis by fitting the Generalised Pareto (GP) distribution in peaks over threshold (POT) framework. By analysing longer periods of data, we can obtain reliable return value estimates to help design better coastal protection structures. This is ongoing work with Prof. James O'Donnell (UConn Marine Sciences) and current and past UConn graduate students.

**Professor Sakunthala Yatigammana**
**Plenary Speaker**

Prof. T.M. Sakunthala Yatigammana Ekanayake is a Professor in the Department of Education, Faculty of Arts at the University of Peradeniya, Sri Lanka. She holds a B.Sc. in BioScience and an MSc in Science Education from the University of Peradeniya, along with a Postgraduate Diploma in Information Technology. Prof. Ekanayake earned her Ph.D. from the Graduate School of Education at the University of Bristol, UK, in 2011, and later received a prestigious Commonwealth Fellowship at the same university in 2016.

As Head of the Department of Information Technology, Faculty of Arts, she has led numerous initiatives integrating technology into education. Her research interests include mobile learning, e-learning, generative AI in education, and science pedagogy. Prof. Ekanayake is the Vice President of the Indian Ocean Comparative Education Society and serves on the Global Comparative Education Journal of WCCES editorial board.

Prof. Ekanayake has published over 40 academic papers, authored and co-authored multiple books, and was recently honoured with the Tier 4* Research Award at the Peradeniya University International Research Sessions and Exposition (iPURSE-2024). With her extensive experience as a professor, department head, and educator, she is dedicated to advancing teaching and learning through the integration of cutting-edge technologies.

**Speech Summary**
**"Harnessing Digital Innovations to Tackle Pedagogical Challenges in Science Education"**
The speech emphasizes the crucial role of teachers in ensuring that science education is impactful. Teachers are not merely providers of knowledge but facilitators of critical thinking, scientific process skills, and positive attitudes toward science. By effectively integrating digital tools into their teaching-learning strategies, teachers can make science learning more accessible and engaging for students. Additionally, the speech underscores the importance of adopting a research-oriented perspective toward science education, enabling teachers to continuously refine their practices, stay aligned with evolving scientific standards, and enhance their professionalism.

The potential of digital innovations such as Virtual Reality (VR), Augmented Reality (AR), simulations, and virtual labs is discussed. These technologies can significantly reduce learning barriers by making abstract concepts tangible and providing interactive and immersive experiences for students. Moreover, the responsible and ethical application of AI tools can facilitate personalized learning, enhance collaboration, and cultivate essential 21st-century skills such as creativity, problem-solving, and digital literacy. Digital innovations also offer teachers opportunities to enhance their research competencies. With the use of data analytics, collaborative online platforms, and AI-driven tools, teachers can implement evidence-based teaching approaches, assess their effectiveness, and contribute actively to advancing knowledge in science education.

In conclusion, the speech emphasizes that by harnessing innovative digital tools, educators can minimize pedagogical barriers and create enriched, meaningful learning experiences. This approach not only improves scientific understanding but also fosters 21st-century skills among students while equipping teachers to be reflective, competent, and responsible professionals in their field.

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***Abstract No: 7*** ***Earth & Environmental Sciences***

# ORIGIN AND GEOCHEMICAL EVOLUTION OF GROUNDWATER IN KUNDASALE-BALAGOLLA AREA, SRI LANKA

**Bhagya Ratnayake[1*] and Rohana Chandrajith[2]**

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Increasing water demand resulted in greater attention to use artificial recharge to improve groundwater supplies. This study focused on the Kundasale-Balagolla Water Supply Scheme in Kandy District, where fluctuating river water levels have affected production and continuous water supply. An alternative groundwater supply of 2,000-3,000 $m^3$ per day is proposed to address this issue. This research aimed to assess groundwater quality and develop a model groundwater recharge system to improve the water supply. In addition to river water, samples were collected from shallow and deep wells. The composition of major ions, trace elements, and stable isotopes ($\delta^2H$ and $\delta^{18}O$) in the water samples were analysed using standard methods. The results of the Piper-trilinear diagram indicated that the groundwater in the region primarily consists of Ca-$HCO_3$ and mixed types. The Gibbs diagram showed that groundwater quality is predominantly influenced by rock weathering, which alters the geochemistry of the groundwater. Additionally, the groundwater appears to be affected by evaporation. According to $\delta 2H$ and $\delta 18O$ plots, all water samples were plotted near the local meteoric water line, suggesting direct recharge from precipitation. Positive deuterium excess values against the oxygen-18 isotope ratio plot indicated enrichment in heavy isotopes due to evaporation or re-evaporation. The saturation index values demonstrated that the groundwater was oversaturated with the mineral phases aragonite, calcite, and dolomite. In conclusion, the ion concentrations in most samples exceeded the maximum permissible drinking water quality standards set by both the WHO and Sri Lankan guidelines. Therefore, it is recommended that water from these wells be treated before use. However, mixing calculations using $\delta^{18}O$ and chloride as tracers did not reveal any relationship between river water and groundwater. Future studies should consider lithology and morphology when selecting suitable sites for artificial recharge.

**Keywords:** Artificial recharge, Groundwater quality, Hydrogeochemical relationships, Mixing of groundwater, Water isotopes

***Abstract No: 9*** ***Earth & Environmental Sciences***

# GEOCHEMICAL CHARACTERIZATION AND GEOTHERMOMETRY OF THE KAPURELLA GEOTHERMAL SPRING, SRI LANKA

**A.M.A.M. Abeysinghe[1,2], M.P. Thilakarathna[1,3], S.P.K. Malaviarachchi[4] and N.D. Subasinghe[1*]**

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The Kapurella geothermal spring, situated in a metamorphic terrain in Ampara District, Sri Lanka, has been the subject of a comprehensive geochemical analysis to understand its geochemical properties. The study analysed the chemical composition (major cations and anions) of the hot spring water and employed various geothermometry techniques to estimate reservoir temperatures. Cation analysis revealed that sodium (Na) is the most abundant element, with 338.68 mg/L, attributed to the dissolution of sodium-rich minerals like feldspars in the granitic/granitic gneiss rocks of the region. Calcium (Ca) and potassium (K), with concentrations of 19.81 mg/L and 7.02 mg/L, respectively, derived from calcium-bearing minerals like calcite, biotite, and K-feldspar were also significant. Other trace elements such as strontium (Sr), magnesium (Mg), lithium (Li), iron (Fe), and manganese (Mn) were observed in lower concentrations, reflecting their limited solubility and low abundance in the rocks in the area. Water samples of Kapurella spring were compared with other geothermal springs of different geological terrains (igneous, sedimentary and metamorphic) in different countries across the world using a Na, K and Ca try plot. Results indicated that regardless of the geological terrain, the major cationic ratios remain similar. While chloride ($Cl^-$) 407.5 mg/L, sulfate ($SO_4^{2-}$) 169.2 mg/L, and fluoride ($F^-$) 9.2 mg/L were observed as major anions in Kapuralla spring water, and the total dissolved solids (TDS) concentration was measured as 377.74 mg/L. Geothermometry calculations provided reservoir temperature estimates as, 75.44 to 131.69 °C (with Na-K geothermometer), as 99.42 °C (with Li-Mg geothermometer), and as 168.92 °C (with Li-Na geothermometer). The Na/1000, K/100, and √Mg tri-plot analyses classified the water as "partially equilibrated", relevant to high-temperature water and indicating the mixing of cold water. Overall, this study enhances the understanding of the geochemical properties of the Kapurella geothermal spring, contributing valuable insights into its geothermal potential and regional geological context.

**Keywords:** Geochemical analysis, Geothermal explorations, Geothermometry, Kapurella geothermal spring

***Abstract No: 17*** ***Earth & Environmental Sciences***

# LITHOSTRATIGRAPHY AND SEDIMENTOLOGY ACROSS THE CRETACEOUS-PALEOGENE (K-PG) BOUNDARY IN THE OFFSHORE MANNAR BASIN: UNRAVELING PALEOENVIRONMENTAL DYNAMICS IN THE EQUATORIAL MARGIN OF THE NORTHERN INDIAN OCEAN

**S.S. Nawarathna[1], P.L. Dharmapriya[1,2*] A.U. Wijenayake[1,2] and E.K.C.W. Kularathna[3]**

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The Mannar Offshore Basin, Sri Lanka, features a rich geological history marked by Precambrian metamorphic rocks overlain by extensive sedimentary sequences. This study examined the lithological characteristics of sedimentary sequences in the Mannar Basin from the Late Cretaceous to Early Paleocene, according to unpublished stratigraphic charts from Petroleum Development Authority Sri Lanka (PDASL) determined by micropaleontological, nano-paleontological, and palynological studies. Samples were available at 10-meter intervals from PDASL, derived from drill cuttings collected during basin exploration, providing insights into sedimentary dynamics across the K-Pg transition. Analysed 25 drill-cutting samples from the CLPL Dorado exploration well, spanning 2800 m to 3050 m. Petrographic and X-ray diffraction analyses revealed a diverse range of lithofacies, including quartz, carbonates (calcite, dolomite, aragonite), and clay minerals (montmorillonite, kaolinite, illite, chlorite). Throughout this period, the basin witnessed the deposition of five distinct lithofacies, encompassing calcareous clayey mixed shale, calcareous shale, clayey shale, siliceous rock, and clay siliceous mixed shale, each reflecting unique depositional environments and diagenetic processes. Of particular note is the occurrence of siliceous rock layers intercalated with feldspathic wacke sandstone during the late Maastrichtian to Early Paleocene transition, indicative of global late Maastrichtian Sea level regression and subsequent arid to semi-arid climatic conditions. The presence of reddish-brown shale samples from the Early to Late Maastrichtian sedimentary succession, characterised by abundant hematite, kaolinite, and chlorite clay minerals, alongside decreasing Total Organic Carbon (TOC) values, suggests an oxidising environment prevailing during this period. Moreover, the identification of montmorillonite and illite-rich black shale samples, along with the appearance of pyrite during the middle Maastrichtian period, underscores anoxic/reducing environmental conditions, persisting up to the Late Campanian period within the shale lithofacies.

*Financial assistance from the PGIS Research grant (Grant No. PGIS/2020/03) is acknowledged*

**Keywords:** Diagenesis, K-Pg boundary, Lithofacies, Mannar Basin, Paleoenvironment

***Abstract No: 26*** ***Earth & Environmental Sciences***

# PREDICTIVE MAINTENANCE OF QUARTZ PROCESSING EQUIPMENT USING MACHINE LEARNING

**H.G. Nipunika[1*], S.M. Dassanayaka[2] and N.P. Dushyantha[1]**

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Sri Lanka's quartz industry plays a vital role in the country's mineral processing industry, accounting for US$ 8.38 million in export earnings in 2023. However, the inefficiencies and machine downtime of the heavy-duty machinery challenge the overall performance of the industry. To address these issues, this feasibility study aimed to apply Machine learning (ML) to implement predictive maintenance in quartz processing machinery, particularly for crushers, mills, and classifiers. The study was structured into two principal phases: digital model development and model implementation. A synthetic dataset was created to simulate sensor readings, including temperature, vibration levels, and running hours, enabling the training of a Random Forest Classifier. Initial results revealed that running hours and temperature were the most significant predictors of machine failure. Since the damping mechanisms in heavy-duty machines absorb vibration, it has a lesser impact. The confusion matrix revealed that the model is more effective in predicting where no maintenance is needed. Further cross-validation with real-world data will be essential to strengthen the model's strength, assessing potential cost savings from downtime reduction and maintenance optimization. By deploying this ML-based model in the real world, the potential operational efficiency in Sri Lanka's quartz industry will be enhanced. This approach could integrate automation into the mineral processing industry, aligning with global trends to improve productivity and reduce maintenance costs of heavy-duty machinery.

**Keywords:** Automation, Digital transformation, Efficiency enhancement, Mineral processing, Operational optimization

***Abstract No: 38*** ***Earth & Environmental Sciences***

# QUALITY ASSESSMENT OF MUNICIPAL SOLID WASTE COMPOST AND COMMERCIALLY AVAILABLE COMPOST IN SRI LANKA

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Employing composting for Municipal Solid Waste (MSW) helps divert organic waste from landfills, providing a cost-effective means of producing agricultural materials. This research aimed to assess the quality of compost in MSW and commercially available compost. MSW compost from Horana, Mathugama, Mirigama, Seethawaka, Kaduwela, and Karadiyana were obtained, and five commercially available compost products (C1-C5) were purchased. Quality assessment was carried out according to the Sri Lanka Standard Institution (SLSI) guidelines. As physical characteristics, MSW and commercially available compost reported a pH range between 4.24 ± 0.25 and 7.68 ± 0.25, electrical conductivity (EC) range between 1.85 ± 0.15 and 7.55 ± 0.15 S/m, sand content of 22.30 ± 0.06% to 33.51 ± 0.10%, moisture content of 15.84 ± 0.55% to 55.52 ± 0.27%, respectively and particle size range of 0.33-24.73%. Both MSW and commercially available compost showed a nitrogen content range of 0.21-2.35%, organic carbon content of 12.53%-50.62%, C:N ratio of 11.29-179.77 and total phosphate content of 0.06%-1.84%. Nutrient content varied as Ca > K > Mg in all compost samples. None of the samples (Cd: 0.01-0.09 mg/kg, Pb: 0.24-0.84 mg/kg, and Cr:0.42-4.17 mg/kg) exceeded the SLSI standard values for Cd, Pb and Cr. Except for Horana, Seethawaka, and C2 samples, others were contaminated with faecal Coliform colonies (3.6-43 CFU/100 mL). *Salmonella* sp. was detected only from the Seethawaka sample. Results revealed that, municipal compost is more compliant with SLSI standards than the commercially available compost. Hence, Municipal solid waste compost is better for agricultural purposes. Because of the strict waste management and quality control that went into making it, this high-quality compost has several advantages for plant development, soil health, and environmental sustainability.

*Financial assistance from the Centre for Water Quality and Algae Research at the University of Sri Jayewardenepura is acknowledged*

**Keywords:** Characterization, Commercial compost, Municipal solid waste compost, SLSI Standards

***Abstract No: 40*** ***Earth & Environmental Sciences***

# IMPACT OF CLEAR-CUTTING ON RUNOFF PATTERNS: A CASE STUDY IN A PINE PLANTATION IN TROPICAL LOWLANDS, SRI LANKA

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Forest plantations play a crucial role in regulating hydrological processes, including the control of surface runoff, which occurs when rainfall exceeds the soil's infiltration rate. The felling of forest plantations, through clear-cutting, can significantly impact hydrological processes by increasing surface runoff, leading to reduced ground water recharge, soil erosion, water pollution and floods. However, limited research has been conducted on the specific effects of clear-cutting on surface runoff in pine plantations. This study investigated the impact of clear-cutting on surface runoff patterns in a *Pinus caribaea* plantation in the tropical lowlands of Sri Lanka. Three 10 m × 3 m surface runoff plots were established on hill slopes within the pine plantation to represent overall site characteristics. The pre-clear-cutting period was considered the control, while the post-clear-cutting period was the treatment. Slope, canopy cover, ground vegetation cover, and litter thickness within each plot were measured. Rainfall and surface runoff were recorded for individual storm events from July to November 2023, covering the southwest monsoon and second inter-monsoon periods. After data screening, data from 28 storm events were used for the analysis. The average surface runoff was 0.43 mm and 1.04 mm before and after clear-cutting, respectively. The results indicated a significant difference ($p < 0.05$) in surface runoff between pre- and post-clear-cutting periods. Positive correlations were observed between rainfall and surface runoff in both periods. Average surface runoff was negatively correlated with the canopy cover and positively correlated with the slope and litter thickness. Clear-cutting increased surface runoff by 141.9%. The findings suggest that surface runoff increased during the post-clear-cutting period due to the loss of canopy interception and soil compaction, highlighting the need for forest management practices to control surface runoff in pine plantations in the tropical lowlands of Sri Lanka.

**Keywords:** Clear-cutting, Forest plantation management, *Pinus caribaea*, Surface runoff

***Abstract No: 51*** ***Earth & Environmental Sciences***

# HERBICIDAL PROPERTIES OF *Lantana camara* AND *Mikania micrantha* INDIVIDUALLY AND IN COMBINATION AGAINST *Brassica juncea*

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Synthetic herbicides are widely used for weed control, but their intensive use poses ecological and environmental hazards. The invasive alien plants (IAPs) *Lantana camara* and *Mikania micrantha* cause considerable damage to agricultural ecosystems. Allelochemicals of these plants can suppress the growth of nearby plants, prompting investigation into their herbicidal potential for eco-friendly, plant-based herbicides. This study aimed to determine the inhibitory effects of *L. camara* and *M. micrantha* aqueous leaf extracts, individually and in combination, on seed germination and early seedling growth of *Brassica juncea* using a Petri plate assay. Mature leaves of the two IAPs were collected, washed, dried at room temperature until a constant weight, and powdered. Aqueous leaf extracts (20%) were prepared from dried leaf powder, followed by a dilution series of 5%, 2.5%, 1.25%, 0.625% and 0.3%. Seed germination and seedling growth of *B. juncea* were tested against various concentrations of *L. camara* and *M. micrantha* extracts, both individually and in combination, by placing 25 seeds in each Petri plate on moistened tissue paper with 5 mL of the respective extract, a positive control (glufosinate ammonium and 2-methyl-4-chlorophenoxyacetic acid), or negative control (distilled water), with four replicates per treatment. Results showed that each leaf extract caused significant ($p \leq 0.05$) inhibitory effects on seed germination and growth parameters (lengths and dry weight of shoots and roots) of *B. juncea* seedlings. Inhibitory effects increased with rising concentrations of the extracts. The combined aqueous leaf extracts exerted an additive inhibitory effect on seed germination, shoot length, root length, dry shoot weight and dry root weight in 84.4%, 93.7%, 98.4%, 65.6% and 93.7% of combinations, respectively. The results indicate that *L. camara* and *M. micrantha* aqueous leaf extracts have the potential for development as plant-based herbicides.

*Financial assistance from Sri Lanka Council for Agricultural Research Policy (Grant No. NARP/16/UP/PGIS/01) is acknowledged*

**Keywords:** Inhibitory effects, Invasive alien plants, Seed germination, Seedling growth

***Abstract No: 52*** ***Earth and Environmental Sciences***

# QUANTIFICATION OF ASCORBIC ACID CONTENT IN *Ziziphus oenoplia* (L.) MILL. ("ERAMINIYA") SEEDS GROWN IN THE WET ZONE OF SRI LANKA

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*Ziziphus oenoplia* (L.) Mill., commonly known as"Eraminiya" in Sinhala, is a traditional medicinal plant found in the Wet Zone of Sri Lanka. This study quantified the ascorbic acid content in its seeds as part of broader research on the antioxidant properties of its fruit and seeds, highlighting their potential health benefits, such as enhancing immune function and reducing oxidative stress. A representative sample of 1 kg was collected, consisting of 150 g each of yellow-green and black fruits (four months post-flowering) from different districts in the Wet Zone. Seeds were separated from the fruits and the Indophenol dye method was used for quantification. Statistical analysis revealed a significant difference ($p < 0.05$) between ascorbic acid content in *Z. oenoplia* seeds (56.7 mg 100 $g^{-1}$) and the fruit (195 mg 100 $g^{-1}$). This value is lower than common fruits such as lemons (199.81 mg 100 $g^{-1}$) and oranges (141.34 mg 100 $g^{-1}$), possibly due to differences in antioxidant requirement between seeds and fruits, variations in biochemical compositions, and the specific plant part analysed. However, *Z. oenoplia* seeds have relatively higher ascorbic acid content than other seeds like pomegranate (12.5 mg 100 $g^{-1}$), orange (20 mg 100 $g^{-1}$), and watermelon (8.5 mg 100 $g^{-1}$) due to the plant's unique phytochemical composition and its adaptability to the Wet Zone climate in Sri Lanka. While the seeds are not typically consumed, their antioxidant properties suggest potential for use in dietary supplements. Further research could explore their application in the pharmaceutical industry.

**Keywords:** Antioxidants, Ascorbic acid, Indophenol method, Wet Zone, *Ziziphus oenoplia*

***Abstract No: 57*** ***Earth & Environmental Sciences***

# TEMPORAL AND SPATIAL CHANGES IN VEGETATION COVER OF MAHAWELI-H SYSTEM: MAHAWELI DEVELOPMENT PROJECT (1988 TO 2022)

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The Mahaweli development project is Sri Lanka's largest and most significant multi-purpose development initiative, covering an extensive area of $57{,}225 \times 10^4$ m² within the Mahaweli H zone. This project has profoundly impacted vegetation cover in the Mahaweli H System, prompting a study of the temporal and spatial changes since its initiation in 1988. This research aimed to assess these changes across the entire Mahaweli H System from 1988 to 2022 and included a trend analysis of vegetation health and conservation efforts within five forest reserves and one wildlife boundary. Data from 1988 to 2022 were analysed, with projections extending to 2042. The period was divided into five-year intervals, and satellite images from the Landsat 5 TM and the Landsat 8 OLI/TIRS were processed using ArcGIS software. Indices were classified using the natural breaks (Jenks) method, facilitating land size determination. A linear regression model was applied to analyse trends in five forest reserves (Licolawewa Upper, Lunuoya, Yoda Ela, Licolawewa Lower, and Bongamuwa) and one wildlife boundary from 1988 to 2042. The overall vegetation area exhibited fluctuations, notably decreasing to $9{,}980 \times 10^4$ m² from 1993-1997, followed by a recovery peaking at $20{,}230 \times 10^4$ m² from 2018-2022. The linear regression analysis of NDVI trends in ArcGIS revealed a positive trend in the Licolawewa Upper and Lunuoya Forest Reserves, as well as in the Wildlife boundary, indicating improved vegetation health and effective conservation efforts. Conversely, the Yoda Ela, Licolawewa Lower, and Bongamuwa forest reserves exhibited negative trends, indicating a decline in vegetation health. The study underscores the importance of continuous monitoring and sustainable land management practices to ensure the long-term health and conservation of vegetation in the Mahaweli H System.

**Keywords:** ArcGIS, Conservation, Landsat, Regression model, Remote sensing, Vegetation

***Abstract No: 69*** ***Earth & Environmental Sciences***

# BIOREMEDIATION OF *Klebsiella pneumoniae* USING BIOCHAR MEDIATED NANO ZERO-VALENT IRON

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Biochar (BC) is a carbon-rich material from biomass pyrolysis. While biochar-supported nano zero-valent iron (nZVI) is increasingly used for bacterial remediation, studies comparing lignin biochar (Lig-BC) and rice husk biochar (RH-BC) nZVI against *Klebsiella pneumoniae* (KP) are limited, hindering the identification of the optimal combination. This study showed how the remediation potential of biochar can be enhanced using nZVI, and its applicability for treating hospital and farm wastewater. Two approaches were used to explore RH and Lig. As synchronous; iron salt was loaded into raw RH feedstock, pyrolyzed at 300 °C (1 hr), and then carbothermally reduced (CR) at 900 °C (1 hr, 50 °C/min), producing biomass of nZVI (BM-nZVI). Depositing nZVI on Lig-BC that had been pre-pyrolyzed (1000 °C for 1 hr, 50 °C/min) produced surface-deposited nZVI (Lig-s-nZVI). As asynchronous, iron salt was loaded onto RH-BC, which had already been pyrolyzed, with subsequent carbothermal reduction producing BC-nZVI. Combining iron salt with dissolved feedstock of Lig to embedded nZVI in a carbonaceous carrier produced engraved nZVI (Lig-eG-nZVI). Through SEM analysis, the produced nZVI particles were characterised. Initially, remediation effects for the materials were assessed using the well diffusion method. The growth inhibition potential of RH-BC and Lig-BC against KP was compared. Pristine BC served as the control material. RH-BC significantly inhibited KP compared to Lig-BC. BC-nZVI showed significant inhibition zones compared to BM-nZVI, whereas pristine gave negligible results. The MIC of nZVI biochar was determined utilizing well diffusion method and it was found to be $1.875 \times 10^{-2}$ g/mL for both BC-nZVI and BM-nZVI materials. Finally, BC-nZVI and BM-nZVI were applied to hospital and farm wastewater to test their ability to inhibit bacterial growth. Genomic DNA was extracted from both samples, followed by polymerase chain reaction and gel electrophoresis to detect KP. This study revealed a mutual relationship between BC-mediated nZVI and bacterial inhibition, highlighting "treating waste with waste" as a cost-effective, eco-friendly approach for wastewater treatment.

*Financial assistance from the College of Chemical Sciences, Institute of Chemistry Ceylon, Sri Lanka (Grant No. 195417) is acknowledged*

**Keywords:** *Klebsiella pneumoniae*, Nano zero valent iron, Rice husk biochar, Wastewater remediation

***Abstract No: 77*** ***Earth & Environmental Sciences***

# CAUSE AND EFFECT ANALYSIS OF IMPACTS OF LAND COVER CHANGES ON BELIHULOYA MINI-CATCHMENT AREA

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The rapid expansion of human activities has significantly transformed landscapes, leading to major impacts on water resources and ecosystem health. This study comprehensively assessed the transformations within the Belihuloya mini catchment, focusing on the effects of land use and land cover changes. The primary objectives included identifying changes, analyzing trends, and evaluating human perceptions of the impacts on the mini catchment. The study utilised remotely sensed data from 1959, 1988, 2000, and 2020 to assess land use and cover changes over time. A questionnaire survey was conducted among 60 randomly selected households across six Grama Niladhari Divisions within the catchment area. Correlation-based pair-wise analysis, paired t-test analysis, vulnerability value calculation, and interpolation mapping were employed to interpret the data. A cause-and-effect analysis was conducted using the Drivers-Pressures-State-Impacts-Responses (DPSIR) framework. The results revealed significant changes in land cover and use over the study period. Forest cover decreased dramatically, from 80% in 1959 to 33% in 1988, primarily due to the expansion of paddy fields and home gardens. Nine major driving forces were identified, highlighting the pressures on the natural environment and wildlife from land and forest clearance for construction. High-altitude areas surrounding the young Belihuloya river faces significant risk due to rapid land use changes, threatening the river's energy flow. The southern region, including Sabaragamuwa University and the Samanalawewa reservoir, is equally vulnerable, potentially compromising the mini-catchment's health. The findings underscore the urgent need for conservation efforts and informed land management practices to mitigate adverse impacts on the mini-catchment ecosystem and ensure sustainable development for future generations.

**Keywords:** Drivers-Pressures-State-Impacts-Responses, Land cover, Mini catchment, Vulnerability

***Abstract No: 78*** ***Earth & Environmental Sciences***

# GREEN SYNTHESIS OF IRON OXIDE NANOPARTICLES USING NATURAL MAGNETITE, RED EARTH AND POLYPHENOLIC SOLUTIONS EXTRACTED FROM *Camellia sinensis*

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Using an environmentally friendly approach, this study investigated a method to synthesize iron oxide nanoparticles (IONP) for water remediation. Natural magnetite from an ore deposit in Buttala, Sri Lanka, and red earth from northeastern coastal areas were used as iron precursors. The reducing agent relevant to the synthesis was extracted with 20 g/L tea leaves (*Camellia sinensis*) by heating to 90 °C with deionized water. The finer portion (< 45 µm) of magnetite and red earth were separated, and 5.00 g of each was dissolved in 100 mL of 5.0 M $HNO_3$. The resulting solutions were added drop wise to the polyphenol solution with stirring at a temperature of 25 °C. The IONP appeared as a black precipitate and the yields were 2.86 g (57.2%) and 3.92 g (78.4%) from magnetite and red earth, respectively. Scanning electron microscopy observations showed that spherical and subspherical IONP aggregates with sizes between 40 and 100 nm. Furrier transformation infrared spectroscopic analysis of IONP confirmed the formation of iron oxides. The peaks at 3192 $cm^{-1}$, 640 $cm^{-1,}$ and 547 $cm^{-1}$ 403 $cm^{-1}$ correspond to stretching vibrations of α-Fe-O-OH bond, Fe-O, iron and α-$Fe_2O_3$, respectively. The synthesised nanoparticles rapidly aggregated and formed micromillimeter-sized clusters due to their extreme reactivity. Iron-based nanoparticles are suitable for decontamination of $NO_3^-$, $F^-$, and $Cl^-$ in both wastewater and naturally contaminated groundwater. Therefore, this eco-friendly synthesis method would be extremely beneficial as it is a cost-effective, safe, innovative, sustainable and environmentally friendly method.

**Keywords:** *Camellia sinensis*, Green Synthesis, Magnetite, Nanoparticles, Red Earth

***Abstract No: 79*** ***Earth & Environmental Sciences***

# TIME-BASED NITRATE ION ANALYSIS IN A STORED DRINKING WATER SAMPLE

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Enhanced nitrate ($NO_3^-$) concentration in stored drinking water poses uncertainties in its accurate detection. In this study, the nitrate concentration of a source water sample used for drinking was analysed through Ion Chromatography (IC). Samples were collected from Natiyagama in Anuradhapura district (8.3314746:80.599199) in sealed containers and were stored under three storage conditions: filtered and refrigerated at 5 °C (sample A), filtered and stored at ambient room temperature (sample B), unfiltered and stored at ambient room temperature (sample C). Each sample was filtered using 0.45 µm before IC analysis. Nitrate concentrations of samples in each storage condition were analysed weekly for 3 months. The highest nitrate increase was observed in sample B, [(Δ(nitrate): 69.4-364 ppm], and while the lowest was noted in sample C [Δ(nitrate): 69.5-74.3 ppm]. The nitrate variation in Sample A showed intermediate values, i.e. (69.5-118 ppm) compared to samples B and C. It is believed that some dissolved material in the commercial filter units may have leached, thus enhancing nitrate reduction in the sample. The possible matrix effects were minimized by collecting all samples (A-C) from the same water source. The enhanced nitrate concentration in sample B could be due to the presence of microorganisms passed through the 0.45 µm filters. However, confirmatory results for the occurrence of microbial effects warrant further research. Our results show that the best storage method to determine nitrate concentration in natural water samples requires storing them at ambient temperature and filtering them before analysis. However, further comments on the nature of filter units cannot be made at this stage due to data paucity. When using nitrate contaminated stored water for consumption, nitrate associate health risks are also poised. Further studies are also recommended on the effect of natural organic matter and the bacterial content to better understand the nitrate fluctuation of the samples upon storage.

**Keywords:** Filtering, Nitrate, Refrigeration, Water storage

***Abstract No: 82*** ***Earth & Environmental Sciences***

# DRINKING SUITABILITY OF GROUNDWATER IN DEDURU OYA RIVER BASIN BASED ON WATER QUALITY INDEX (WQI)

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The deterioration of groundwater quality is a major problem worldwide. The Water Quality Index (WQI) is a method that combines individual water quality parameters into an overall quality rating for human consumption. The WQI comprehensively assesses groundwater quality and helps identify critical areas requiring immediate attention. This study assessed groundwater quality in the Deduru Oya River basin (DOB) using the WQI. The DOB is an important water resource in Sri Lanka, primarily meeting domestic and agricultural needs. Thirty (30) groundwater samples from deep (11) and shallow (19) wells in DOB were analysed for key physicochemical parameters, including pH, electrical conductivity (EC), major anions, cations, and trace elements. The WQI was calculated using the weighted arithmetic method based on the WHO guidelines for drinking water quality, considering 14 parameters (pH, EC, alkalinity, total hardness, $SO_4^{2-}$, $Cl^-$, $F^-$, $Na^+$, $K^+$, $Ca^{2+}$, $Mg^{2+}$, Mn, Fe, Zn). Lower WQI values indicate better water quality. The results showed WQI values ranging from 3.72 to 1518, with 53.3% of samples falling within the excellent (0-25) to good (25-50) quality range, while 40% were considered unfit for consumption (> 100). About 3.3% of the samples were poor (51-75) and very poor quality (76-100). Elevated EC values caused extreme WQI, such as 1518. Most excellent to good-quality water was found in the upper part of the basin. The areas in the lower catchment had higher WQI values, indicating poorer water quality, likely due to agricultural runoff and industrial discharges. The lower catchment is often affected by the cumulative effects of water use and pollution from upstream. The results highlight the need for targeted groundwater management strategies to reduce contamination and ensure safe drinking water for the local population. Future studies can explore temporal variations to better understand groundwater quality dynamics in the region.

**Keywords:** Deduru Oya River basin, Drinking water, Groundwater contamination, Groundwater quality, Water Quality Index

***Abstract No: 84*** ***Earth & Environmental Sciences***

# ANALYSING THE NEED FOR BUILDING CLASSIFICATION BASED ON LAND DEFORMATION IN SRI LANKA: A CASE STUDY FROM THE KANDY DISTRICT

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Land deformation poses significant challenges to buildings in Sri Lanka, particularly in urban areas with older, potentially vulnerable structures. This study highlights the necessity of a building classification system to evaluate risks from urban deformation, aiding decisions on rebuilding or modifying buildings for safety and resilience. Given Sri Lanka's ageing infrastructure and susceptibility to geophysical changes, systematic risk assessment is crucial. The research aimed to develop a classification system for buildings based on their vulnerability to urban deformation, enhancing urban planning and disaster preparedness. Utilizing remote sensing data and Geographic Information System technology, the study assessed land deformation impacts in Kandy, Sri Lanka. Sentinel-1 Synthetic Aperture Radar data was processed using Interferometric Synthetic Aperture Radar techniques to generate a deformation map. Concurrently, Sentinel-2 multispectral data, analysed using the Support Vector Machine method, produced a detailed building footprint map. The integration of these datasets, including building age and material type, facilitated the classification of buildings into risk categories. The Geographic Information System database, incorporating building numbers, deformation classification, and construction era, was developed using historical records and correlation analysis. Correlating deformation and building maps allowed the classification of buildings into high, moderate and low-risk categories based on deformation values. Findings revealed that 16.67% of buildings are high-risk, requiring immediate action; 50% are moderate-risk, needing structural upgrades, and 33.33% are low-risk, requiring minimal intervention. This classification system offers a clear framework for prioritizing resources and planning, which is crucial for urban development and disaster management. However, it is limited by the availability of high-resolution data, which may affect the precision of risk assessments. The database allows authorities to model scenarios, prioritize actions and plan for sustainable urban growth, improving disaster preparedness and response. This system aids in selecting building methods and designs resilient to deformation, enhancing urban resilience in Sri Lanka through data-driven risk assessment.

**Keywords:** Building classification, Geographic Information System database, Sentinel-1 SAR, Sentinel-2, Urban deformation

***Abstract No: 85*** ***Earth & Environmental Sciences***

# EFFECTS OF CLIMATIC VARIATION ON EPIPHYTIC CRYPTOGAMIC DIVERSITY IN THE KOTTAWA RAINFOREST, SRI LANKA

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Cryptogams offer early warning signals to identify climate change mitigation and adaptation strategies. Studying the responses of epiphytic cryptogams to changing environmental conditions is pivotal for conserving biodiversity. The Kottawa Rainforest in Sri Lanka hosts a rich diversity of epiphytic cryptogams, including fungi, lichens, bryophytes (mosses, liverworts, hornworts) and pteridophytes (ferns and fern allies). The present study investigated the impact of temperature, precipitation and humidity on the diversity of these organisms. Nine permanent sampling plots (10 m × 10 m) were randomly established in the Kottawa Rainforest. The presence and coverage of epiphytic cryptogams (fungi, lichens, bryophytes, and ferns) on the bark of each tree, from the base to Diameter at Breast Height (DBH), were determined using a transparent grid quadrat (20 cm × 20 cm). Sampling was conducted once a month from January to December 2023. Climatic factors, including precipitation, humidity and temperature, were recorded throughout the year. Specimens of epiphytic cryptogams in the study plots were collected and observed using a stereo microscope and identified to the species level using taxonomic keys. Pearson correlation coefficients and multiple regression analysis were conducted to assess the correlation between temperature, precipitation, humidity, and species diversity. The analysis revealed a significant negative correlation between temperature and species diversity ($r$ = -0.92, $p < 0.05$), indicating higher temperatures are associated with lower cryptogam diversity. Conversely, precipitation positively correlated with species diversity ($r$ = 0.35, $p < 0.05$), suggesting that increased precipitation supports greater cryptogam diversity. There was no significant correlation between humidity and species diversity ($r$ = 0.42, $p > 0.05$). These findings indicate the sensitivity of cryptogam diversity to climatic variations, particularly temperature and precipitation. Therefore, conservation efforts are crucial to safeguard the biodiversity of epiphytic cryptogams in the face of ongoing climatic changes.

*Financial assistance from the National Research Council (Grant No. 22-101) is acknowledged*

**Keywords:** Correlation, Humidity, Precipitation, Species diversity, Temperature

***Abstract No: 95*** ***Earth & Environmental Sciences***

# EFFECTS OF "GM/GR" BIOSTIMULANT ON GROWTH AND YIELD OF SALAD CUCUMBER

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This study investigated the efficacy of a proprietary biostimulant, "GM/GR", which contains nano-nutrients suspended in a 99.637% sucrose carrier, on the growth and yield of salad cucumber. The biostimulant was designed to stimulate growth and enhance resistance to biotic and abiotic stress factors in salad cucumber. The greenhouse trial was conducted at the sub-campus in Mahailluppallama, Faculty of Agriculture, University of Peradeniya, under controlled conditions (29 °C day temperature, 27,000 lux light intensity, and 77% RH) over a 10-week period. A completely randomized design with three replicates (three plants per replicate) was implemented. The two treatments were control (T1) with recommended levels of Albert fertilizer and test (T2) with Albert fertilizer supplemented with GM/GR. A 0.067 g/L GM/GR solution was applied to T2 as 400 mL per plant three weeks after planting (WAP) and 800 mL per plant at six WAP. ANOVA and the Friedman test were used to analyse continuous and discrete data, respectively. Significantly higher ($p < 0.05$) values were observed in plant growth parameters such as stem diameter and leaf area per plant in T2 compared to the control. The total fruit yield per plant (1.7 kg) was not significantly different between treatments, and the difference was only 13.33% higher in T2 compared to T1. However, T2 recorded a relatively higher number of flowers, up to 6 WAP. No significant differences were observed between treatments in antioxidant concentrations, polyphenols, Vitamin C, total soluble solids, fruit dry weights, or leaf chlorophyll content, indicating that GM/GR does not alter the chemical composition of the plant. Overall, the findings suggest that combining GM/GR with recommended levels of Albert fertilizer can enhance growth and yield in salad cucumber without affecting fruit composition under greenhouse conditions.

**Keywords:** GM/GR biostimulant, Greenhouse cultivation, Salad cucumber yield

***Abstract No: 97*** ***Earth & Environmental Sciences***

# A PRELIMINARY STUDY ON THE POTENTIAL OF USING FRESHWATER FLORA AS AN INDICATOR IN AQUATIC ENVIRONMENTAL RISK ASSESSMENT

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This study explored the potential of using freshwater flora to assess heavy metal and pesticide pollution in water bodies. A survey on agrochemical usage was conducted in five Grama Niladhari divisions in Matara, Sri Lanka, through direct interviews with one hundred farmers. The study was carried out in the Thihagoda canal by collecting samples of *Salvinia natans*, *Hydrilla verticillata*, *Nelumbo nucifera*, and water from surface (10 cm), mid (65 cm), and bottom (100-120 cm) depths. Composite water and plant samples were analysed for pesticides using HPLC and for heavy metals using ICP-MS. The heavy metal pollution index for As, Cu, Zn, Cd, Ni, Pb, Cr, and Mn in water and the plants' Bio-Concentration Factor (BCF) were calculated using standard formulas. The most commonly used fertilisers at the site were mixed fertiliser (65%) and organic liquid fertiliser (55%), while the predominant herbicide and pesticide were Satunil (75%) and Gaucho-Imidacloprid (100%), respectively. Both pesticides were detected in all water and plant samples. Organic liquid fertiliser contained As (0.05 mg/L), Cr (13.13 mg/L), and Pb (0.56 mg/L), while mixed fertiliser also showed As (0.74 mg/kg), Cr (3.93 mg/kg), and Pb (6.75 mg/kg). *Salvinia* and *Hydrilla* exhibited a BCF > 5000 for As, Cr, and Pb, indicating strong bioconcentration potential. The heavy metal pollution index for As, Cu, Zn, Cd, Ni, Pb, Cr, and Mn in water and the plants' Bio-Concentration values below 100 at all three water depths suggested the absence of significant risk of heavy metal pollution in the canal. However, the high BCF values in plants highlighted the bioaccumulation of most metals. These results underscore that pollution assessments should not rely solely on water analysis and emphasize the importance of incorporating aquatic flora as key indicators in water quality assessments to better evaluate environmental risks in water bodies.

**Keywords:** Fertilizers, Freshwater flora, Heavy metals, Pesticides, Water quality

***Abstract No: 99*** ***Earth & Environmental Sciences***

# ASSESSMENT OF ENVIRONMENTAL HEALTH IN SELECTED LOCATIONS OF SOUTHERN COAST OF SRI LANKA USING AZTI'S MARINE BIOTIC INDEX BASED ON MARINE POLYCHAETES AS INDICATORS

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The southern coast of Sri Lanka, renowned for its marine biodiversity and economic importance, faces escalating anthropogenic pressures threatening its ecological integrity. This study assessed environmental health in three selected sites: Galle harbour, Unawatuna beach, and Gin river mouth, utilizing AZTI's Marine Biotic Index (AMBI) based on marine polychaetes as bioindicators. Benthic sediment samples were collected along line transects extending 100 m offshore at each site. Polychaete specimens were identified to the species level. Sediment grain size analysis was conducted using the wet sieving method. Our findings indicated that Galle harbour, characterised by a comparatively muddy bottom, experiences moderate disturbance (mean AMBI = 3.958). It is dominated by Ecological Group (EG) II species (86.1%), indifferent to disturbance, with a notable presence (11.1%) of second-order opportunistic species from EG IV. This moderate disturbance likely results from pollution sources, including harbour activities, oil spills, and untreated sewage. Unawatuna beach showed slight disturbance (mean AMBI = 1.566), dominated by species indifferent to disturbance (EG II = 65.0%). This condition is likely due to tourism-related activities and pollution from hotels, including sewage and wastewater discharge. The Gin river mouth is known for potential pollution from industrial waste, agricultural and urban runoff, and siltation from soil erosion. Although we expected significant disturbance at this location, our AMBI results classified it as slightly disturbed (mean AMBI = 3.000). This may be attributed to our sampling coinciding with the heavy rainy season, which likely altered the benthic community dynamics due to freshwater influx. Hence, this finding highlights the importance of continuous temporal observations in such areas to grasp species abundance dynamics. Overall, our study underscores the valuable role of polychaetes as indicators in coastal environmental monitoring and their applications with marine biotic indices.

**Keywords:** AZTI's Marine Biotic Index (AMBI), Bioindicators, Environmental health, Marine polychaetes, Southern coast of Sri Lanka

***Abstract No: 124*** ***Earth & Environmental Sciences***

# PRECIPITATION, SEA SURFACE TEMPERATURE (SST), AND THEIR RELATIONSHIP OVER THE TROPICAL INDIAN OCEAN FROM 1982 TO 2020

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Precipitation, sea surface temperature (SST) and their interactions contribute to the climate, ecology, economy, and social aspects of a given area. The precipitation over the tropical Indian Ocean fluctuates with SST. The evaporation, wind direction, wind speed, Indian Ocean dipole, El Niño, and La Niña are influenced by SST. This study aimed to identify the prevailing patterns and annual trends of precipitation and SST of the tropical Indian Ocean region (30°N, 20°S, 40°E, 110°E) from 1982 to 2020. Monthly precipitation and SST data were obtained from Asia-Pacific Data-Research Center. MATLAB R2020a version was used to analyse data. Monthly anomalies of the precipitation and SST were calculated by removing the seasonal cycle of the data set. Annual trends of precipitation and SST were analysed by annual means. The highest and lowest (driest) monthly precipitation was in July (4.30 mm) and March (2.69 mm), respectively. The precipitation range of June-July-August is 3.69 mm to 4.86 mm, and December-January-February data varied from 2.69 mm to 3.62 mm. May (28.5 °C) and January (26.4 °C) months represented the highest (warmest) and lowest (coldest) monthly SST, respectively. The annual trend of precipitation and SST showed a ± 0.004 mm/year and a positive 0.02 °C/year, respectively. The mean annual SST of the tropical Indian Ocean during recent years (2000-2020) was 0.4 °C higher compared to the past 17 years (1982-1999). A significant positive correlation was observed between the annual SST and precipitation (+ 0.34 at 0.05 level of significance). Therefore, increasing SST due to global warming may change normal precipitation pattern, and these changes can have substantial implications for ecosystems, weather patterns and climate dynamics.

**Keywords:** Annual trend, Monthly climatology, Precipitation, Sea Surface Temperature (SST), Tropical Indian Ocean

***Abstract No: 129*** ***Earth & Environmental Sciences***

# ASSESSMENT OF ZOOPLANKTON ABUNDANCE IN RELATION TO WATER QUALITY PARAMETERS: A CASE STUDY IN MAGALLA RESERVOIR IN THE NORTHWESTERN PROVINCE OF SRI LANKA

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The study was conducted in the freshwater reservoir Magalla in Nikaweratiya, Sri Lanka. The aim of the study was to assess the abundance of zooplankton in relation to selected water quality parameters. Four sampling sites were chosen; site 1 - wastes were added by nearby residences, site 2 - a bathing area, site 3 - receiving urban wastes, and site 4 - minimally disturbed (Reference site). Sampling was carried out once a month from May to December 2023. Standard methods were used for in situ analysis of water quality parameters, including water temperature (°C), dissolved oxygen concentration (mg/L), pH, total dissolved solids (mg/L), electrical conductivity (µS/cm), salinity (%) and transparency (cm). Zooplankton was collected using a 300 µm plankton net, preserved in 5% formalin and observed using a Sedgewick-rafter counting slide under a light microscope. Data were analysed using Minitab software (Version 19). According to Principal Component Analysis, water transparency, total dissolved solids and temperature were highest in sites 1 and 2, conductivity and salinity were highest in site 3 and dissolved oxygen concentration, and pH were highest in the reference site. Nineteen zooplankton species belonging to five main groups, namely, protozoa, ostracodes, cladocerans, rotifers, and copepods, were identified. Zooplankton abundance peaked in July and August, with the highest values observed at the reference site, while sites impacted by waste had significantly lower abundance. Zooplankton abundance plummeted in October and November, with the lowest values observed at site 3, which was contaminated by waste. The abundance of zooplankton at sites 1, 2, and 3 differed significantly ($p < 0.05$) from the reference site, and there was no significant difference among the three sampling sites according to the Kruskal Wallis test and Mann-Whitney U Test. This study revealed the effect of water quality parameters on the abundance and diversity of zooplankton in the Magalla reservoir, highlighting the importance of maintaining optimal water conditions to support a diverse and healthy zooplankton community.

**Keywords:** Abundance, Freshwater, Reservoir, Water quality, Zooplankton

***Abstract No: 132*** ***Earth & Environmental Sciences***

# CONSUMER PREFERENCE AND SENSORY ACCEPTABILITY OF MI-2 CHILI PODS (*Capsicum annum*) CULTIVATED WITH *Mimosa pigra*-BASED BIOFERTILIZER

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This research investigated how organic farming practices using *Mimosa pigra*-based biofertilizers affect the sensory quality of MI-2 chilli pods, with a focus on enhancing understanding of sustainable agriculture's role in shaping food quality and maintaining the cultural significance of chilli peppers in Sri Lankan cuisine. The biofertilizer was formulated by chopping *Mimosa pigra* aerial parts during the vegetative stage and allowing them to decompose in a pit for six months. The experiment consisted of four treatments, each replicated nine times, with 10 plants per pot. The treatments included: (1) *Mimosa pigra* alone (MP), (2) *Mimosa pigra* combined with calcium carbonate (MP + C), (3) *Mimosa pigra* combined with inorganic fertilizer (MP + IF), and (4) a negative control (NC) without fertilizer. Pots were prepared using a 2:2:1 mixture of garden soil, goat manure, and sand. Data were analysed using ANOVA to compare sensory ratings across treatments, followed by post-hoc tests, with significance set at $p < 0.05$. Results were presented as mean scores with 95% confidence intervals. A sensory evaluation, conducted with 50 participants using a 5-point hedonic scale, assessed taste, colour, texture, odour, and overall acceptability. Chilli pods treated with MP biofertilizer received the highest ratings for overall acceptability ($p = 0.02$) and taste ($p = 0.03$) compared to other treatments. Pods from MP + C, MP + IF, and NC treatments were also preferred for colour and texture, though the differences were less pronounced. Notably, chilli pods grown with MP were rated highest for overall acceptability. These findings suggest that *Mimosa pigra*-derived fertilizer could support eco-friendly agriculture and offer a sustainable management practice for controlling invasive species in Sri Lanka. Future research will explore the effects of varying *Mimosa pigra* fertilizer concentrations on chilli quality and yield over multiple seasons, along with long-term soil health impacts and potential applications for other crops.

**Keywords:** *Capsicum annum*, Hedonic scale, *Mimosa pigra*, Organic fertilizer

***Abstract No: 143*** ***Earth & Environmental Sciences***

# MORPHOLOGICAL AND BIOCHEMICAL CHARACTERIZATION OF EFFICIENT DIESEL-DEGRADING BACTERIA ISOLATED FROM PETROLEUM-CONTAMINATED SUBSURFACES

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The widespread use of petroleum products like diesel has led to environmental contamination, necessitating studies aimed at minimizing its impact upon release into the environment. Among the potential petroleum-degrading microbes, previous studies have identified bacteria as the most effective. However, bioremediation success relies on identifying native bacteria from contaminated sites, as they are better suited to local conditions. Degradation of complex hydrocarbons like diesel requires multiple bacterial species, as no single strain can break down all its components. Thus, this study aimed to characterize and identify efficient diesel-degrading bacteria from petroleum-contaminated soil collected from garages in Kandy, Sri Lanka, and to design bacterial consortia that can efficiently degrade diesel. Diesel-utilizing bacteria in collected soil samples were enriched using Bushnell Haas broths supplemented with diesel. Potential diesel-degrading bacteria were isolated using spread plating and streak plating techniques. These isolates were subjected to turbidity assay and 2,6-Dichlorophenolindophenol (2,6-DCPIP) assay to quantitatively determine the most effective degrading bacteria. The recognised efficient bacteria were characterised using morphological and biochemical tests and were used to design bacterial consortia. Based on the findings of the quantitative tests, three of the isolated diesel-degrading bacteria were determined to be the most efficient. The morphological and biochemical test results led to the subsequent identification of these three isolates as belonging to the genera *Klebsiella*, *Enterobacter*, and *Staphylococcus*. Of these, *Klebsiella* was shown to be 5.87% and 10.87% more effective than the other two isolates, respectively. Of the four bacterial consortia that were designed using pure bacterial isolates, three consortia were more successful at degrading diesel than the individual bacterial isolates based on the 2,6-DCPIP assay. It showed that the consortium consisting of *Enterobacter* and *Klebsiella* was the most successful. The findings of this study can be employed for bioremediation of diesel-contaminated sites.

**Keywords:** 2,6-Dichlorophenolindophenol assay, Bacterial consortia, Bioremediation, Diesel-degrading bacteria, Turbidity assay

***Abstract No: 157*** ***Earth & Environmental Sciences***

# CONTROL OF *Aspergillus* SPECIES GROWTH ON STORED RICE USING MICROENCAPSULATED CINNAMON BARK OIL

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Improper storage conditions for rice often lead to fungal contamination, posing severe health risks to consumers. Among these fungi, *Aspergillus* spp. is a significant contributor, known for producing hepatotoxic aflatoxins in stored grains. This study evaluated the efficacy of cinnamon bark oil incorporated into chitosan microcapsules (CNBO-CS-MCs) as a natural fungicide to inhibit the growth of aflatoxin-producing *Aspergillus* species. Both CNBO and chitosan are non-toxic to humans and recognised as antimicrobials. However, the direct application of CNBO is limited due to its high volatility and potential to alter the colour and taste of food products. To overcome these drawbacks and enhance its effectiveness, CNBO was microencapsulated using chitosan via the ionotropic gelation method. Process parameters were optimized by varying the amounts of chitosan (1-3%), CNBO (1-3 g), and sodium tripolyphosphate (STPP) (0.5-1%) as a cross-linking agent. Light microscopic images showed that CNBO-CS-MCs were spherical, while SEM images indicated a crimped surface layer. Particle size analysis revealed a size range of 100-1000 nm. The optimum formulation was identified as 3% chitosan, 3 g CNBO, and 1% STPP, achieving an encapsulation efficiency of 85% and a loading capacity of 16.5%. GC-MS analysis of CNBO revealed cinnamaldehyde (74.6%) as the major compound. *Aspergillus* spp. was isolated from stored rice, cultured on potato dextrose agar (PDA) medium, and identified morphologically. To qualitatively determine aflatoxins in stored rice, a thin-layer chromatography (TLC) mobile phase solvent system was developed, identifying ethyl acetate (1:1 v/v) as the best solvent system. The TLC analysis confirmed aflatoxin contamination in the stored rice. To assess the effectiveness of CNBO-CS-MCs, rice grains were inoculated with an *Aspergillus* spore suspension (1 mL) and treated with CNBO-CS-MCs. The minimum inhibitory concentration (MIC) and minimum lethal concentration (MLC) of CNBO-CS-MCs against *Aspergillus* spp. were 6.0 mg (1.0 mg CNBO) and 14.0 mg (2.3 mg CNBO), respectively. This research highlights the potential of microencapsulated CNBO as a natural fungicide, providing an effective and safer alternative for managing fungal contamination in stored rice.

*Financial assistance from the University of Kelaniya Research Council Grant (Grant No. RC/MDRG/2021/01) is acknowledged*

**Keywords:** Aflatoxin, *Aspergillus* spp., Chitosan, Cinnamon bark oil, Encapsulation

***Abstract No: 158*** ***Earth & Environmental Sciences***

# ARAGONITE SATURATION AND NUTRIENT LEVELS ON CORAL REEFS IN THE EASTERN AND SOUTHERN COASTS OF SRI LANKA

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Corals rely on adequate aragonite saturation level ($\Omega_{ar}$) in the ocean. Reduced $\Omega_{ar}$ makes corals more susceptible to dissolution. High concentrations of phosphate ($PO_4^{3-}$) lower the $\Omega_{ar}$ and nitrate ($NO_3^-$), intensifying coral bleaching during heat stress. Identifying how these parameters affect corals can guide effective interaction strategies to protect these ecosystems. This study evaluated the $\Omega_{ar}$, $NO_3^-$, and $PO_4^{3-}$ concentrations of coral reefs on the eastern coast (EC) and southern coast (SC) of Sri Lanka from March to May 2024 during the global coral bleaching event. Sampling was done in six sites on EC (Pasikudah, Kalkudah, Pigeon Island, Kayankerni, Adukkupar, and Salli Beach) and six sites on SC (Polhena, Mirissa, Talaramba, Weligama, Unawatuna, and Hikkaduwa). Three water samples were randomly collected from each coral reef from the sea surface, and salinity, pH, and temperature were recorded on-site. A set of samples was preserved at 4 ºC and immediately transported to the laboratory to determine total alkalinity, $NO_3^-$, and $PO_4^{3-}$ concentrations. Total alkalinity and $PO_4^{3-}$ data were plotted using R 4.3.1 software for $\Omega_{ar}$ calculation. The mean values of the $\Omega_{ar}$, $NO_3^-$ and $PO_4^{3-}$ on the SC were 4.21 ± 0.43, 2.19 ± 1.28 µmol/L, and 0.74 ± 0.22 µmol/L, and the same on the EC were 4.44 ± 0.29, 1.29 ± 0.91 µmol/L, and 0.35 ± 0.07 µmol/L, respectively. One-way ANOVA test confirmed no significant difference ($p > 0.05$) of $\Omega_{ar}$ in sampling areas. However, there was a significant difference ($p < 0.05$) in $NO_3^-$ and $PO_4^{3-}$ concentrations in sampling areas. Results showed $\Omega_{ar}$ was above the ecological threshold (3.5-3.6). Higher $NO_3^-$ concentrations above 2 µmol/L in the SC were likely due to human activities, which may intensify coral bleaching during heat stress. The current result showed that $\Omega_{ar}$ in both coastal areas was ideal for coral formation and growth.

**Keywords:** Aragonite saturation level, Coral bleaching, Eastern coast, Nutrient, Southern coast

***Abstract No: 172*** ***Earth & Environmental Sciences***

# COMPARATIVE EVALUATION OF WATER HYACINTH, VEGETABLE WASTE AND GLIRICIDIA AS NITROGEN SOURCES FOR COMPOSTING PADDY HUSK

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Paddy husk is one of the most widely produced agricultural wastes in rice production. The co-composting of paddy husk is an effective method for addressing this waste issue. This study aimed to transform ordinary paddy husk into high-quality compost using water hyacinth (*Eichhornia crassipes*), vegetable waste, and gliricidia (*Gliricidia sepium*) as nitrogen sources. The quality of the compost was compared using pH, electrical conductivity (EC), organic carbon (C), total nitrogen (N), available phosphorus (P), and exchangeable potassium (K). The experiment followed a Completely Randomized Design (CRD) with four treatments: T1 = paddy husk only, T2 = paddy husk + water hyacinth, T3 = paddy husk + Gliricidia, and T4 = paddy husk + vegetable waste, mixed in a 1:1 ratio. The mixtures were aerobically decomposed using the compost pile method and analysed after 67 days. The results were compared with the compost standards provided by the Sri Lanka Standards Institution. A pot experiment was conducted to evaluate the effect of the prepared compost on the growth of water spinach (*Ipomea aquatica*). The pH values of all trials ranged between 6.5 and 7.9, and EC values ranged from 0.13 dS/m to 0.977 dS/m. The T2 compost mixture (paddy husk + water hyacinth) showed significantly higher ($p < 0.05$) levels of total nitrogen (1.15% ± 0.03) and potassium (0.466% ± 0.01) compared to other mixtures. The T3 compost mixture (paddy husk + gliricidia) exhibited the highest phosphorus level (1.33% ± 0.08). Low potassium levels were consistent across all compost mixtures. Considering the pH, EC, total nitrogen, and phosphorus levels obtained for the T2 mixture (pH 7.96, EC 0.977 dS/m, N 1.15%, and P 1.257%), along with the highest fresh weight (6.836g ± 0.373) and dry weight (0.6075g ± 0.037) of plant samples from the pot experiment, the compost mixture containing paddy husk and water hyacinth was found to be the most suitable for field application.

**Keywords:** Compost, Gliricidia, Paddy husk, Vegetable waste, Water hyacinth

***Abstract No: 182*** ***Earth & Environmental Sciences***

# SEDIMENTOLOGICAL CHARACTERIZATION OF GIANT'S TANK CLAY DEPOSITS IN SRI LANKA: IMPLICATION FOR THEIR GENESIS

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Giant's tank clay deposits, which are interconnected with reddish-brown sandy soil (Red Earth deposits) and cover over 400 $km^2$ in the Mannar District of Northern Province, Sri Lanka. A comprehensive investigation into the genesis of the montmorillonite clay deposits at Giant's tank is necessary to elucidate their depositional environment. Thus, this study aimed to determine the origin and formation processes of montmorillonite clay deposit at Giant's tank using sedimentological analyses. Four 1 m-deep core samples were collected within and outside the tank, with sub-samples taken from each core at 0.2 m intervals used for the analyses. Particle size distribution (macro and micro) and grain morphology (skewness, kurtosis, roundness, mean size) analyses were conducted using Image J Java-based software. The roundness of weathering-resistant minerals (Quartz, Magnetite, Ilmenite, Zircon, Garnet, Spinel, and Sphene) and the polymodal grain size distribution indicated that the sediments had been transported for longer distances by both fluvial and aeolian processes. The results of grain morphology (positively skewed plot against mean size) indicated minimal influence from oceanic currents and lagoons, suggesting that the sediments have been deposited in a non-marine environment. Additionally, the polymodal distribution of sediment grain sizes, along with their morphological parameters (positively skewed grain morphology, plots of skewness vs kurtosis, and mean roundness of 0.71-0.76), indicated sediments from multiple sources implying a complex origin for the clay deposits. The results revealed that both aeolian and fluvial processes have significantly contributed to the sediment transport and deposition in the area of the deposit. Future studies would enlighten the sedimentary environment of these clay deposits.

**Keywords:** Giant's tank, Grain morphology, Microscopic analysis, Sediment, Shape descriptors

***Abstract No: 190*** ***Earth & Environmental Sciences***

# MERCURY EXPOSURE AND CO-EXPOSURE OF OTHER TRACE METALS IN GOLD WASTE SEPARATORS IN SMALL-SCALE JEWELLERY SECTOR IN SRI LANKA

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Mercury (Hg), commonly used in the separation of gold waste in the small-scale jewellery sector (SSJS), is known to pose a high risk of exposure. In Sri Lanka, SSJS is an important industrial sector and consumes a significant amount of Hg in the separation of gold from gold-contaminated waste. Currently, no biomonitoring studies have been conducted on Hg exposure in SSJS in Sri Lanka. A case-control study was carried out to analyse Hg exposure and concurrent exposure to 15 other trace metals among gold workers engaged in SSJS. In this study, urine samples from 39 subjects and 18 control subjects involved in SSJS were analysed for trace metals using Inductively Coupled Plasma Mass Spectrometry (ICP-MS). The urine creatinine levels were analysed using an automatic biochemical analyser. There was a striking difference between Hg concentrations in subjects and controls ($p < 0.05$), with the average total Hg concentrations of 6.95 ± 17.9 and 0.46 ± 0.86 the /g, respectively. A recent study on Hg exposure and health problems in urban gold mining in Indonesia, which follows a similar process to gold waste recovery in SSJS Sri Lanka, also found a high difference in the total Hg concentration in gold workers and the control group (10.8 and 6.6 µg/g, respectively). The results of both studies showed that the total Hg concentration in the subject group was higher than in the control group. Almost 12.8% of subjects in the present study had urinary Hg concentrations above Human Biomonitoring Level I (5.0 µg/g Cre). Of these, 7.7% exceeded the biological tolerance limit (25.0 µg/g Cre). Mercury had strong positive correlations with V, Cr, Mn, Zn, As, Pd, Ag, Cd, Pt and Au. The levels of Co, Ag, and Cd were significantly high in the studied subjects, which could be attributed to unknown factors and warrants further investigation.

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**Keywords:** Co-exposure, Gold-Mercury amalgam, Human exposure, Mercury vapour, Urine-Mercury

***Abstract No: 192*** ***Earth & Environmental Sciences***

# MICROPLASTIC POLLUTION IN SELECTED MANGROVE ECOSYSTEMS OF SOUTHERN SRI LANKA

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Over the past decade, microplastics (MP < 5 mm) have received global attention and have raised concerns about the negative impacts on both aquatic and terrestrial environments. To date, mangrove ecosystems (ME) present at the intersection of land and sea have been identified as a potential sink for MP due to various environmental characteristics, such as the complex root system in ME and slow-moving water that facilitates sedimentation. As mangrove ecosystems provide diverse ecological conditions for both fauna and flora, there is a crucial value in evaluating the different types of MP present in the ME and quantifying the abundance and distribution of MP in the different MEs. This study was carried out to recognize the types of MP, their distribution, and the environmental factors that affect MP in five selected ME, i.e., Hikkaduwa, Rathgama, Koggala, Galle, and Rekawa in Southern Sri Lanka. Soil and water samples were collected from 180 sampling points in the selected ME using standard sampling methods and equipment. Sediments were digested following the oxidative reduction method, and MP extraction was done using density separation and filtration. Microplastics were counted and categorised according to the particle shape, size, and colour. Data were analysed using Minitab (v. 21) and SPSS software. Both the mean number of MP per litre of water (MPW) and per kg of dry weight of sediments (MPS) were highest in Hikkaduwa (MPW: 16.00 ± 5.06, MPS: 79.17 ± 71.33) and lowest in Rekawa (MPW: 8.00 ± 3.58, MPS: 34.38 ± 48.26) with a no significant difference among the study sites ($p > 0.05$). MP were identified as two major types, i.e., filaments and fragments, and those were also highest in Hikkaduwa compared to the other sites. Filaments and fragments were detected in eight different colours; black, white, blue, green, red, grey, pink, and transparent. This study provides crucial information on MP pollution in the ME of Southern Sri Lanka, emphasizing the significance of mitigatory measures to control the impact of MP on overall environmental well-being.

*Financial assistance from the China Sri Lanka Joint Center for Education and Research (CSL-CER) is acknowledged*

**Keywords:** Coastal pollution, Hikkaduwa, Marine environment, Microplastics

***Abstract No: 229*** ***Earth & Environmental Sciences***

# ABUNDANCE AND DIVERSITY OF PLANKTON IN MAMUNUGAMA TANK CASCADE SYSTEM

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Plankton are critical biological indicators used to assess the water quality in aquatic ecosystems. The objectives of the study were to identify the phytoplankton and zooplankton and estimate their diversity and abundance in the Mamunugama Tank Cascade System (TCS), located in the Kurunegala District, Sri Lanka. This TCS consists of six interconnected tanks: Ulpath tank, Athaudagama tank, Ihala Thimbiriyawa tank, Mamunugama tank, Kandubodagama tank and Weera tank. Plankton samples were collected from August 2023 to February 2024, covering both wet and dry months. At each visit, three samples were collected from each tank using a 55 µm mesh size plankton net. Planktons were identified based on the morphological features using standard keys, and their abundance was estimated using a Sedgewick-Rafter counting cell. The Simpson and Shannon-Wiener diversity indices were calculated. A total of forty-five phytoplankton species from seven groups were identified, with chlorophytes accounting for 40%, making them the dominant group, while Chrysophyta represented the lowest abundance of 2.2%. Twenty-four species of zooplankton were recorded representing four groups, with Rotifera being the most abundant group, accounting for 45.5%, and Cladocera being the least abundant group, accounting only for 9.1%. Plankton abundance was higher during wet months compared to dry months. The Simpson index indicated a high degree of diversity (D = 0.81-0.99) in all tanks during both dry and wet months. The Shannon-Wiener index values ranged from H = 2-3 in the dry months and H = 3-4.5 during the wet months. The dominance of chlorophytes and rotifers suggests favourable conditions for these groups. Seasonal variations in plankton abundance and diversity highlight the seasonal dynamics in aquatic ecosystems.

**Keywords:** Plankton diversity, Shannon-Wiener index, Simpson index, Tank cascade systems

***Abstract No: 236*** ***Earth & Environmental Sciences***

# SOCIAL NORMS OF RESOURCE UTILIZATION WITHIN FOREST FRAGMENTS BY RURAL COMMUNITIES IN WET ZONE, SRI LANKA

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Forest fragmentation, primarily due to exploitation and land conversion, has become a significant global concern. Such activities have resulted in sharp decline in forest biodiversity, degraded the quality and supply of resources, and caused substantial loss of stored carbon. Understanding the social norms and interdependence between forests and rural communities is vital for their sustainable management. Using the Social-Ecological System framework, this study identified and analysed the norms influencing villagers' attitudes toward tropical forest utilization within the agricultural landscape of the Wet Zone in Sri Lanka. The study area encompassed 18 forest fragments near the western part of the Sinharaja Forest Reserve. Data collection involved 53 semi-structured interviews with households located within 100 m of forest fragments, focusing on who uses forest resources and the social norms governing eligibility for their use. Activities attributed to others and perceptions of harmful practices were recorded. Findings revealed that the majority of villagers (31 out of 53) consider themselves as eligible for resource utilization, citing generational rights and livelihood needs. However, there was limited recognition of the ecological impacts of certain practices, such as timber extraction and hunting. While activities like deforestation are universally recognised as harmful, there was reluctance to oppose these practices, driven by communal cohesion and concerns about personal repercussions (38 out of 53). The study underscores a complex interplay of motivations, including resource preservation (26 out of 53), risk mitigation (6 out of 53), community security, and barriers such as distrust of authorities and respect for others' claimed ownership. The insights into local attitudes and behaviours provide a foundation for targeted conservation strategies that align with community values and address barriers to sustainable resource management.

**Keywords:** Forest fragmentation, Sinharaja, Social norms, Socio-ecological system

***Abstract No: 239*** ***Earth & Environmental Sciences***

# GREEN SYNTHESIS, CHARACTERIZATION, AND pH DEPENDENT ADSORPTION OF LEAD(II) BY HYDROXYAPATITE NANOPARTICLES

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Hydroxyapatite [$Ca_{10}(PO_4)_6(OH)_2$] has tremendous potential for remediation of pollution in the environment. Its unique structure and properties, including exceptional adsorption capacity, ion exchange capability, thermal stability, and acid-base adjustability, make it particularly important in environmental management. Green template-mediated hydroxyapatite (HA) synthesis is a novel and environmentally friendly approach, promoting the development of eco-friendly nanotechnology. The primary objective of this research was to provide significant insight into the application of green-synthesised HA nanoparticles (NP), utilizing compounds in banana peel (BP) as surfactants and effective adsorbents for Pb(II) ions, addressing Pb(II) contamination in diverse environmental settings. The average crystal dimensions of pure hydroxyapatite nanoparticles (HA-NPs) along the "a" and "c" axes were 17 nm and 23 nm, respectively. The corresponding values of the hydroxyapatite nanoparticles synthesised using banana peel (HA-BP NPs) were 27 nm and 32 nm, respectively. Further, HA-NPs and HA-BP NPs have aspect ratios of 1.40 and 1.18, suggesting that both nanoparticles are rod-shaped. Scanning electron microscopic images reveal that introducing banana peel powder to HA would be advantageous, resulting in HA-BP NPs being significantly homogenous with uniform morphology with a length of ~ 74 nm compared to less homogeneous HA-NPs with a length of ~ 140 nm. The percentage removal of Pb(II) by HA-BP NPs is determined to be over 98.0% for 10 ppm and 15 ppm Pb(II) solutions at a controlled pH of 3.0. However, the extent of removal sharply decreases to 62.3% at the same pH for 25 ppm Pb(II) solution; but increased to 78.9% at pH 4. The decreased removal percentage at higher concentrations could be attributed to the saturation of adsorption sites. It is concluded that HA-BP NPs are effective adsorbents at low pH, offering a promising solution for addressing Pb(II) contamination.

**Keywords:** Adsorption, Green synthesis, Hydroxyapatite, Lead, Nanoparticles

***Abstract No: 247*** ***Earth & Environmental Sciences***

# ENHANCING MICROPLASTICS DEGRADATION USING Fe-RICH RED YELLOW LATOSOLS: A FENTON AND PHOTOCATALYTIC APPROACH

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Microplastics (MPs) have a long persistence in the environment due to their slow natural degradation. Fenton process and photo-catalytic reactions, where Fe plays a major role, have the potential of degrading polymers. This study aimed to investigate the impact of natural iron-rich soil on the degradation of MPs via the Fenton process and photo-catalytic reactions. Secondary MPs (< 2 mm) were manually prepared from polyethylene (PE), polypropylene (PP), poly-ethylene-terephthalate (PET), high density polyethylene (HDPE), polystyrene (PS) and polyamide (PA) and mixed separately with Fe-rich soil (red yellow latosols-RE) and Fe-low soil (immature brown loamy soil-GS) at a ratio of 40 pieces/20 g of soil. Two separate experimental set-ups were maintained for visible light (standard incandescent light bulb > 400 nm) and UV light (UV bulb in a black box-360 nm) conditions. Samples were in saturated moisture condition. A control experiment was performed without soil but with moisture only. No measures were taken to control microbial activity in any of the set-ups. After 24 hours of exposure, MPs were recovered by handpicking, weighed and analysed for morphological changes and structural modifications using SEM, FT-IR and Raman spectroscopy. The highest weight loss was observed in PE-RE (1.1%), PP-RE (2.1%) and PS-RE (1.9%) mixtures exposed to UV light. A weight increase was observed in HDPE-RE, PET-RE and PA-RE due to strong aggregations of soil particles on MPs surface. According to the variations of peak positions and intensities of FT-IR and Raman spectroscopy, PE, PET, HDPE, PS and PA showed a relatively higher degradation with Fe-rich soil compared to Fe-low soil under UV light. Even though slight surface changes were observed under SEM, complete degradation was not observed within 24 hours. However, the data confirmed that the Fe-rich soils can enhance the MPs degradation. The experiments are underway to determine the optimum time required for maximum MPs degradation.

*Financial assistance from the PGIS Research Grants (Grant No. PGIS/2022/09) is acknowledged*

**Keywords:** Degradation, Iron-rich soils, Microplastics, Photocatalysis

***Abstract No: 253*** ***Earth & Environmental Sciences***

# COMPARISON OF MICROBIAL LOAD AND DIVERSITY DURING HAZE EVENTS: A CASE STUDY IN KANDY, SRI LANKA (2022-2024)

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Air pollution refers to the presence of physical, chemical, or biological contaminants in the air. Sri Lanka experiences an annual haze due to high pollution levels from the Indian subcontinent, affecting air quality and visibility. This study aimed to investigate the microbial load (ML) and bacterial diversity during the 2024 haze event and compared it with the 2022 event. Air samples were gathered thrice daily (0800-0830, 1200-1230, and 1700-1730) from 12th to 27th March and 2nd to 17th April 2024, based on the Air Quality Index (AQI) and haze visibility, at a location situated 1.7 km away from Kandy City. Control samples were taken on clear, non-hazy days at the same location. The same methodology and location were applied during the haze event that occurred from 9th to 16th December 2022. Samples were collected using fine-particulate air samplers on sterile filter papers (PTFE, 2µm pore size, and QMA, 2.2 µm pore size). Filter papers were cut and transferred into 8 mL of sterile water, then shaken in an orbital shaker at 100 rpm for 2 hrs before centrifugation. The Muse cell analyser was used to count the total ML using the flow cytometry technique. The highest microbial count, $1.44 \times 10^7$ cells/$m^3$ of air, occurred on the evening of 14th March during the haze, while the lowest, $1.11 \times 10^6$ cells/$m^3$ of air, was recorded on the evening of 17th April under non-hazy conditions. Significantly higher ($p < 0.05$) microbial levels were reported consistently in the evenings compared to mornings and noons. The AQI, wind speed, and atmospheric temperature all showed a positive correlation with ML. The ML was notably higher in 2024, approximately 18 times greater than in 2022. These findings suggest that microbial diversity and abundance during haze events are affected by air quality and meteorological factors, though further studies are needed.

**Keywords:** Air quality, Bacterial diversity, Haze event, Meteorological factors, Microbial load

***Abstract No: 254*** ***Earth & Environmental Sciences***

# STATUS OF THE CRITICALLY ENDANGERED INDIAN COURSER (*Cursorius coromandelicus*) IN THE NORTHERN PROVINCE OF SRI LANKA

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The Northern Province has a great diversity of habitats, which attract a large number of birds, both migrant and resident. The Indian Courser (*Cursorius coromandelicus*) is a rare resident bird species in Sri Lanka where it is considered critically endangered, even though globally it is classified as a least concern species. In Sri Lanka, it is found in the arid zone belt, mostly the coastal area extending from south of Mannar to the Jaffna Peninsula. The objective of the present study was to determine the status of the Indian Courser in the Northern Province. The distribution and abundance of this species were assessed using data collected from 2014 to 2018 on waterbirds of the Northern Province. The point count method was used to determine abundance, while binoculars (8 × 40, 10 × 42) and a spotting scope (25 × 50) were used for direct observations. Monthly counting was carried out between 0630-0830 h and 1530-1830 h. A total of 20 individuals were recorded from Vidathaltivu in Mannar and Delft Island in Jaffna: eight individuals from Vidathaltivu and 12 individuals from Delft inhabiting very dry barren plains and grassy patches. Anthropogenic activities that disturb these birds were not observed in either area. On Delft Island, they were recorded at a considerable distance from human settlements. Our findings reveal an extremely restricted range for this species in the Northern Province with very low abundance. The areas where this species was recorded are potentially very good avitourism destinations, given the extent of bird habitats and the presence of other rare and very rare bird species. Therefore, special attention should be given to protecting, monitoring, and conserving this species.

**Keywords:** Critically endangered, Delft Island, Indian courser, Northern Province

***Abstract No: 264*** ***Earth & Environmental Sciences***

# CRITICAL EVALUATION OF RESERVOIR HYDROGEOCHEMISTRY IN CHRONIC KIDNEY DISEASE OF UNCERTAIN ETIOLOGY (CKDu) PRONE AREAS OF WILGAMUWA AND HASALAKA, SRI LANKA

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Over the last three decades, Chronic Kidney Disease of Uncertain Etiology (CKDu) has gained attention as a health problem, particularly in the dry zone of Sri Lanka. The disease is believed to be associated with drinking water quality. Man-made water collecting reservoirs (tanks) with different scale are common in the dry zone region that are primary use for domestic and irrigation purposes. For this study, two adjacent regions with high and low prevalence of CKDu were used to compare the reservoir water quality. Key geochemical parameters and chlorophyll-a concentrations were analysed in reservoirs from Wilgamuwa ($n$ = 6), a region with high CKDu prevalence, and Hasalaka ($n$ = 4), a low-prevalence area, across both the dry and wet seasons. The study showed increased values of electrical conductivity (EC), total dissolved solids (TDS), $NO_3^-$ and $PO_4^{3-}$ concentrations in all reservoirs during dry periods. The average EC and TDS in Wilgamuwa (89.4-163.0 µS/cm and 64.2-117.8 mg/L) were higher than in Hasalaka (56.9-70.6 µS/cm and 40.6-49.0 mg/L). The average total alkalinity levels in all Hasalaka reservoirs and only one reservoir in Wilgamuwa were below 50 mg/L, while others were above 70 mg/L. Approximately four-fifths of samples ($n$ = 8) had higher average concentrations of $PO_4^{3-}$ (0.46-1.34 mg/L) than accepted guidelines for aquatic life. The average $NO_3^-$ concentrations in most samples (ranging from 4.25 to 7.53 mg/L) were below the acceptable limit of 10 mg/L. However, only one in Wilgamuwa had an exceptionally high average $NO_3^-$ concentration of 17.62 mg/L. The average chlorophyll-a concentrations in Wilgamuwa (0.012-0.023 mg/L) and Hasalaka (0.007-0.023 mg/L) suggested a mesotrophic state. The results suggested that elevated $NO_3^-$ and $PO_4^{3-}$ levels may be due to the use of inorganic fertilizers in rice fields in the reservoir's catchment areas, which poses a direct threat to reservoir eutrophication and aquatic life. Additionally, these reservoirs, which serve as potential sources of recharge for wells in the area, may have negative impacts on certain health issues in the community. Future research efforts should be carefully planned to elucidate the combined effects of geochemical components in reservoir water as algal toxin can pose severe health impacts. This can be achieved through continuous monitoring of reservoirs and strategically selected wells in the vicinity.

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**Keywords:** Chlorophyll-a, Chronic Kidney Disease of Uncertain Etiology, Total Alkalinity

***Abstract No: 273*** ***Earth & Environmental Sciences***

# FLUORIDE AND CHLORIDE ION CONCENTRATIONS IN DRINKING WATER DUGWELLS NEAR SUNDARAPOLA GARBAGE DUMP SITE OF KURUNEGALA DISTRICT, SRI LANKA

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Increasing concentrations of chloride and fluoride in drinking water are major concerns associated with garbage dump sites. This study investigated the chloride and fluoride concentrations of drinking water dug wells located downstream of the municipal solid waste dumping site at Sundarapola in Kurunegala District, bi-weekly for a five-month period. The concentrations were compared with the World Health Organization (WHO) standards. Six drinking water dug wells were selected for water quality analysis, which were located at increasing distances of 150 m, 170 m, 250 m, 400 m, 500 m, and 800 m from the dump site and compared with a control sample located at 1.2 km from the dump site. Ion Chromatography analysis was carried out to determine the concentrations of anions. The results showed a significant increase in the mean values for the anions of chloride (493.64 ppm) and fluoride (0.68 ppm), which exceeds the WHO permissible levels of 250 ppm and 0.60 ppm, respectively. From August to December 2023, the pH, temperature, conductivity and precipitation (rainfall) varied in the range 5.74 ± 0.01-7.38 ± 0.01, 26 ℃-25.7 ℃, 2053.33 ± 0.16 µS/cm-371.33 ± 0.16 µS/cm and 88.2 mm-371.8 mm, respectively. The chloride concentration varied from 1378.54 ± 123.99 ppm to 90.44 ± 40.23 ppm, and fluoride concentration varied from 0.80 ± 0.09 ppm to 0.60 ± 0.10 ppm with respect to 20.32 ± 0.09 ppm to 9.62 ± 0.07 ppm and 0.56 ± 0.01 ppm to 0.43 ± 0.03 ppm in control samples. Four dug wells located closer to the dump site of the six dug wells investigated have exceeded the threshold values of fluoride and chloride ion concentrations. There was no correlation between rainfall, fluoride and chloride concentrations. The community should be aware, and appropriate measures must be carried out to purify the selected dug well waters before consumption.

**Keywords:** Chloride, Fluoride, Leachate contamination, Water quality

***Abstract No: 275*** ***Earth & Environmental Sciences***

# PRELIMINARY STUDY ON EVALUATING THE CARBON STOCKS PRIOR TO SEAGRASS RESTORATION IN SINNA ARICHCHAL, KALPITIYA, SRI LANKA

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Seagrass meadows serve as significant carbon sinks, playing a crucial role in climate change mitigation. They capture $CO_2$ through photosynthesis, forming organic matter in tissues and sediments, which enhances carbon storage via sediment stabilization. The reduction of seagrass leads to decreased carbon sequestration, exacerbating climate change impacts. This ongoing study focuses on establishing a one-hectare seagrass meadow and evaluating its impact on blue carbon storage. Prior to restoration, four 60 cm-deep soil core samples were collected from both the donor and the restoration sites at Sinna Arichchal Island, Kalpitiya, Sri Lanka, using a Russian peat auger. Each core sample was divided into six 10 cm subsamples (24 total subsamples) based on depth and analysed using the loss-on-ignition method to quantify total organic carbon content. The mean total organic carbon percentage was compared using the t-test, revealing a higher percentage at the donor site ($7.28 \pm 2.89$) than at the restoration site ($6.71 \pm 3.40$), suggesting a potentially greater carbon content at the donor site. However, this difference was not statistically significant ($t = 0.45$, $p = 0.667$). The higher carbon percentage at the donor site may be attributed to the presence of seagrass, less disturbance, and better preservation. Further sampling and analysis are necessary to confirm this trend with statistical significance. To ensure the successful establishment of the restored seagrass, regular monitoring of growth, health, and environmental conditions is essential. Post-restoration surveys will analyse and compare sediment samples to assess changes in blue carbon stocks before and after restoration, determining the extent of potential improvement in carbon storage.

*Financial assistance from Khiri Reach, the conservation projects arm of Khiri Travel is acknowledged*

**Keywords:** Blue carbon, Climate change, Loss on ignition method, Seagrass restoration

***Abstract No: 276*** ***Earth & Environmental Sciences***

# PRELIMINARY OBSERVATION OF MICROPLASTICS IN DRINKING WATER FROM TREATMENT PLANTS IN KANDY: COMPARISON OF RAW AND TREATED WATER

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Microplastics are increasingly infiltrating ecosystems, locally and globally, amplifying concerns about their presence in drinking water. This study aimed to quantify microplastics in raw and treated water from five water treatment facilities in the Kandy District. Raw and treated water samples were collected over six months, from September 2023 to March 2024, from five water treatment plants supplying drinking water from the Mahaweli River. The five locations from upstream to downstream are Meewatura, Getambe, Gohagoda, Polgolla, and Haragama. Eighty litres of raw and treated water were sieved on-site through a 45 µm steel mesh. The residue was then collected and subjected to wet peroxide oxidation to digest organic detritus. This was followed by density separation using a saturated NaCl solution and vacuum filtration onto a membrane filter. Visual examination at 40× magnification with stereomicroscopy characterised the residual membrane filter-bound microplastics. Microplastics were present in raw (mean ± standard error; 20.5 ± 1.8) and treated water (31.7 ± 2.9). There was a significant effect of purification (generalised linear mixed model, $p = 0.0001$) and an interaction between purification and the location of the treatment plant ($p = 0.01$). The number of microplastics was higher in treated water and upstream treatment plants when compared with raw water and downstream plants, respectively. All microplastics were fibrous structures, ranging from 23.7 to 2,959.5 µm in length. There were no differences in lengths of microfibres between raw and treated water or between locations of treatment plants (Mixed Effect Model, $p > 0.05$). These findings show the persistent presence of microplastics even in treated water. As microplastics are potentially hazardous to human health, it is necessary to determine their sources to reduce their occurrence in drinking water.

**Keywords:** Mahaweli river, Microfibres, Plastic pollution, Potable water

***Abstract No: 280*** ***Earth & Environmental Sciences***

# NOVEL ANODE STRIPPING VOLTAMMETRIC METHOD USING ELECTROCHEMICALLY MODIFIED ELECTRODES FOR ARSENIC SPECIES DETECTION IN WATER

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Arsenic is a heavy metal that is particularly toxic in its inorganic form, $As^{3+}$, and causes health issues in humans, even in trace amounts. Conventional analytical techniques for detecting $As^{3+}$, such as atomic absorption spectroscopy, inductively coupled plasma mass spectrometry, and neutron activation analysis, are not suitable for real-time onsite detection of arsenic in water, which is essential for minimizing arsenic contamination. Recent studies have reported that anodic stripping voltammetry on a modified glassy carbon electrode offers a cheaper and field-portable alternative for detecting trace amounts of $As^{3+}$ in water samples. The drop-casting method was used to modify the bare electrode with AuNPs in such studies. However, the drop-casting method leads to poor reproducibility and high noise levels. Alternatively, this study employed the electrochemical deposition of AuNPs from a solution of 1.00 mM $HAuCl_4$ in 0.500 M $H_2SO_4$ by cathodically scanning the potential between +1.0 V and -0.6 V at a scan rate of 50 mV/s under air-saturated conditions. The optimum number of cycles for the electrodeposition was found to be twenty. A detection limit of 0.0625 mM for $As^{3+}$ with an $R^2$ value of 0.9847 was obtained through cyclic voltammetric analysis of $As^{3+}$ in 0.500 M $H_2SO_4$ on the modified electrode. An enhanced detection limit of 100 nM, with an $R^2$ value of 0.9723, was achieved using anodic stripping voltammetry. The deposition time and applied voltage for the anodic stripping analysis were optimized to 1200 s and -0.4 V, respectively. Future studies will focus on analysing water and soil samples using the newly developed method.

**Keywords:** Anodic stripping voltammetry, Arsenic, Electrodeposition, Gold nanoparticles, Modified glassy carbon electrode

***Abstract No: 283*** ***Earth & Environmental Sciences***

# EFFICIENT LOW-COST REMOVAL OF Pb (II) FROM INDUSTRIAL WASTEWATER USING "YAKADA MARAN-DERIVED CHARCOAL"

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Heavy metal pollution of water resources is a serious issue, implicating several health concerns, including neurological effects, cardiovascular issues, kidney damage, and reproductive effects. Lead (Pb) is particularly problematic among heavy metals due to its high toxicity, environmental persistence, and tendency to bio-accumulation. Chronic exposure to lead causes long-term damage to cardiovascular and renal systems. Biosorbents are promising materials for the removal of heavy metals through adsorption. This study explored the removal of Pb(II) ions from synthetic industrial wastewater using "Yakada Maran" (YM) *Syzygium zeylanicum*, a cost-effective, readily available natural material collected from Balangoda, Sri Lanka. The YM was converted into charcoal (YMC) to maximize its adsorption abilities. Batch experiments were conducted using 10 mg/L Pb(II) solution. Optimal dosage, shaking time, settling time and the effect of pH were identified. However, the settling time does not affect the results. Langmuir isotherm model best described the adsorption process, suggesting monolayer adsorption of lead on YMC. The lead removal efficiency of YMC was 92.5%, with the maximum adsorption capacity of 4.63 mg/g. The kinetic data fit the pseudo-second-order model with a high correlation coefficient of 0.9995, indicating that the chemisorption is the rate-limiting step. Future research will be focused on developing and testing regeneration methods to enhance the sustainability of the biosorbent.

**Keywords:** Adsorption isotherm, Biochar, Column study, Kinetic model, Low-cost adsorbent

***Abstract No: 285*** ***Earth & Environmental Sciences***

# IMPACT OF SOCIO-ENVIRONMENTAL FACTORS INCLUDING NATURE ENGAGEMENT ON THE PSYCHOLOGICAL WELL-BEING OF VETERINARY UNDERGRADUATES OF THE UNIVERSITY OF PERADENIYA

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The psychological well-being of undergraduate students is crucial for their personal development. Recent studies indicate that proximity to nature can improve psychological well-being, leading to increased interest in nature-based interventions for mental health. This preliminary study explored various factors influencing the psychological well-being of veterinary undergraduates, including environmental, social, economic, and individual aspects. Ethical clearance for the study was obtained (Arts/Ethics/2024/01/20.1), and a representative sample of 112 students was selected through stratified random sampling to ensure the inclusion of all academic years, genders, and ethnicities. A self-administered questionnaire was developed and used to assess the students' satisfaction related to their personal and academic life, residential environments, financial and non-financial support available to them and relationships. Findings indicated that students' happiness in their achievement of educational and other goals, internal and external environments of hostels or boarding places, and decision-making freedom had moderate correlations with their overall happiness, with Kendall's Rank Correlation Tau values of 0.31 ($p < 0.05$), 0.284 ($p < 0.05$) and 0.277 ($p < 0.05$), respectively. However, their GPA, level of happiness in the non-financial help received, and the amount of money in their possession for personal expenses had weak correlations of 0.169 ($p < 0.05$), 0.167 ($p < 0.05$) and 0.132 ($p < 0.05$), respectively, with overall happiness. The student groups with the highest and the least engagement levels with nature reported average overall happiness scores of 7 ($n = 5$, SD = ± 0.71) and 5.86 ($n = 21$, SD = ± 1.61), respectively on the 1-9 Likert scale. These results suggest that engagement with nature positively correlates with overall happiness, underscoring the potential of nature-based solutions in fostering psychological well-being among the undergraduates of the University of Peradeniya.

*Financial assistance from the University of Peradeniya under the Multidisciplinary Research (Grant No. 370) is acknowledged*

**Keywords:** Happiness, Mental health and well-being, Nature-based solutions

***Abstract No: 288*** ***Earth & Environmental Sciences***

# AIR QUALITY ASSESSMENT USING GAS SENSORS IN URBAN TRAFFIC AREAS IN PERADENIYA, SRI LANKA

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The issue of air quality is a pressing environmental concern, as 99% of the global population resides in areas where air quality standard levels are not met. Onsite and real-time air quality monitoring is required to ensure the respiratory health of the urban population. However, air quality monitoring is difficult to achieve using benchtop equipment such as gas chromatography and mass spectrometry. The primary emphasis of this research was to systematically explore and assess pollution levels by using portable gas sensors in urban areas in Peradeniya, thereby contributing valuable insights to the existing body of knowledge on environmental monitoring in this area. The study analysed $NO_2$, $CO_2$, and CO gas levels at designated monitoring locations. The analysis examined the effects of traffic density, time variability, road infrastructure, and environmental conditions. The monitoring device was developed by integrating hardware components with Arduino IDE software. The results implied that emissions from road traffic have a greater influence on $CO_2$, CO, and $NO_2$ concentrations than meteorological conditions. The levels of pollution were found to be elevated by approximately 100% in traffic locations, which is a 25% increase compared to normal traffic conditions. The observed trends showed a 20% increase in pollutant gasses in the afternoon and evening. Galaha junction had an approximate 40% increment than Gatambe, and it demonstrates that the pollution levels have varied significantly within short distances. The levels of all three gases were higher at the Galaha and Gatambe junctions compared to the reference location, University ground. Afternoon hours showed higher pollution levels, which were affected by high ambient temperature. Analysis of the present study was limited to a specific area, which may limit the generalizability of the results to overall air pollution and potentially restrict the applicability of findings to urban traffic areas. Further investigations, including multiple geographic locations in the Kandy and Peradeniya areas, are being conducted to calibrate the developed detection system to measure gas concentrations in ppm.

**Keywords:** Air quality, Arduino IDE software, Gas sensors, Urban traffic

***Abstract No: 291*** ***Earth & Environmental Sciences***

# *Agave americana* AS A PROMISING GREEN BIOSORBENT FOR Ni(II) REMEDIATION

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The heavy metal content in the environment has been rising due to industrial advancement. Nickel (Ni) poses adverse health impacts, such as gastrointestinal distress, pulmonary fibrosis, and skin dermatitis, when present in excess, although it is a micronutrient essential for cellular functions. Excess Ni(II) concentrations can also induce ecological damage by disrupting the cellular functions of flora and fauna. Therefore, Ni remediation from industrial effluent is essential to safeguard human quality of life and ecosystem health. Fibrous biosorbents present promising green alternatives compared to other biosorbent types, offering advantages such as ease of surface modification to attract intended contaminants and simple removal. This study aimed to conduct a comprehensive investigation of the adsorption characteristics of Ni(II) on *Agave americana* fibres as a value-added product. Batch experiments were conducted under optimal parameters; 40 min shaking time, 20 min settling time, and ambient pH, which indicated a significant removal rate of 90.39% at an agitation speed of 150 rpm and room temperature with an optimum dosage of 20 g/L of the sorbent. Kinetic studies validated the pseudo-second-order model for the adsorption of Ni(II) on *Agave americana* fibre, with regression coefficients of 0.9968 and 0.9726 at ambient pH and initial solution pH of 4, respectively, suggesting that chemisorption is the rate-limiting factor in adsorption. Moreover, the fitting of kinetic data to the Weber-Morris intra-particle diffusion model at ambient pH and initial solution pH of 4 implied that both intra-particle diffusion and the boundary layer can affect the rate of adsorption. Further studies could expand the scope of Ni remediation from industrial effluent on a larger scale.

**Keywords:** Biosorbents, Intra-particle diffusion, Kinetic studies, Optimization

***Abstract No: 300*** ***Earth & Environmental Sciences***

# GIS-BASED ASSESSMENT OF NATURE-BASED ECOTOURISM POTENTIAL IN THE JAFFNA DISTRICT, SRI LANKA

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Ecotourism is responsible traveling to natural areas that conserve the environment and sustain the well-being of local community. Jaffna District has a great potential for tourism development. Lagoons, marshlands, mangroves, salt marshes, birding habitats, beaches, and sand dunes are major resources for promoting nature-based ecotourism. Despite numerous attempts to identify the ecotourism potential in Jaffna, GIS-based approaches are rare. Thus, the present study was designed to evaluate the potential of nature-based ecotourism in the district using the Multi Criteria Decision Making (MCDM) method as a tool in the Geographic Information System (GIS). Ecotourism potential analysis was carried out based on a biodiversity survey undertaken from 2013 to 2018 in the Jaffna peninsula. MCDM and criteria ranking method in GIS were used for the suitability analysis. For this, ecotourism aspects such as wildlife in the area (diversity of birds, including abundance of flamingos) and the presence of beaches, mangroves, salt marshes, and sand dunes were considered. Here, factors such as the presence of wildlife, accessibility, community characteristics, and aesthetic and social values were considered. For evaluating the suitability of wildlife, criteria such as species diversity and richness of birds were used. For evaluating the suitability of beaches (facilities) and to evaluate the suitability of mangroves, salt marshes, and sand dunes, density and distribution were used, and tourist preferences, proximity to residential areas, proximity to tourists' accommodation, scenic beauty, and distance from main roads were used for each aspect (factors were selected according to expert opinion). The ranking levels were applied within the criterion and between the criteria. Suitability maps for each aspect were produced through overlaying of thematic maps of each aspect. Based on multi-criteria analysis, eight flamingo sites, 15 birding areas, 17 mangrove areas, three beaches, seven salt marsh sites, and six sand dunes with high potential for promotion of nature-based tourism were identified. The present study showed that 70 species of migrant birds, including the Greater Flamingo (*Phoenicopterus roseus*), an uncommon migrant, and critically endangered, rare and restricted resident and migrant birds, true mangroves species with large extents, five bird species of salt marshes, sunny beaches associated with the fishing community and sand dunes with vegetation cover have great potential for designing and promoting nature tour activities. Lack of investments, ecotourism promotional activities, and other infrastructure facilities negatively affect the ecotourism development of the study areas. Hence, these areas should be promoted for ecotourism development with stakeholder participation from a sustainable point of view.

**Keywords:** Ecotourism, Jaffna District, Multi-Criteria analysis, Nature-based tourism

***Abstract No: 301*** ***Earth & Environmental Sciences***

# GEO-ECOTOURISM POTENTIAL IN JAFFNA DISTRICT, SRI LANKA WITH SPECIAL REFERENCE TO THE SAND DUNES

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The northeastern part of the Jaffna District in Sri Lanka has large extents of sandy areas, the major parts of which are sand dunes, present from Manatkadu to Chundikulam. These hold high potential for the promotion of ecotourism. Previous studies leading to understanding the status of sand dunes as resources in the Northern Province are limited. The objective of the present study was to evaluate the geo-ecotourism potential mostly based on sand dunes using the Multi-Criteria Decision Method (MCDM) as a tool in Geographic Information System (GIS). The potential analysis was carried out based on studies undertaken from 2013 to 2018, covering the sand dunes sites in the northeastern part of the Jaffna peninsula. Tourist preferences were identified through a questionnaire survey, and distances were calculated using GIS techniques. For suitability analysis, MCDM and criteria ranking method of GIS were used. The evaluation process for sites was conducted based on six criteria, *viz.* height and distribution of sand dunes, tourist preferences, proximity to residential areas, proximity to accommodation, distance from main roads, and scenic beauty based on expert opinion. The ranking levels were applied within the criterion and between the criteria. Suitability maps for sand dunes were produced through overlaying of thematic maps of criterion. According to multi-criteria analysis, among the 12 major sand dunes areas, six areas such as Vallipuram, Manatkadu, Kudaththanai, Ampan, Nagarkovil East and Chundikulam were of high potential based on their height and distributions (final output value 2.94). Nagar Kovil South represents a moderate potential (output value 2.60) and the rest of the five places were of low potential (2.15). Sand dunes of the study areas are associated with natural vegetation, and they are considered natural scenic beauty and heritage. These resources are being subjected to sand mining for construction activities, which negatively affects the protection they provide from natural disasters such as tsunamis, cyclones, sea waves, and high tides. Environmental conservation activities should be implemented through strict law enforcement, public awareness, and stakeholders' contributions based on an inclusive approach to creating a sustainable, resilient community.

**Keywords:** Geo-ecotourism, Jaffna Peninsula, Multi-criteria analysis, Sand dunes, Sand mining

***Abstract No: 302*** ***Earth & Environmental Sciences***

# NAGAR KOVIL AREA AS AN ENVIRONMENTAL SENSITIVE AREA IN THE JAFFNA DISTRICT, SRI LANKA

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Environmentally sensitive areas (ESAs) are landscape elements or places that are vital to the long-term maintenance of biological diversity, soil, water, and other natural resources both on-site and in a regional context. Nagar Kovil area includes Kudaththanai, Ampan, Nagar Kovil, Kudarappu, Mamunai Chempiyanpattu, and Maruthankeny, which are located in the Vadamarachchi East Division in the Jaffna District. These areas are covered by Thondamanaru Lagoon, which is associated with significant extents of mangroves that are notable for their bird diversity compared with other parts of the Jaffna peninsula. The objective of the present study was to identify potential ecological characteristics to determine the environmental sensitivity of the Nagar Kovil area. The point-count method was used to determine bird diversity, while the random quadrat method was used to assess the abundance of mangrove species in the area from 2013 to 2018. A total of 38 species of resident birds from Nagar Kovil and 27 species from Mamunai were recorded. The resident bird fauna of Nagar Kovil had a Shannon Index value of 1.418 and an Evenness value of 0.390, whereas those values were 0.911 and 0.276, respectively, for Mamunai. More than 2000 Greater flamingos visit this region from May to August of each year. Among the 21 recorded mangrove species in Sri Lanka, five species; *Excoecaria agallocha, Rhizophora mucronata, Aegiceras corniculatum, Lumnitzera racemosa* and *Avicenna marina,* were recorded, and the two species, *Avicenna marina* and *Aegiceras corniculatum* are rare species. *Rhizophora mucronata,* with a height of more than 25 m, had a relatively high density. A marsh crocodile was also identified, and fish and shellfish, including crabs, were also found in these areas. The study revealed that Nagar Kovil areas sufficient physical and ecological characteristics, to be considered as an environmental sensitive area for conservation point of view.

**Keywords:** Environmental sensitive area, Nagar Kovil, Mangroves, Thondamanaru lagoon

***Abstract No: 11*** ***ICT, Mathematics, and Statistics***

# PRIME LABELLING OF CENTERLESS DOUBLE WHEEL GRAPH USING PYTHON PROGRAMMING

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This research investigated the prime labelling of the Centerless Double Wheel graph ($CDW_{2n}$) using Python programming. Prime labelling is a type of graph labelling that assigns labels to graph vertices such that the greatest common divisor of the labels of adjacent vertices is one. While most previous works on prime labelling have largely relied on manual methods to assign values to vertices based on specific conditions, this study automates the labelling process through programming. The Centerless Double Wheel graph is a simple graph obtained by using the Cartesian product of Cyclic graph; $C_n$ with $n$ vertices and Complete graph of the form $K_2$ and is denoted by $CDW_{2n}$ (i.e. $C_n \times K_2 = CDW_{2n}$). If $n$ is an even integer, then $CDW_{2n}$ achieve its prime labelling based on whether $n + 1$ is prime, or, $2n + 1$ is prime. Contrarily, this study established that no prime labelling exists for $CDW_{2n}$ when $n$ is odd. The proof of the theorem is given as a combinatorial version, and the algorithmic approach was detailed using Python, offering a step-by-step procedure for generating and labelling $CDW_{2n}$ graphs. This work advances the understanding of prime graph labelling and provides computational tools to simplify the process, setting a foundation for future exploration of more complex graph structures.

**Keywords:** Centerless Double Wheel graph, Prime labelling, Python programming

***Abstract No: 12*** ***ICT, Mathematics, and Statistics***

# LAND ALLOCATION MODEL FOR SELECTED UPCOUNTRY VEGETABLES IN SRI LANKA AND CASE STUDY IN NUWARA ELIYA DISTRICT

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Due to the practical essentiality of the land allocation models for crops, such models play an important role in operations research in agriculture. Vegetables could be essential to the agricultural food sector, contributing significantly to the national economy. Vegetables are wasted due to excess supply; on the other hand, if there is not enough supply of vegetables, the price will increase. High price fluctuations in vegetables can often be seen in local vegetable markets. One of the main reasons behind this instability of vegetable prices is a lack of proper cropland allocation. Therefore, it is essential to have a cultivation plan for vegetables. In Sri Lanka, vegetables are categorised into up-country and low-country vegetables. This study aimed to determine the optimal land allocation for selected crops in four upcountry districts: Nuwara Eliya, Badulla, Kandy, and Matale. This study developed a linear goal programming model to allocate land for eight selected upcountry vegetables and tested this model using the Nuwara Eliya District as a case study. Twenty-two agrarian divisions in the Nuwara Eliya District, covering a total of 7,270 hectares of land, were considered. Data were collected bi-weekly throughout the year 2023 and analysed using the model. The results indicate that the demand for beetroot, cabbage, and leeks can be met, and beans, carrots, and radishes have a sufficient supply relative to demand. However, there is a shortfall in the supply of tomatoes and wild cabbage ("knol khol"). The proposed model provides a framework for determining how much of each vegetable to cultivate, when, and in which region to meet demand while minimizing costs.

**Keywords:** Agricultural operations research, Land allocation, Linear goal programming, Vegetable cultivation

***Abstract No: 14*** ***ICT, Mathematics, and Statistics***

# GOAL PROGRAMMING MODEL TO DETERMINE MINIMUM SUPPORT PRICE FOR PADDY FARMERS

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Paddy is the main agricultural crop in Sri Lanka, and 1.8 million Sri Lankan families are involved in paddy cultivation. Farmers are facing economic difficulties due to the lack of a fair price for their paddy production, as they are unable to cover production costs and basic living expenses. This study developed two nonlinear goal programming models to determine the minimum support price (MSP) for paddy farmers and to find the minimum amount of land to be cultivated to achieve that MSP. There are two seasons for paddy cultivation in Sri Lanka, namely "Yala" and "Maha", and the "Yala" season (May-August) was considered in this study. Paddy farmers' one-season income should at least cover the season's production costs and six months of living expenses. This study considered the five major paddy-growing districts of Sri Lanka; Ampara, Anuradhapura, Hambantota, Kurunegala, and Polonnaruwa. In the first model, the five districts were considered separately, and the MSP values of those districts and the minimum land to be cultivated to achieve those MSP values were obtained. The second model was focused on finding a common MSP value for all the selected districts, as well as determining the minimum amount of land required to be cultivated to achieve that MSP. The proposed models were solved using MATLAB programming language. As a local minimum was expected to be found, the solution was tested using four different algorithms: Sequential Quadratic Programming, Interior Point Sequential, legacy Sequential Quadratic Programming, and the Conjugate Gradient algorithm, to see if they all converged to the same value. Here, only one type of paddy has been considered, and the model can be extended by considering paddy varieties.

**Keywords:** Land allocation model, Minimum support price, Paddy cultivation, Sri Lanka

***Abstract No: 16*** ***ICT, Mathematics, and Statistics***

# HYBRIDIZED METHOD TO SOLVE THE INTEGRATED PROBLEM OF VEHICLE ROUTING AND SCHEDULING AT THE COLLECTION CENTER

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The vehicle routing and vehicle scheduling problems are two of the well-studied problems in the field of Operations Research. Most of the operations in these two problems are inter-related at a collection centre in a supply chain. Therefore, the proper coordination among these inter-related operations is essential to increase the efficiency of the supply chain. This study is an extended work on the Mixed Integer Quadratic Programming (MIQP) model developed to solve the integrated Vehicle Routing and Scheduling Problems (VRSP). In this study, the Genetic Algorithm (GA) and GA-based hybridized (HGA) method were proposed to solve the large-scale instances of VRSP. The objectives of this study were to test the accuracy of the proposed GA and to recommend a better method among GA and HGA based on the competency of their solutions. In the HGA, the GA was hybridized with the 'reversion local search method'. For the computational experiments on the MIQP, the benchmark instances were used. The Relative Percentage Deviation (RPD) formula was used to compare the solutions obtained from the methods. The accuracy of the GA was tested by comparing its results with the exact optimal solution obtained using the Branch and Bound algorithm to the MIQP model for the VRSP. The results reveal that up to 91% accuracy in the optimal solution can be reached by the GA method, and it is more than 97% on average. The RPD values reveal that up to 21% improvement in the optimal solution can be obtained by the HGA compared to the GA. It can be concluded that, on average, more than 12% improvement in the quality of the solution can be reached by HGA than that of from GA. This study recommends that GA with reversion local search method produces highly accurate optimal solutions to the VRSP.

**Keywords:** Collection centre, Hybridized method, Vehicle routing, Vehicle scheduling

***Abstract No: 27*** ***ICT, Mathematics, and Statistics***

# MACHINE LEARNING-DRIVEN DISEASE DIAGNOSIS AND MANAGEMENT FOR DIVERSE CROPS USING CNN AND TRANSFER LEARNING

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This research aimed to develop a machine-learning-based framework for disease diagnosis in a variety of crops, including rice, bell pepper, tomato, potato, and coconut. The primary objective of this study is to minimize the gap between farmers and accessible disease identification technologies and increase diagnostic accuracy by using Convolutional Neural Networks (CNN) and advanced transfer learning. CNNs effectiveness in image recognition, especially in capturing spatial hierarchies in images make CNN well suited for identifying complex patterns in crop disease images. This was achieved with a dataset sourced from Kaggle's "Plant Village" and a few other repositories, comprising diverse images of diseased crops. The dataset was pre-processed to account for multiple disease types within each crop. Mirroring the techniques developed for image recognition tasks and using CNNs fed with transfer learning made it possible to train models with impeccable sensitivity, specificity, and accuracy by dividing the dataset into 80% for training to ensure sufficient data exposure,10% for testing to evaluate the model's performance on unseen data and 10% for validation to tune the hyperparameters and check overfitting. Furthermore, the models, based on the Visual Geometry Group (VGG) model, showed good efficiency with high precision, recall, F1 scores, and accuracy on a range of crops. The base CNN model showed slightly weaker performance with precision, recall, and F1-scores of 0.95, 0.95, and 0.95 and accuracy of 94.81%, indicating the VGG model's superior effectiveness across various crops. Validation metrics confirmed the models' high sensitivity and specificity. The resulting web and mobile applications embed a variety of user-friendly interfaces for presaging real-time disease as well as management counselling approaches that are accessible to meet the needs of farmers and agronomists.

**Keywords:** Convolutional Neural Network, Disease diagnosis, Hyperparameters, Transfer learning, Visual Geometry Group

***Abstract No: 28*** ***ICT, Mathematics, and Statistics***

# NOVEL VARIATION OF THE RABIN CRYPTOSYSTEM USING CONTINUED FRACTIONS

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Cryptography is the process of concealing information and communications so that only the intended recipient can read it. It involves the use of complex algorithms and computational techniques to transform original data into unreadable forms, ensuring its confidentiality. The Rabin Cryptosystem is one of the widely known public key cryptosystems and its security depends on the inherent difficulty of integer factorization, mirroring the RSA cryptosystem. Two large prime numbers are selected as private keys, and their product serves as the public key. A message is encrypted by squaring and decrypted by computing the square roots modulo the composite number generated by the two primes. A variant known as the H-Rabin Cryptosystem incorporates a third prime number for enhanced security. In both the Rabin and H-Rabin Cryptosystems, the chosen prime numbers share a congruence of 3 modulo 4. In the present study, the key generation was developed using three odd primes and continued fraction representations of random positive integers. This modified public key cryptosystem employs the product of any three odd primes $p, q,$ and $r$ as $n$ and another key $e_a$ with the continued fraction representation for its public key, with private key as $p, q, r$ and multiplicative inverse of $e_a$ modulo $n$. In the encryption, the plaintext converts into binary form to ensure that the message can be represented in a numerical form suitable for mathematical operations. Bits were replicated to increase the security of the encryption process. After converting it into the decimal form, the message was encrypted by squaring modulo, the product of the three odd primes. The decryption process is based on the Chinese Remainder Theorem and the Tonelli-Shanks Algorithm to find the square roots modulo that composite number. In the Rabin cryptosystem, solving the quadratic residue of the ciphertext yields four distinct solutions. Both the H-Rabin cryptosystem and our proposed algorithm produce eight different outputs, necessitating the identification of the original message among these possibilities. A replication technique that was used during encryption was applied to identify the correct plaintext. A polynomial-time Las Vegas algorithm RANDOM-FACTOR with the BREAK-RABIN oracle to factor composite numbers efficiently, reducing the likelihood of successful factoring and strengthening the overall cryptographic security.

**Keywords:** Chinese Remainder Theorem, Continued fractions, Integer factorization, Rabin cryptosystem, Tonelli-Shanks algorithm

***Abstract No: 34*** ***ICT, Mathematics, and Statistics***

# SYMMETRICITY OF POLYNOMIALS DEFINING DISTINGUISHED VARIETIES ON THE SYMMETRIZED BIDISK

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Let $\mathbb{D}$ be the unit disk, $\mathbb{T}$ be the unit circle, and $\mathbb{E}$ be the set $\mathbb{C} \setminus \overline{\mathbb{D}}$ in $\mathbb{C}$. For a polynomial $f(z,w) \in \mathbb{C}[z,\ w]$ such that its zero set $Z(f) \subset \mathbb{D}^2 \cup \mathbb{T}^2 \cup \mathbb{E}^2$, we say $Z(f) \cap \mathbb{D}^2$ is a distinguished variety on $\mathbb{D}^2$ and the polynomial $f(z,w)$ is called a polynomial defining a distinguished variety on $\mathbb{D}^2$. A polynomial $f(z,w) \in \mathbb{C}[z,w]$ is said to have bidegree $(n,m)$ if $f(z,w)$ has degree $n$ in $z$ and degree $m$ in $w$. The reflection of $f(z,w)$ at bidegree $(n,m)$ is defined as the $\tilde{f}(z,w) = z^n w^m \overline{f\left(\frac{1}{\bar{z}},\ \frac{1}{\bar{w}}\right)}$. A polynomial $f(z,w)$ is called essentially $\mathbb{T}^2 -$ symmetric if $f(z,w) = c\,\tilde{f}(z,w)$ for some $c \in \mathbb{T}$. Every polynomial that defines a distinguished variety on $\mathbb{D}^2$ is symmetric with respect to $\mathbb{T}^2$ in the sense that it is essentially $\mathbb{T}^2 -$ symmetric. Let $\pi : \mathbb{C}^2 \to \mathbb{C}^2$ be the symmetrization map given by $\pi : (z,w) \mapsto (z + w, zw)$ and $\mathbb{G} = \pi(\mathbb{D}^2)$, $\Gamma$ be the boundary of $\mathbb{G}$ and $\partial\Gamma = \pi(\mathbb{T}^2)$ be the distinguished boundary of $\mathbb{G}$, where $\mathbb{G}$ is called the symmetrized bidisk. For a polynomial $g(s,p) \in \mathbb{C}[s,p]$ such that its zero set $Z(g) \subset \mathbb{G} \cup b\Gamma \cup \mathbb{C} \setminus \Gamma$, we say $Z(g) \cap \mathbb{G}$ is a distinguished variety on the symmetrized bidisk $\mathbb{G}$, and $g(s,p)$ is referred to as a polynomial defining a distinguished variety on the symmetrized bidisk $\mathbb{G}$. In this work, symmetric properties of polynomial defining a distinguished variety on the symmetrized bidisk $\mathbb{G}$ were studied. Given a polynomial $g(s,p)$ of bidegree $(k,l)$, the reflection of $g$ was defined as $\hat{g}(s,p) = p^k \overline{g\left(\frac{1}{\bar{p}/\bar{s}},\ \frac{1}{\bar{p}}\right)}$. A polynomial $g$ is essentially $\partial\Gamma$-symmetric if $g(s,p) = c\,\hat{g}(s,p)$, where $c \in \mathbb{T}$. It was proved that a polynomial defining a distinguished variety on the symmetrized bidisk is essentially $\partial\Gamma$- symmetric. This study contributes to the broader understanding of geometric representation and properties of polynomial defining distinguished varieties on the symmetrized bidisk.

**Keywords:** Distinguished varieties, Inner toral polynomials, Symmetrized bidisk

***Abstract No: 36*** ***ICT, Mathematics, and Statistics***

# INTEGER LINEAR PROGRAMMING MODEL FOR TUTOR WORKLOAD ASSIGNMENT: A CASE STUDY

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The scheduling problem is one of the prominent problems among operations researchers due to its high applicability and cost of obtaining optimum solutions. There are many variations, applications, and solution techniques for scheduling problems. This study was devoted to obtaining a model based on a case study, assigning tutorial staff to tutorial classes, and conducting practical classes. Assigning teaching assistants to tutorial and practical classes is challenging for many universities. With a large number of students and a limited number of teaching assistants, it's crucial to ensure that assignments maximize both the assistants' satisfaction and their capacity to support students effectively. Although there are some similarities in the demonstrator workload problem among different departments, it varies from department to department depending on the number of theoretical and practical course units, the number of students registered for each course unit, the number of tutors, different rules of assignments, etc. This study considered the tutor workload assignment for semester one of the Department of Mathematics, University of Ruhuna, as a case study. An integer linear programming model was proposed, considering the objectives of equal workload among tutors and also assigning classes according to their preferences. Several constraints, such as the number of tutors needed for each tutorial class, grading all the tutorials weekly, assigning a required number of demonstrators for each practical class, and year-wise variations among tutors, were considered. The optimal solution for the case study of the proposed integer linear programming model was obtained by employing the MATLAB programming language using the Branch and Bound algorithm. The solution of the model provides the assignments of tutors for each tutorial class and practical class, with a possible equal workload among tutors.

**Keywords:** Branch and Bound algorithm, Integer linear programming, Scheduling problem, Workload assignment

***Abstract No: 43*** ***ICT, Mathematics, and Statistics***

# ENHANCED AUTOMATED RECOGNITION OF SRI LANKAN WILD CAT SPECIES UTILIZING FINE-TUNED DEEP LEARNING MODELS

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Conserving wild cat species in Sri Lanka relies heavily on precise species identification, a task traditionally handled by specialists. The morphological identification process is often lengthy and subject to errors. This study introduces a deep learning based automated identification system for wild cat species to assist biodiversity conservation efforts in Sri Lanka. Four distinct wild cat species in Sri Lanka: Leopard (*Panthera pardus kotiya*), Rusty-spotted cat (*Prionailurus rubiginosus*), Jungle cat (*Felis chaus*), and Fishing cat (*Prionailurus viverrinus*) were used for the study. Conservation of these species is crucial for maintaining the balance of the ecosystem. There is a significant research gap in transfer learning model utilization in the field of wild cat species conservation in Sri Lanka, and this research endeavoured to address that by fine-tuning DenseNet121, DenseNet169, InceptionV3, Xception, NASNetMobile, and InceptionResNetV2 models. The distinctive features of each species were identified using these models. A dataset comprising 400 images was distributed evenly, with 100 images allocated per species. This research marks the first application of deep learning for wild cat identification in Sri Lanka using fine-tuned convolutional neural network models, comparing several transfer learning models to determine the most effective method for species identification. The DenseNet121 model demonstrated a notable accuracy of 93.75% and F1-score of 93.49% on the augmented dataset. Even though data augmentation was used to mitigate this limitation, the size of the dataset may limit the generalizability of the results. These findings suggest that deep learning can greatly enhance the accuracy and efficiency of species identification, contributing to more effective conservation strategies.

**Keywords:** Convolutional Neural Networks, Deep learning, DenseNet121, Sri Lankan wild cats, Transfer learning

***Abstract No: 46*** ***ICT, Mathematics, and Statistics***

# APPLYING ANT COLONY OPTIMIZATION ALGORITHM TO SOLVE THE DETERMINISTIC SINGLE OBJECTIVE ASSIGNMENT PROBLEM

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This study proposed a metaheuristic algorithm known as the Ant Colony Optimization Algorithm (ACOA) to solve the deterministic Assignment Problem (AP) with a single objective. The AP is a special type of linear programming problem where the objective is to minimize the cost or time of completing a number of jobs by a number of persons/machines. The ACOA was designed based on the foraging behaviour of ants seeking a path between their colony and source of food. The ACOA is a probabilistic technique for finding the optimal path of the AP. When searching for food, ants initially explore the area surrounding their nest in a random manner. While moving, ants leave a chemical known as pheromone on the ground along the trail. When choosing their way, they tend to choose the path marked by strong pheromone concentrations. Ants' pheromone laying phenomenon and, hence, locating the closest food source is adopted in the selection of the shortest path in the ACOA. To illustrate the proposed method, an AP was formulated by randomly generating the Assignment Cost Matrix (ACM). For the first row of the ACM, the transition probabilities were determined applying the ACOA. Subsequently, the shortest path for the first row of the ACM is found by comparing the cumulative probability solution set and the generated random set. The optimal solution for the first row of the ACM was recorded, and afterwards, the row and the column of the ACM corresponding to the selected path were excluded. This process was repeated for the rest of the rows and the optimal solution respect to each row is recorded. The proposed iterative technique converges to the optimal solution of the AP. The optimal assignment found using this method was verified by applying the Hungarian Algorithm (HA). The results indicate that this method is effective in finding the optimal assignment and performs better in terms of computational time for large-scale APs compared to the HA. Future works will focus on applying APs with uncertain assignment costs.

**Keywords:** Ant colony optimization algorithm, Assignment cost matrix, Assignment problem, Hungarian algorithm

***Abstract No: 58*** ***ICT, Mathematics, and Statistics***

# $(k, c)$-CHOOSABILITY OF CYCLE GRAPHS, WHEEL GRAPHS AND GENERALIZED PETERSEN GRAPHS GP$(n, 1)$

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List colouring is a way of graph colouring used in graph theory, in which each vertex can be assigned a list of permissible colours. A graph is deemed $k$-choosable, or $k$-list colourable if it can be properly list coloured regardless of the specific assignment of a list containing $k$ colours to each vertex. The aim of this research was to understand the concept of $L$-list colourability for every $(k, c)$-assignment $L$ of any planar graph and identify values for $k$ and $c$ of three families of planar graphs: the cycle graphs, wheel graphs and generalized Petersen graphs of the form GP$(n, 1)$ that are $(k, c)$-choosable. Earlier studies on $(k, c)$-choosability of planar graphs were reviewed, and the methods used in the findings were applied to complete the research problem. Significant results relating to the relationship between $k$-choosability, $(k, c)$-choosability, and the list chromatic number for any graph $G$ were proved in this research. It was proved that the cycle graph $C_n$ and generalized Petersen graphs GP$(n, 1)$ are 3-choosable for any $n \geq 3$, $(k, 3)$-choosable for any $k \geq 3$ and $(3, t)$-choosable for $t = 1, 2, 3$. Also, the wheel graph $W_n$ is 4-choosable, $(k, 4)$-choosable for any $k \geq 4$ and $(4, t)$-choosable for $t = 1, 2, 3, 4$. Specific values for $k$ and $c$ for the existence of $(k, c)$-choosability were found for all three families of planar graphs.

**Keywords:** $(k, c)$-assignment, $(k, c)$-choosability, $k$-choosable, List colouring, Planar graphs

***Abstract No: 61*** ***ICT, Mathematics, and Statistics***

# NETWORK-BASED INVESTIGATION INTO TUBERCULOSIS SPREAD IN NUWARA ELIYA DISTRICT, SRI LANKA

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Tuberculosis (TB) remains a major health challenge in low- and middle-income countries like Sri Lanka, requiring ongoing control and elimination efforts. This study focussed on the Nuwara Eliya District, a popular tourist destination that highlights the need for targeted TB control measures due to the high number of visitors. The primary objective was to forecast TB patients for 2024 by gender, age group, and TB type using ARIMA models for descriptive analysis while constructing a synthetic dataset that includes gender, age, TB type, and relationship based on the forecast results. This dataset was validated through k-fold cross-validations and then converted into a network, where the nodes represent patients and edges represent patient contact relationships. The constructed network was analysed using centrality measures, cluster analysis, and Technique for Order of Preference by Similarity to the Ideal Solution (TOPSIS) methods. Data collection involved annual data from 2012 to 2021 obtained from the National Programme for Tuberculosis Control and Chest Disease website and primary data from Nuwara Eliya Hospital for 2022 and 2023. The ARIMA model was applied solely for forecasting. The synthetic dataset constructed by taking percentages of forecasting data, underwent k-fold cross-validation, achieving an accuracy of approximately 66.39%, supporting the reliability of the forecasting model. Centrality analysis identified influential nodes crucial for disease transmission, while cluster analysis revealed low local clustering but a robust community structure, suggesting that targeted interventions within specific groups could enhance TB control efforts. The TOPSIS method ranked the top ten most influential patients, offering strategic targets for intervention. These findings underscore the importance of tailored control measures to effectively manage TB in high-visitor areas.

**Keywords:** ARIMA, Cluster analysis, TOPSIS method, Tuberculosis

***Abstract No: 72*** ***ICT, Mathematics, and Statistics***

# NEW THIRD-ORDER APPROXIMATION FOR FRACTIONAL DERIVATIVES

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Fractional derivatives (FDs) have seen diverse applications over the past few decades in many fields, including physics, biology, finance, and engineering. They are particularly useful for modelling memory and hereditary properties, which are essential for understanding materials and processes with memory effects that integer-order derivatives cannot capture. The non-local nature of FDs introduces computational challenges, including reduced accuracy, inefficiency, and instability, especially when solving fractional-order differential equations numerically. The Grünwald approximation (GA), which provides a first-order approximation of FDs, often results in unstable numerical solutions for fractional-order differential equations, like the space fractional diffusion equation. The shifted GA offers improved stability but retains only first-order accuracy. Similarly, Lubich approximations for FDs fail to provide stable solutions and revert to first-order accuracy when shifted. A second-order approximation was recently developed and applied to the space fractional diffusion equation, showing promising stability. Building on this, third-order and fourth-order approximations have been derived from the second-order method, albeit in quasi-compact form. This study proposed a new third-order accurate approximation derived from the second-order approximation, utilizing a convex combination of the second-order approximation with two different shifts, $r_1, r_2$. The proposed third-order approximation is applied to a one-dimensional steady-state problem with numerical test examples. The results indicate that the third-order approximation is significantly more accurate than the second-order approximation, achieving a convergence order of 3, consistent with the theoretical order. For instance, with a grid size $h = 1/2048$ and fractional order $\alpha = 1.5$, using $r_1 = -1$ and $r_2 = 1$, the maximum error of the proposed approximation is 4.20E-08, compared to 1.63E-05 for the second-order approximation. The proposed method has potential applications for solving super-diffusion problems in various fields, such as finance and physics.

**Keywords:** Fractional derivatives, Generating functions, Grünwald approximation, Space fractional diffusion equation

***Abstract No: 128*** ***ICT, Mathematics, and Statistics***

# UNDERSTANDING RAINFALL DYNAMICS IN KEGALLE, SRI LANKA: INSIGHTS FROM CIRCULAR AND LINEAR ANALYSIS

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Rainfall is a crucial component of the Earth's water cycle, providing essential moisture for life. Traditional linear regression models often struggle to capture the complex interactions between meteorological variables, especially circular variables like wind direction. This study focused on circular regression models to overcome these drawbacks and enhance rainfall forecasts. The dataset obtained from Bogala Graphite Lanka PLC, covered hourly data from January 1, 2022, to January 1, 2023, in Kegalle. It contained observations of rainfall, wind speed, wind direction, and temperature. Summary statistics were calculated for the numerical variables, and various plots, including boxplots, hydro plots, and circular histograms, were used to identify trends. Additional predictor variables were created to avoid predicting rainfall occurrence for the same hour by introducing lagged values for wind speed, wind direction, and temperature. First, several Circular-Linear Logistic Regression Models (CLLRMs) were fitted to the entire dataset, with an 80% training index dividing the data into training and testing sets. Then, the best-fitted model was selected based on the performance statistics. To account for the seasonal variability of Sri Lanka's monsoon patterns, the dataset was divided into subsets corresponding to the first inter-monsoon, southwest monsoon, second inter-monsoon, and northeast monsoon. A Linear-Ridge Logistic Regression Model was employed for the first inter-monsoon dataset to address multicollinearity among the predictor variables, while a standard Linear Logistic Regression Model was constructed for the northeast monsoon dataset, as circular variables were found to be statistically insignificant. For the other two seasons, CLLRMs were fitted. The Spearman's rank correlation coefficient revealed a weak negative correlation between rainfall and temperature, with no significant correlation to wind speed. The seasonal models exhibited high accuracy (80%-90%) and specificity (85%-90%), demonstrating notable sensitivity compared to CLLRM fitted for the entire dataset, with temperature having a greater impact on rainfall than wind speed and direction. Future research may focus on developing CLLRMs and Multinomial Models to understand rainfall patterns more accurately, aiming to predict both rainy and non-rainy conditions and distinguish between light, moderate, and heavy rainfall.

**Keywords:** Correlation, Multicollinearity, Ridge regression, Sensitivity, Specificity

***Abstract No: 130*** ***ICT, Mathematics, and Statistics***

# CORDIAL LABELLING OF PENDANT GRAPHS

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Graph theory is a significant area of discrete mathematics, exploring the relationships and structures formed by vertices and edges. One important concept within graph theory is graph labelling, where labels are assigned to vertices or edges based on specific rules. Cordial labelling is a type of graph labelling characterised by its balanced nature and diverse applications, including network design, coding theory, and communication systems. In cordial labelling, each vertex of a graph is assigned a label from the set $\{0, 1\}$ such that the number of vertices labelled 0 and 1 differ by at most one. Each edge is then labelled according to the absolute difference between the labels of its endpoints, ensuring that the number of edges labelled 0 and 1 also differ by at most one. This research addressed the problem of determining whether pendent graphs admit cordial labelling. Pendant graphs, characterised by having one or more vertices of degree one, are commonly found in various real-world networks. The primary contribution of the present study is a proof of the fact that every pendant graph is cordial. This result shows that pendant graphs inherently allow cordial labelling, enhancing theoretical understanding of graph labelling and offering practical insights for designing balanced network structures. The finding also suggests potential directions for future research, such as extending the result to more complex graph families and exploring further applications of cordial labelling.

**Keywords:** Balanced network structures, Cordial labelling, Pendant graphs

***Abstract No: 135*** ***ICT, Mathematics, and Statistics***

# SURVIVAL ANALYSIS OF OVARIAN CANCER PATIENTS AND INFLUENTIAL SOCIO-DEMOGRAPHIC AND GENETIC FACTORS

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Ovarian cancer is a fatal disease primarily affecting postmenopausal women, with the highest incidence in those over 50. Annually, approximately 190,000 new cases are diagnosed worldwide. Due to nonspecific symptoms and inadequate screening methods, the disease is often detected at advanced stages, leading to poor survival outcomes. Although less common than breast cancer, ovarian cancer-related deaths are projected to rise by 2040. This study aimed to estimate the survival probabilities of patients and assess how socio-demographic and genetic factors influence survival. Key socio-demographic variables include age at diagnosis (under 50, 51–70, and over 70), race (Asian, White, Black or African, and others), and ethnicity (Hispanic/Latino and others). Six overexpressed genes in 177 patients over a three-year follow-up period were evaluated. Kaplan-Meier estimates revealed survival rates of 84% in the first, 59% in the second, and 38% in the third year. The Log Rank test was used to compare survival curves and Cox proportional hazards models quantified relationships between the covariates. Results indicated that older age groups face significantly higher hazard rates, and White non-Hispanic/Latino patients exhibit poor survival. Significant risk factors include interactions between age and specific genes, as well as time-dependent gene expression. These findings emphasize the importance of tailoring treatment plans considering race, ethnicity, age, and genetic expression to improve patient care outcomes.

**Keywords:** Cox PH model, Genetic expression, Kaplan Meier method, Ovarian cancer, Survival analysis

***Abstract No: 142*** ***ICT, Mathematics, and Statistics***

# IMPACT OF RAINFALL AND FUEL PRICE ON WHOLESALE PRICE OF UPCOUNTRY VEGETABLES

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Econometric models and panel data analysis are commonly used methodologies for quantifying relationships among economic variables for predicting outcomes and informing policy decisions. The objective of this study was to develop a Vector Autoregression (VAR) model to statistically assess the impact of rainfall and fuel prices on the wholesale prices of three major upcountry vegetables in Nuwara Eliya. Monthly wholesale price data were obtained from the Hector Kobbekaduwa Agrarian Research and Training Institute (HARTI) for the years 2020 to 2024. Monthly rainfall data for Nuwara Eliya over the same period was collected from the Department of Meteorology, while fuel prices were sourced from the Ceylon Petroleum Corporation. Granger causality tests indicated that changes in wholesale prices were significantly influenced by rainfall variations. The absence of autocorrelation among the model variables suggested that the model effectively captured the temporal dependencies in the data. This indicated that the model was well-specified, providing a reliable foundation for accurate predictions. VAR model coefficients showed that fuel prices have a negligible impact on vegetable prices, with increases of 0.00014, 0.000023, and 0.000011 in rupees per kilogram for carrots, leeks, and cabbage, respectively. In contrast, rainfall has a significant negative impact on prices, -15.08819 for carrots, -13.072 for leeks, and -13.078 for cabbage. These results showed that fuel prices had a negligible impact on wholesale prices due to their low magnitude. This analysis provided insight into how variations in rainfall and fuel prices affected the price. However, the VAR model assumes linear relationships and constant coefficients, which may not fully capture the complexities of real-world economic dynamics.

**Keywords:** Dynamic model, Granger causality, Supply chain, Temporal dependency, Vector autoregressive model

***Abstract No: 149*** ***ICT, Mathematics, and Statistics***

# COMPARISON OF REGRESSION METHODS FOR MODELLING LONGITUDINAL DATA

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This study conducted a detailed comparative analysis of three regression methods suitable for modelling longitudinal data: linear regression, quantile regression, and rank-based regression, utilizing both Monte Carlo simulations and an empirical dataset. The findings from the simulation study yield several key insights. For smaller sample sizes, linear regression, and rank-based regression demonstrate greater accuracy compared to quantile regression. Although the performance of all three methods improves with increasing sample sizes, quantile regression consistently lags behind. Furthermore, the number of independent variables significantly influences regression accuracy in smaller datasets, but this effect diminishes as the sample size grows. The empirical analysis employs the "beach water quality" dataset as a case study, partitioning it into training and test sets to evaluate the performance of the three regression methods. The results indicated that the linear regression model achieves the lowest Mean Squared Error (MSE) and Root Mean Squared Error (RMSE) on both training and test data indicating superior performance. Conversely, the rank-based regression model exhibits the highest MSE and RMSE across both datasets, reflecting comparatively poorer performance. The results suggest that the linear regression model is the most reliable for longitudinal data, consistently outperforming the other two models in the scenarios considered.

**Keywords:** Linear regression, Longitudinal data, Rank-based regression, Quantile regression

***Abstract No: 153*** ***ICT, Mathematics, and Statistics***

# FIFTH-ORDER RUNGE-KUTTA METHOD FOR SOLVING QUADRATIC RICCATI EQUATION

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The quadratic Riccati Differential Equation (RDE), a non-linear ordinary differential equation, has found numerous applications in many fields including biology, finance, and engineering. Solving the RDE analytically is challenging due to several reasons such as the lack of closed-form solutions, complex solution forms, and singularity issues. Numerical methods are often preferred for solving RDE. The initial-value problem for RDE, denoted by IVPRDE, with the initial condition $y(t_0) = \alpha \in \mathbb{R}$, is given by $y'(t) = p(t) + q(t)y + r(t)y^2 = f(t, y)$, where $p(t), q(t)$, and $r(t)(\neq 0)$ are continuous functions defined on the interval $[t_0, T]$. Recently, the classical fourth-order Runge-Kutta (RK4) method has been applied to obtain numerical solutions for IVPRDE, establishing its stability and convergence. In literature, higher-order (> 4) Runge-Kutta methods have not yet been applied to solve the IVPRDE. This study aimed to apply a fifth-order Runge-Kutta method, specifically Butcher's fifth-order Runge-Kutta (BRK5) approximation, to numerically solve the IVPRDE and obtain its numerical solutions. The stability and convergence of the proposed method were established. Using BRK5, maximum errors on a discretized domain of $[t_0, T]$ with different uniform grid sizes ($h$) were computed and compared with those of RK4 method for four numerical test examples. Numerical results demonstrate that BRK5 has a superior accuracy over RK4. For example, when $h = 0.01$, the maximum errors due to BRK5 for the tests are 3.1086e-15, 1.8797e-12, 8.8818e-16, and 7.4052e-14, whereas the corresponding errors computed by RK4 are 2.6645e-15, 1.4105e-09, 6.5340e-10, and 6.7954e-11. These results verify the effectiveness of BRK5 over RK4 for solving IVPRDE.

**Keywords:** Higher order Runge-Kutta methods, Initial value problems, Numerical solution, Riccati differential equation

***Abstract No: 161*** ***ICT, Mathematics, and Statistics***

# PRIME FACTOR COUNTING METRIC ON POSITIVE RATIONAL NUMBERS

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Up to the same topology, there are only three real absolute values on the rational numbers: the discrete metric, the Euclidean metric, and the p-adic metric. This work introduced a novel metric for positive rational numbers, henceforth referred to as the prime factor counting metric, which is based on their unique prime factorizations and is compatible with multiplication. While this metric has been successfully established for positive integers before, this study extends it by utilizing the greatest common divisor and least common multiple operations for positive rational numbers. The study showed that the extension retains the properties of a metric and provides a unit distance criterion based on prime factors. The criterion offers an intuitive method for calculating the distance between positive rational numbers through prime factor adjustments. The proposed metric induces the discrete topology on $\mathbb{Q}^+$, which can be better described using a Hasse diagram and the associated graph metric, where each edge represents multiplication or division by a prime number.

**Keywords:** Hasse diagrams, Metric spaces, Prime factor counting metric, Real absolute values

***Abstract No: 173*** ***ICT, Mathematics, and Statistics***

# SOLVING HEAT EQUATION USING RADIAL BASIS FUNCTION FINITE DIFFERENCE METHOD

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Heat conduction in a surface layer is crucial for diverse applications in geophysics, environmental science, and engineering influencing processes from geothermal energy extraction to underground cable system efficiency and building foundation stability. The Radial Basis Function Finite Difference (RBFFD) method is a powerful numerical technique for solving interpolation problems and partial differential equations (PDEs), particularly in domains with complex boundary conditions. This approach discretises and solves PDEs effectively by fusing the accuracy of finite differences with the flexibility of radial basis functions (RBFs). When it comes to tackling heat conduction problems, the RBFFD method has several advantages over traditional numerical techniques, particularly over the Finite Difference Method (FDM) and Finite Element Method (FEM). The objective of this study was to investigate the use of the RBFFD approach in the domain $\Omega = [-1, 1]$ to solve a one-dimensional time-dependent heat equation. A MATLAB algorithm was written to solve PDEs using the RBFFD method and specifically to solve the heat conduction problems. The solution graphs obtained using the RBFFD method were compared with the analytical solution to validate the accuracy of the numerical approach. The maximum absolute error of the approximated solution was calculated to be 0.00524. Based on this error and the solution graphs, the approximated solution can be considered very accurate.

**Keywords:** Heat equation, Numerical methods, Radial Basis Function Finite Difference method

***Abstract No: 177*** ***ICT, Mathematics, and Statistics***

# RELATIONSHIP BETWEEN MACROECONOMIC VARIABLES AND SECTORAL INDICES: EVIDENCE FROM COLOMBO STOCK EXCHANGE

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A stock exchange is a trading place for buying and selling financial instruments, such as bonds and shares issued by businesses. Sri Lanka's primary stock exchange is the Colombo Stock Exchange (CSE). There is a lack of information in the literature about the relationship between different sector indices and different macroeconomic variables across longer periods. However, many studies have been conducted in Sri Lanka on the relationship between macroeconomic variables and stock market returns. This study examined the impact of macroeconomic variables on sector indices and identified potential causal relationships between them. Using monthly data from January 2003 to December 2019, statistical techniques such as the Augmented Dickey-Fuller (ADF) unit root test, the Johansen cointegration test, Vector Auto-Regressive (VAR), and Vector Error Correction Model (VECM) were used to examine the relationship between the Money Supply, Inflation Rate, Interest Rate, and Exchange Rate on 18 sector price indices registered at the CSE. The findings indicated that most of the various sector indices of the CSE have a consistent long-term association with the macroeconomic variables of Inflation Rate, Interest Rate, and Exchange Rates. At the same time, there was no short-term relationship between macroeconomic variables and the two sectors of food, beverages and tobacco, and telecommunications. Both the money supply sector and the footwear and textile sector did not show a consistent, long-term equilibrium relationship with other macroeconomic factors and industries. There was no significant relationship between macroeconomic variables and the health care, information technology, bank finance and insurance, and stores and supplies sectors at 10% significance levels. This result is important for policymakers, companies, investors, and other economic actors. Future research may consider different approaches and datasets with varying frequencies, such as weekly and daily, while also adding other macroeconomic variables like industrial production and gross domestic product.

**Keywords:** Colombo Stock Exchange, Johansen cointegration, Macroeconomic variables, Sector indices, VECM

***Abstract No: 183*** ***ICT, Mathematics, and Statistics***

# ENHANCING URBAN TRAFFIC FLOW THROUGH INTEGRATED OPTIMIZATION AND STATISTICAL ANALYSIS

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Urban traffic congestion is a major problem that requires advanced mathematical models for effective traffic flow management. Traditionally, regression techniques have been used to fit empirical data into traffic flow models, but recent optimization methods promise more precise and reliable models. The main objective of this study was to discuss the importance of optimization techniques in estimating speed-density parameters. This study evaluated the Greenshields, Greenberg, and Underwood traffic flow models using both regression and optimization approaches. Previous studies used regression analysis and algorithms such as an Enumeration Algorithm to obtain model parameter estimates. In this study, mathematical optimization models were introduced, and Python's SciPy optimization module was used to solve these models, ensuring robust parameter estimation. Results showed that Greenberg's optimization model had poor alignment between predicted and observed values. However, Greenshields and Underwood optimization models have provided reliable speed-density estimates compared to other methods. The optimization models integrate constraints based on speed-flow models and flow-density relations, allowing model parameters to be shaped not only by the model equation and dataset but also by these constraints. The models become more precise by introducing constraints for road conditions and establishing jam density limits.

**Keywords:** Enumeration algorithm, Mathematical optimization, Regression analysis, Traffic flow models, Urban traffic

***Abstract No: 188*** ***ICT, Mathematics, and Statistics***

# MASS OF RAYS ON COMPLETE OPEN SURFACES

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This research explored the relationship between total curvature and the mass of rays on finitely connected complete open surfaces, deriving several integral formulas. On a complete, non-compact Riemannian 2-manifold, a ray is a unit speed geodesic where every sub-arc minimizes distance, ensuring the distance between any two points on a ray equals its arc length. Such manifolds have at least one ray passing through each point due to their completeness and non-compactness. The primary goal was to demonstrate three key theorems regarding the relationships between total curvature, Euler characteristics, and ray behaviour on Riemannian surfaces. The study revisited previous research on total curvature and Euler characteristics, explored the relationship between the mass of rays and total curvature, and examined Riemannian planes with varying Gaussian curvature. It also examined the relationship between isoperimetric inequality, positive total curvature and the asymptotic behaviour of mass integrals. In conclusion, this study extended the previous results on total curvature to manifolds with one end, providing new insights into the interplay between total curvature and Riemannian metrics. These findings can be extended to manifolds with K-ends and general Alexandrov spaces, emphasizing the importance of total curvature.

**Keywords:** Complete open surfaces, Finitely connected manifolds, Geodesics, Total curvature

***Abstract No: 189*** ***ICT, Mathematics, and Statistics***

# FACTORS AFFECTING PROMPT RESPONSE IN EMERGENCY SITUATIONS AMONG UNDERGRADUATES IN SRI LANKA

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First aid knowledge and prompt response in emergencies are crucial for saving lives and reducing morbidity. Prompt responses are referred to in accidents as quick and proper life-saving care before a patient receives substantial therapy. This study explored the factors influencing prompt responses among undergraduates in Sri Lanka using logistic regression. While previous research has focused on the impact of first aid training on emergency response capabilities, this study considered additional factors such as confidence, cultural influences, and emotional conditions. Data were collected by circulating an online survey questionnaire among university undergraduates, which consisted of the main four sections (A, B, C, and D). Sections A, B, C, and D were created to give marks to their first aid knowledge, experience, confidence, and cultural factors with emotional conditions impact on prompt responding using the Likert scale of 1 (poor) to 5 (excellent). A total of 124 undergraduates have responded to the survey from various universities in Sri Lanka, with a total of 31 male and 93 female undergraduates. Logistic regression Sigmoid function analysis examined the relationship between first aid knowledge, experiences, confidence, and cultural factors with prompt responses. Results indicated that only 19.35% of undergraduates demonstrated the ability to respond promptly in emergencies. First aid knowledge and confidence in facing the situation were found to be significantly associated with prompt responses ($\chi^2$ = 18.73, $p$ < 0.001). The odds ratio of gender vs. first aid knowledge and confidence were greater than one, implying the associations. This study resulted in 54.47% of undergraduates believing that cultural factors and emotional conditions affect emergency response. The odds ratio of gender vs cultural factors with emotional conditions resulted in no association. These findings underscore the importance of considering multiple factors in assessing emergency response capabilities among undergraduates.

**Keywords:** Confidence, Cultural factors, First aid, Knowledge, Undergraduates

***Abstract No: 193*** ***ICT, Mathematics, and Statistics***

# BIRD SPECIES CLASSIFICATION USING STATISTICAL FEATURE ANALYSIS OF AVIAN FLIGHT CALLS

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Detecting bird species through avian flight calls is essential for monitoring biodiversity and assessing the sustainability of ecosystems. This method provides a non-invasive way to study bird populations and their migratory patterns, aiding conservation efforts and ecological research. This study aimed to explore three research questions: the effectiveness of statistical feature extraction methods in bird identification, the classification of birds using supervised machine learning methods, and selecting the best model that classifies the birds. The study used the CLO-43SD dataset with multi-class species identification in avian flight calls. The dataset consists of 5428 audio clips of avian flight calls from 43 different species of North American wood warblers in the family Parulidae and is split into training and testing sets for analysis and validation. The analysis is conducted using R and Python. Statistical features such as the number of samples, length, root mean square error (RMSE), zero crossing rate, chromatogram, tempo, spectral centroid, spectral contrast, and Mel frequency cepstral coefficient (MFCC) were extracted for each avian flight call. These features are used with classification methods, such as random forest (RF), classification trees (CT), support vector machines (SVM) and Naïve Bayes (NB), to classify bird sounds. Results indicated that the RF and CT models with all statistical features provide high accuracies at 0.9960 and 0.9988, respectively, reassuring the audience about the reliability of the research. The Boruta analysis, the mean and standard deviation of MFCC, and the number of samples were selected as important features for classification. After downscaling the number of features, the accuracy is 0.9958 for RF and 0.9544 for CT. Kappa statistics are higher for the above classification techniques. Support Vector Machines and NB classifiers showed low accuracies compared to RF and CT, suggesting the RF and CT models would be more appropriate for classifying bird sounds. The results obtained using machine learning techniques for statistical features demonstrate the potential for automated and accurate species identification. This approach enhances the ability to monitor avian biodiversity and opens new directions for ecological research and conservation strategies.

**Keywords:** Mel frequency cepstral coefficient, Ornithology, Random Forest, Supervised learning

***Abstract No: 194*** ***ICT, Mathematics, and Statistics***

# APPLICATION OF KRUSKAL'S ALGORITHM IN FINDING BASIC FEASIBLE SOLUTIONS FOR TRANSPORTATION PROBLEMS

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Transportation problems (TPs) are prevalent in logistics and operational research optimization challenges. The structure of the transportation problem consists of multiple shipping routes connecting various sources to different destinations, with the objective of minimizing the overall transportation cost. The literature describes the development of many traditional methods to address transportation problems. Some methods, such as the Stepping Stone Method and the Modified Distribution Method (MODI), are intended to find an optimal solution to TP, while the Northwest, Least Cost, and Vogel's Approximation techniques are concentrated on identifying a basic feasible solution. The proposed algorithm was based on a graphical method and has proven to provide initial basic feasible solutions to a reasonable degree of satisfaction, regardless of the scale of TPs. The modified Kruskal's algorithm was adjusted to select edges that minimize transportation costs, subject to the constraints imposed by the demands and supply chains. This includes sorting the edges in ascending order of their cost and adding them to the solution iteratively until all nodes are connected and the constraints are satisfied. This study suggested an algorithmic approach simpler than the well-known heuristic algorithms.

**Keywords:** Initial basic feasible solution, Kruskal's algorithm, Minimum spanning tree, Transportation problems

***Abstract No: 198*** ***ICT, Mathematics, and Statistics***

# METHOD OF DIRECTLY DEFINING THE INVERSE MAPPING FOR SOLUTIONS OF SINGULAR BOUNDARY VALUE PROBLEMS

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Traditionally, researchers widely used perturbation and asymptotic techniques to gain analytical approximations for nonlinear problems. When nonlinearity becomes strong, perturbation and asymptotic approximations of nonlinear problems often fail. The Homotopy Analysis Method (HAM) was proposed to solve highly nonlinear problems. Unlike perturbation techniques, the HAM does not depend on any small or large physical parameters, and it gives a convenient way to guarantee the convergence of solution series. HAM allows for great freedom in the selection of base functions, initial guesses, and linear operators. However, to find unknown functions, one should calculate the inverse of the linear operator. In scientific computing, calculating the inverse operator for the differential equation consumes a significant amount of time. To overcome this obstacle, a new approach, the Method of Directly Defining inverse Mapping (MDDiM), was proposed with the freedom to directly choose the inverse linear mapping. Later, this method was extended to systems of nonlinear ordinary differential equations. In this study, MDDiM was extended and applied to obtain an approximation series solution for a class of nonlinear singular boundary value problems. The singularity in the problem makes it more challenging to solve compared to other nonlinear boundary value problems. Since the inverse operator was directly defined, the series solutions were obtained using less CPU time, low error, and less complicated terms. The proposed technique produced a highly accurate and reliable solution to the problems within an error range of $10^{-5}$ to $10^{-9}$ in a few iterations. Therefore, it can be concluded that MDDiM is easy to use and accurate.

**Keywords:** Homotopy analysis method, Method of Directly Defining inverse Mapping, Singular boundary value problems

***Abstract No: 200*** ***ICT, Mathematics, and Statistics***

# NEW ITERATIVE TECHNIQUE FOR SOLVING NONLINEAR EQUATIONS

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Finding roots of Non-linear Equations (NEs) in the form $f(x) = 0$ over $\mathbb{R}$ is a common problem in many engineering and scientific applications. Direct methods to find the roots of NEs are limited. For example, while direct formulas exist for polynomial equations up to the fourth degree, no such methods are available for transcendental equations. Consequently, iterative methods for searching roots of NEs have long been considered for research. The Bisection method, Regula-Falsi Method (RFM), Secant Method (SM), and Newton-Raphson Method (NM) are well-known classical iterative techniques. The rate of convergence, or convergence order ($p$) of an iterative technique is of great importance since it measures how fast it can approach the root of the NE. It is known that the rate of convergence of the RFM is linear. This study aims to construct an iterative technique with a superior convergence order compared to the RFM. This study proposed a new iterative technique for searching simple roots of non-linear equations. To construct this technique, a convex combination of the Newton-Raphson formula at two points is considered so that its iterative formula is given by: $\text{NewM}_\lambda$: $x_{n+1} = \lambda\left(x_{n-1} - \frac{f(x_{n-1})}{f'(x_{n-1})}\right) + (1-\lambda)\left(x_n - \frac{f(x_n)}{f'(x_n)}\right), \quad 0 \le \lambda \le 1,\ n = 1, 2, 3, \ldots$. The convergence analysis of the proposed method is also established. It displays a superlinear convergence over RFM, with order $p = \sqrt{2}$. The performances of $\text{NewM}_\lambda$ are illustrated by several numerical examples, confirming its effectiveness in searching roots. For instance, with an accuracy of $|f(x)| \le 10^{-15}$, the root (number of iterations) of $f(x) = (x+2)e^x - 1 = 0$ in $(-1, 1)$ is obtained by $\text{NewM}_{0.5}$, RFM, SM, and NM are $-0.4428544010023885(12)$, $-0.4428544010023892(85)$, $-0.4428544010023886(10)$, and $-0.4428544010023885(6)$, respectively.

**Keywords:** Convergence order, Newton method, Non-linear equations, Simple roots

***Abstract No: 201*** ***ICT, Mathematics, and Statistics***

# METHOD OF DIRECTLY DEFINING INVERSE MAPPING FOR CAUCHY REACTION-DIFFUSION PROBLEMS

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Perturbation and asymptotic techniques were widely used by researchers to obtain analytical approximations for nonlinear problems, which often fail when nonlinearity is strong. The Homotopy Analysis Method (HAM) was suggested to solve higher nonlinear problems. The HAM works independently of physical parameters and ensures the convergence of solution series. While the HAM offers great flexibility in selecting base functions, initial guesses, and linear operators, it also requires substantial time to compute the inverse linear operators for differential equations. The Method of Directly Defining inverse Mapping (MDDiM) was introduced to overcome this difficulty. The MDDiM offers the freedom to select the inverse linear mapping directly. In this study, an approximation series solution of the time-dependent reaction-diffusion problems was obtained by extending and applying MDDiM. Reaction-diffusion equations are used to describe nonlinear systems in fields such as physics, chemistry, ecology, biology, and engineering. Since the direct definition of the inverse operator, series solutions have been obtained with less CPU time, minimal errors, and simplified terms. The proposed method achieved a remarkable level of accuracy, with solutions falling within an error range of $10^{-5}$ to $10^{-10}$, with five iterations. Therefore, it can be concluded that MDDiM is convenient and accurate.

**Keywords:** Cauchy reaction-diffusion problems, Homotopy analysis method, Method of Directly Defining inverse Mapping

***Abstract No: 203*** ***ICT, Mathematics, and Statistics***

# OPTIMIZING PERFORMANCE OF BASIC SIMULATED ANNEALING ALGORITHM

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The Simulated Annealing (SA) algorithm, an optimization technique inspired by metallurgy annealing, is highly effective for solving complex problems by exploring various states to avoid local optima. This study aimed to enhance the efficiency of the SA algorithm by investigating the effects of two critical parameters: Markov chain length ($Lk$) and cooling schedule. The SA algorithm was implemented using the Metropolis criterion, starting at a high initial temperature and gradually reducing via an exponential cooling schedule. To improve the exploration of the solution space, a dynamic $Lk$ was introduced, where $Lk$ is adapted based on the current temperature. This dynamic approach was compared with a fixed $Lk$ setting under an exponential cooling schedule. The study evaluated the performance of both exponential and linear cooling schedules when paired with the dynamic $Lk$, examining how different cooling schedules affect algorithm performance. The algorithm was assessed using unimodal and multimodal benchmark functions, measuring expected squared error and computation time over 500 runs for each configuration, providing insights into the convergence behaviour of the algorithm and solution quality. The results demonstrated that dynamically adjusting the $Lk$ significantly improves computational efficiency without compromising solution quality. However, the choice of cooling schedule presents a trade-off between accuracy and computational cost, with the linear cooling schedule yielding more accurate solutions at a higher computational expense. These findings emphasize the importance of carefully selecting parameters to optimize the performance of SA algorithms across diverse optimization problems.

**Keywords:** Cooling schedule, Markov chain length, Simulated annealing

***Abstract No: 207*** ***ICT, Mathematics, and Statistics***

# UNVEILING RAINBOW CONNECTIONS IN EXTENDED SANDAT GRAPHS

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Graph theory is a fundamental area of discrete mathematics, with graph colouring being one of its most captivating topics. In particular, edge colouring involves assigning colours to the edges of a graph, ensuring that no two adjacent edges have the same colour while using the fewest possible colours. A rainbow path in an edge-coloured graph is one where no two edges in the path have the same colour. If every pair of vertices in a graph is connected by at least one rainbow path, the graph is rainbow-connected. The minimum number of colours needed for a graph to be rainbow-connected is called the rainbow connection number ($rc(G)$). Map colouring, optimizing timetables, solving Sudoku puzzles, and minimum cost are some examples of the applications of graph colouring. Hence, it is important to study and introduce new graph classes. The present study introduced the comb product of the operation of cycle graph $C_n$ and the higher-order extended version of the Sandat graph $SSt_m(n)$. The comb product of $C_4$ and $SSt_m(n)$ has been explored in detail. This comb product can be illustrated by connecting each vertex of $C_4$ to $SSt_m(n)$ such that the vertex set $V(C_4 \triangleright SSt_m(n)) = \{r_k, s_{ij}^h, t_i : 1 \leq k \leq 4, 1 \leq i \leq n, 1 \leq j \leq 2, 1 \leq h \leq m+1\}$ and the edge set $E(C_4 \triangleright SSt_m(n)) = \{r_1r_2, r_2r_3, r_3r_4, r_4r_1\} \cup \{rt_i, rs_{ij}^h, t_is_{ij}^1, s_{ij}^p s_{ij}^{p+1} : 1 \leq i \leq n, 1 \leq j \leq 2, 1 \leq h \leq m+1, 1 \leq p \leq m\}$. An algorithm has been proposed for rainbow colouring of this graph aiming to establish the rainbow connection number. Future works will be conducted to confirm this rainbow connection number and introduce the comb product of the non-symmetric higher-order extended Sandat graphs. The rainbow connection number has practical applications in network design, such as in secure data transmission, where diverse routing paths help prevent interception and ensure reliability.

**Keywords:** Comb product, Cycle graphs, Edge colouring, Rainbow colouring, Sandat graphs

***Abstract No: 211*** ***ICT, Mathematics, and Statistics***

# MULTI-OBJECTIVE OPTIMIZATION MODEL TO SUPPORT FRESHLY CUT VEGETABLE PROCESSING DECISIONS

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This study focused on optimizing fresh-cut vegetable processing decisions using a multi-objective optimization approach. It aimed to minimize processing times and costs by selecting alternative processes at different stages of production. Limited attention has been given to optimizing the fresh-cut vegetable process, particularly in applying multi-objective optimization approaches to support processing decisions. The fresh-cut vegetable process consists of several stages, including peeling, cutting, washing, and packing, with alternative methods in each stage, which are different in terms of their operations cost and times. The problem was formulated as an integer bi-objective combinatorial optimization model, optimizing total processing time and cost. Since the problem was NP-hard type, discrete non-dominating sorting genetic algorithm-II (NSGA-II) and discrete non-dominated sorting particle swarm algorithm (NPSO) have been employed to investigate their complementary algorithmic performance. Both primary and secondary data have been used in estimating the process parameters of each processing alternative. NPSO demonstrated a more robust convergence performance in terms of computational time compared to NSGA-II, while the latter algorithm produced a greater number of solutions on the Pareto front than the former. Future studies may focus on evaluating the performance of other alternative algorithms on comprehensive fresh-cut vegetable processing systems.

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**Keywords:** Evolutionary meta-heuristics techniques**,** Multi-objective optimization, NSGA-II, Particle swarm optimization, Process selection decision

***Abstract No: 216*** ***ICT, Mathematics, and Statistics***

# COLOUR CORRECTION MODEL IN DEEP LEARNING FOR FISH HABITAT MONITORING

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This study investigated the use of deep learning techniques for fish habitat monitoring, focusing on the impact of a Colour Correction Model (CCM) on underwater imagery. The primary objective was to assess whether the CCM can enhance the performance of the You Only Look Once (YOLOv8m) framework in fish species classification and marine environment assessment. The results reveal that the integration of the CCM does not enhance the performance of the YOLO framework. While the CCM improved image clarity and fidelity, the classification accuracy increased only marginally from 65% to 66%, and metrics such as precision, recall, and F1-score showed minimal improvement. Subsequent models, including YOLO and TensorFlow, do not exhibit significant improvements in classification accuracy. The evaluation of various deep learning models was rigorously conducted, highlighting the strengths of each model and the challenges addressed in marine habitat monitoring. While training and validation loss were effectively reduced by the CCM, this did not translate into improved performance metrics for fish classification. These findings underscore the complexity of underwater imagery and the need for further refinement in preprocessing techniques. This research contributes a nuanced understanding of the role of colour correction in deep learning applications for environmental monitoring. Future work should focus on exploring alternative preprocessing methods and integrating more sophisticated deep learning architectures to enhance classification outcomes. Despite setbacks, the potential for advanced deep learning models to revolutionize marine biology remains significant, promising valuable contributions to the preservation and understanding of marine ecosystems.

**Keywords:** Colour correction model, Environmental conservation, Fish habitat monitoring, Underwater imagery

***Abstract No: 218*** ***ICT, Mathematics, and Statistics***

# REDUCED ORDER MODEL FOR BREAST CANCER DETECTION

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Breast cancer often starts in the milk ducts or glandular lobules. According to the World Health Organization, there are about 2.3 million new cases and over 600,000 deaths annually. In Sri Lanka, around 3,000 new cases are diagnosed yearly, highlighting the need for better detection methods. Imaging techniques have limitations, like reduced sensitivity in dense breast tissue and potential false positives, which means dataset features may not always effectively capture crucial information for detecting breast cancer. This study presents a dimensional reduction process using Principal Component Analysis (PCA), a powerful technique for feature selection and dimensionality reduction, particularly effective with large datasets. This study aimed to create a low-dimensional model that can be used to classify breast cancers accurately. A benchmark dataset called Wisconsin Diagnostic Breast Cancer (WDBC) was used for data preprocessing and creating a reduced-order model using PCA. The performance of the reduced order model was evaluated by reconstructing the original data using the selected principal components and assessing the accuracy of this reconstructed data. The reconstruction error was measured using the Mean Squared Error (MSE) metric. The scree plot revealed a notable difference in the percentage of correctly reconstructed benign and malignant cases when selecting principal components 1 and 2, highlighting a substantial drop in variance. However, when choosing between 3 to 30 components, the percentages of correctly reconstructed benign and malignant cases remained consistent at 70.78% and 29.22%, respectively. These values are identical to the class distributions observed from the original data. Ten principal components were selected for model reduction, resulting in a reconstruction error of 0.0002 MSE. This low error value reflects a very accurate reconstruction from the reduced dimensions. These findings suggest the capability of the reduced order model to identify benign and malignant cases, which can be further used for investigations with high dimensional and complex data.

**Keywords:** Breast cancer detection, Feature extraction, Principal component analysis, Reduced order modelling

***Abstract No: 219*** ***ICT, Mathematics, and Statistics***

# INADEQUACY OF ZERNIKE POLYNOMIALS FOR ACCOUNTING THE VARIABILITY OF WAVEFRONT MEASUREMENTS

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Wavefront measurements have been crucial in vision science and ophthalmology, especially for wavefront-driven corrections like laser refractive surgeries and customized contact lens design. However, the accuracy of these corrections hinges on precise measurements. In clinical practice, multiple measurements are taken from a patient's eye during each session to avoid ambiguous conclusions from a single measurement. Despite these efforts, variations in measurements occur due to aberrometer misalignments, pupil size, lens position, and eye accommodation. These variations directly impact custom vision corrections, leading to errors. However, comprehensive studies on these dynamics are lacking, but understanding them is crucial in vision science. Previous studies have found that the variability in repeated measurements is significant, as indicated by changes in Zernike coefficients. However, these studies have only examined this variability through the Zernike coefficients themselves. In contrast, this study uniquely investigated their variability using the raw local slope data from wavefront measurements. The least squares estimation was implemented to analyse data from patients with astigmatism, myopia, keratoconus, and keratoplasty. Further, measurement noise was simulated using normally distributed random numbers, with signal-to-noise ratios (SNR) varied between 20 dB and 80 dB. The SNRs for individual Zernike coefficients have been determined. The results from patients showed that most Zernike coefficients had SNRs above 10, indicating minimal measurement variation impact. A few Zernike modes had SNRs below 2 for some patients. The study concludes that it is crucial to balance the addition of more Zernike modes with measurement variability to avoid introducing errors in custom vision corrections. Moreover, the results challenge the existing findings and suggest opportunities for deeper analysis and new insights.

**Keywords:** Least squares estimation, Signal-to-noise ratio, Variability, Wavefronts, Zernike coefficients

***Abstract No: 223*** ***ICT, Mathematics, and Statistics***

# INTEGRATING MAXIMUM FLOW AND MINIMUM COST FLOW FOR OPTIMIZED TRANSPORTATION NETWORKS

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In network theory, a captivating challenge is presented by the interplay between Maximum Flow (MF) and Minimum Cost Flow (MCF). A network is comprised of nodes and edges. The highest volume of flow achievable between source and sink nodes is signified by the MF of a network, considering constraints such as capacity, direction, and supply-demand. Applications are prevalent in distribution, transportation, and various other networks, which are manually addressed using algorithms such as Ford-Fulkerson and Edmonds-Karp. The minimum cost flow, defined as the feasible flow with the lowest network cost while meeting supply and demand constraints like capacity and direction, is known. Plumbing, transportation, and communication systems are among the examples. Solutions are manually found using algorithms such as the primal network simplex method and cycle-cancelling. This study investigated the integration of MCF with MF within a unified mathematical model, utilizing the network's minimum cut. The optimal path for heavy vehicles navigating two-way roads in a particular part of Kandy city was focused, where the maximum flow was determined by the network's minimum cut. The most efficient routes were identified by applying the minimum cut and MCF approach while excluding connector roads to prevent heavy vehicles from travelling through them. In conclusion, the minimum cut of the network provides a definitive solution for determining the maximum flow. Identifying the bottleneck path through the minimum cut, analysing and optimizing heavy vehicle flow ensures the minimum cost and maximum efficiency in the transportation network. Future work will explore dynamic adjustments to the minimum cut in response to real-time traffic variations, enabling the recalibration of optimal paths and consistent transportation efficiency.

**Keywords:** Bottleneck capacity, Maximum flow, Minimum cost flow, Minimum cut

***Abstract No: 242*** ***ICT, Mathematics, and Statistics***

# ENHANCING PITCH DETECTION BY DEVELOPING METHODS OF TIME-FREQUENCY ANALYSIS

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Time-frequency analysis is an indispensable technique for understanding the dynamics of signals over time, providing insights into instantaneous occurrences, temporal patterns, and hidden structures within complex data. In the present study, the methods of time-frequency analysis were used for a qualitative analysis of music signals. The Short Time Fourier Transformation (STFT) and Continuous Wavelet Transformation (CWT) were investigated for qualitative analysis of music signals. Digital Signal Processing (DSP) is vital in studying the accuracy of the conversion from analog signals to digital signals, minimizing potential errors that could be generated in the process. The primary contribution of this work was the introduction of a novel "Hann-Kaiser window" for the short-time Fourier transformation, which enhances pitch detection and reduces spectral leakage. This window combines the attributes of the Hann window and Kaiser window, resulting in better frequency resolution and reduced leakage compared to traditional windows. The efficiency of the modified window function was evaluated using specific parameters, including Signal-to-Noise Ratio (SNR), main-lobe width, and side-lobe suppression. The spectrograms revealed sharper pitch differentiation, particularly in harmonically rich regions of the signal, while the scalograms provided detailed insights into the transient features of the music signal. These visualizations demonstrated the Hann-Kaiser window's ability to enhance the clarity of individual frequency components, making it easier to track pitch variations over time. The implementations of time-frequency representations were performed using Python, generating spectrograms and scalograms. Building on these results, future research directions could focus on integrating these time-frequency analysis methods into music signal processing workflows, further refining the accuracy of pitch detection.

**Keywords:** Hann-Kaiser window, Pitch detection, Signal processing, Spectrogram analysis, Time-frequency analysis

***Abstract No: 263*** ***ICT, Mathematics, and Statistics***

# CORDIAL LABELLING OF BLOOM GRAPHS WITH DIFFERENT REGULAR POLYGON PETALS

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Cordial Labelling (CL) represents a concept related to graceful and harmonious labelling in graph theory where the number of vertices/edges labelled with each label differs by, at most, one from the number of vertices/edges labelled with any other label. Two notable types of CL are Mean Cordial Labelling (MCL) and Product Cordial Labelling (PCL). A graph that admits MCL and PCL is called a Mean cordial graph and a Product cordial graph, respectively. This study investigated the MCL and PCL of Bloom Graphs with different shapes of regular polygon petals by dividing graphs into four sets based on the parity of the number of petals ($n$) as well as the number of vertices in a petal ($m$) and generating common cordial labelling patterns for bloom graphs. It was found that while the general principles of two cordial labelling are applicable to most Bloom Graphs, an exception arises when $n$ is odd, and $m$ is even. Future research will explore the relationship between MCL and PCL in greater depth and extend these findings to other graph classes to enhance our understanding of cordial labelling and its applications.

**Keywords:** Bloom graphs, Cordial labelling, Mean cordial labelling, Product cordial labelling

***Abstract No: 268*** ***ICT, Mathematics, and Statistics***

# CONVERTING WIREFRAME IMAGES TO UI DESIGNS USING CONDITIONAL ADVERSARIAL NETWORKS

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This study presents a novel method that uses Conditional Generative Adversarial Networks (cGANs) to transform wireframes into User Interface (UI) designs. Wireframes outline the structural and functional components of a website, serving as crucial blueprints in UI design. Converting wireframes into polished UI designs is time-consuming and labour-intensive. This automated solution minimizes manual effort by using cGANs. Due to the lack of suitable datasets, 1,000 UI screenshots were manually collected from 75 software company websites, and corresponding wireframes were created. The 700 pairs were used for training, 150 for validation, and 150 for testing. In the proposed method, wireframes are converted into UI images by the generator of the cGAN, and these images are verified by the discriminator to ensure they match real UI designs. The cGAN was trained for 100 epochs with adversarial and L1 loss functions to enhance the robustness of the model and prevent overfitting. The experimental findings show that the proposed approach is capable of producing user interface designs, greatly speeding up the design process and increasing productivity. Quantitative metrics, including the Structural Similarity Index Measure (SSIM) and the Peak Signal-to-Noise Ratio (PSNR), were used to assess the structural and visual characteristics of the generated UI images and evaluate pixel-level similarity. An SSIM of 0.76 and a PSNR of 27.6 were achieved on test data, indicating close alignment with the ground truth screenshots. This study revealed how incorporating AI accelerates software design and prototyping in UI development. Future work will focus on increasing the dataset size, covering additional domains, utilizing more sophisticated GAN architectures, and incorporating human evaluations to further validate the results.

*Financial assistance from the National Institute of Fundamental Studies (NIFS), Sri Lanka is acknowledged*

**Keywords:** Conditional adversarial networks (cGAN), Generative AI, Image-to-image translation, Wireframe to UI translation

***Abstract No: 270*** ***ICT, Mathematics, and Statistics***

# GENETIC ALGORITHM APPROACH FOR THE BALANCED ASSIGNMENT PROBLEM

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The Assignment Problem (AP) presents a crucial challenge in operations research, involving the allocation of resources to tasks to minimize costs or maximize profits. There are many approaches developed to address the AP, including the Modified Ant Colony Optimization Algorithm, Bottleneck Cost Method, New Revised Zero's to One's Method, Matrix One's Assignment Method, and Maximum Difference Cost Method. The Hungarian method produces very prominent results, and it is effective for small to medium-sized problems, yet becomes computationally intensive for large-scale APs. This study proposed a heuristic approach using a genetic algorithm (GA) designed even for large-scale APs. This modified GA incorporated tournament selection for parent selection, applies crossover operations targeting the minimum value in each row, and prevents redundant assignments through swap mutation. These techniques simplify the algorithm compared to the other methods. A numerical example was analysed to illustrate the practical application of the proposed method. This example demonstrated how the proposed method effectively handles the problem, providing clear insights into its accuracy. This approach, where solutions improve generation by generation, highlights the potential of GAs for tackling complex or large-scale assignment problems.

**Keywords:** Assignment problem, Genetic algorithm, Hungarian method, Tournament selection

***Abstract No: 271*** ***ICT, Mathematics, and Statistics***

# NOVEL METHOD TO SOLVE THE TRAVELING SALESMAN PROBLEM USING DISTANCE MATRIX

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The Traveling Salesman Problem (TSP) is a well-known optimization problem. Its objective is to find the shortest path for a salesman to visit each city on a list and then return to the initial city. A number of approaches have been developed to solve the TSP, including dynamic programming, branch and bound, the nearest neighbour algorithm, genetic algorithms, simulated annealing, and ant colony optimization. These techniques have their roots in various mathematical fields, operations research, graph theory, and even fuzzy theory. While branch and bound method provides the exact solution, it is computationally expensive. In contrast, approaches such as genetic algorithms, simulated annealing, and ant colony optimization offer approximate solutions with less computational time. This study proposed a new matrix-based approach to solve TSP, which involves the following key steps: identifying and selecting row minimum values in the distance matrix, getting the maximum of them and highlighting corresponding rows and columns, finding the minimum values of the highlighted rows, and selecting the minimum among them. This algorithm is then repeated iteratively to refine the path selection.

**Keywords:** Combinatorial optimization, Heuristic optimization, NP-hard problems, Traveling salesman problem

***Abstract No: 274*** ***ICT, Mathematics, and Statistics***

# SPATIAL AND TEMPORAL PATTERNS OF COMMUNICABLE DISEASES IN SRI LANKA

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Communicable diseases caused by bacteria, viruses, and parasites present major global health challenges. Understanding their transmission patterns is key to effective prevention and control. In Sri Lanka, limited research has been conducted to investigate the spatial and temporal patterns. The present study considered eight communicable diseases, including dengue fever, dysentery, encephalitis, enteric fever, leptospirosis, typhus fever, viral hepatitis, and food poisoning. Weekly data were collected from the Sri Lanka Epidemiology Unit website from 2007 to 2023. The current study found strong positive correlations among enteric fever, dysentery, and viral hepatitis. After 2015, dengue cases increased significantly, modelled by ARIMA(1,1,0)(0,0,1)[52], with a peak in 2017. Encephalitis cases rose from 2017 to 2023, best forecasted by ARIMA(1,1,1). Enteric fever declined after 2020, with ARIMA(1,1,2)(1,0,0)[52] indicating stability. Models were selected using AIC and BIC with residual diagnostics confirming forecast accuracy. Model validation showed predicted values within confidence intervals. Time series analysis also modelled typhus fever, viral hepatitis, food poisoning, and dysentery. Disease patterns shifted before and after COVID-19, potentially due to immunity changes caused by the pandemic. Dynamic time warping identified six clusters for dengue and four for leptospirosis, with K-medoid clustering showing better separation, supported by higher mean silhouette scores. Other diseases had less defined clusters, indicated by negative silhouette scores for both K-medoids and hierarchical clustering. This underscores challenges in accurate grouping due to small case numbers and the need for adaptive public health strategies. By identifying these patterns, the study informs targeted public health interventions, such as optimizing resource allocation, improving disease surveillance, and tailoring prevention strategies to specific regional and temporal trends in Sri Lanka.

**Keywords:** ARIMA, Communicable diseases, Epidemiology, Public health

***Abstract No: 277*** ***ICT, Mathematics, and Statistics***

# MODELLING RECORD-BREAKING ODI CRICKET BATTING PERFORMANCES WITH EXTREME VALUE THEORY

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This study aimed to explore the highest individual scores recorded in One Day International (ODI) cricket matches through extreme value theory which further uncovers an area that has not been extensively studied in previous research. Data for this study was downloaded from ESPNcricinfo, covering the period from 1971 to 2024. The dataset comprised the career highest scores of 1,171 cricket players across eight countries with 24 variables, including player names, country, matches played, highest scores, strike rates, and other relevant metrics. Preliminary analysis reveals that the highest individual score recorded is 264, while the lowest is 0, with an average highest score of 60.85. It was observed that top-order and opening batters tend to have the highest ODI scores compared to players in other positions. Additionally, a multiple linear regression analysis identifies factors such as the number of matches played, batting average, and the number of fours and sixes have a significant effect on achieving a higher score throughout the career of a player. Also, players with longer careers tend to have the highest individual scores. Furthermore, extreme value theory was used to model the career highest scores recorded by individual players. Among the widely known extreme value distributions, it was revealed that the Weibull distribution is the most appropriate extreme value distribution for modelling. The estimated Weibull distribution parameters (scale = 1.00, shape = 60.85) indicate that the career highest scores are distributed with a heavy tail with a broader spread out to cover a wide range of highest scores. Furthermore, Weibull distribution is fitted for each country, and it is found that the distribution of the career highest scores for players from England is significantly different from other countries. The findings of this study will be valuable for sports analysts and coaches in understanding and optimizing extreme batting performances in cricket.

**Keywords:** Cricket, Extreme value theory, Weibull distribution

***Abstract No: 278*** ***ICT, Mathematics, and Statistics***

# OPTIMAL VACCINATION AND ISOLATION STRATEGY TO CONTROL THE SPREAD OF COVID-19 IN SRI LANKA

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The coronavirus, SARS-CoV-2, which was responsible for the COVID-19 pandemic, caused historically unprecedented challenges on the global level. It is essential to understand the unique aspects of virus transmission dynamics to develop control techniques that can help to control pandemics. This study focused on the human-to-human and environment-to-human transmissions of COVID-19, considering the threshold level of SARS-CoV-2 for human infection. To minimize the economic impact of the disease and its related expenses, optimal control was incorporated to measure the optimal rate of vaccination and the optimal rate of isolation of symptomatic infected humans. In this optimal control problem, the main objective was to reduce the total number of people infected with the virus (both asymptomatic and symptomatic individuals) and the number of deaths due to disease while minimizing the overall cost of controlling the disease during the pandemic. The Pontryagin's maximum principle was applied to derive the necessary conditions that the optimal controls and corresponding states must satisfy, and the forward-backward sweep method was used to determine the optimal solution for the model. The model was solved for a 200-day period, considering a maximum allowable vaccination rate of 0.3% of the susceptible population per day and an isolation rate of 5% of the symptomatic infected individuals per day. The results indicated that both vaccination and isolation should be implemented at their respective maximum allowable levels. Specifically, vaccination should be carried out at a rate of 0.3% of the susceptible population for 102 consecutive days, while 5% of the symptomatic infected individuals should be isolated continuously throughout the entire period. With these controls, the infectious population can be reduced by 42.35%, and the deaths due to COVID-19 can be decreased by 29.27%. To develop evidence-based methods for combating upcoming pandemics, government officials and public health authorities can benefit significantly from these findings.

*Financial assistance from the PGIS Research Grant 2020 (Grant No. PGIS/2020/04) is acknowledged*

**Keywords:** COVID-19, Environment-to-human transmissions, Optimal control, Vaccination

***Abstract No: 279*** ***ICT, Mathematics, and Statistics***

# STATISTICAL ANALYSIS ON CHILD INJURY ADMISSIONS: A CASE STUDY

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Limited studies have been conducted in Sri Lanka on child injuries with respect to different types of injuries. The main objective of this study was to analyse the patterns in all types of injuries among newborn to 18-year-old children. The dataset was obtained from Sirimavo Bandaranayake Specialized Children's Hospital, Peradeniya, Sri Lanka for the period 2019-2023. Records of 10,317 on child injury admission along with 18 variables including date of admission and discharge, age, gender, mode of discharge and information about the time, place and mechanism of injury. The preliminary analysis revealed that the average stay per admission is 1.52 days. The maximum length of stay during the period was 62 days. A time series plot revealed that the number of child injury admissions was at its lowest during the COVID-19 pandemic lockdowns. The highest number of daily injury admissions were reported on Saturdays, while during the pandemic period, it was on Fridays. Head injuries are the most common, and 79% of them were superficial injuries. Upper limbs were the second most injured body part, and more than half of them were fractures. The average length of stay in the hospital due to head injury (1.30 days) was significantly different from the average length of stay in hospital due to upper limb injuries (1.53 days). Association analysis indicated that there are statistically significant associations among the mechanism of injury, place of occurrence of injury, activity done at the time of injury, affected body region, nature of injury and age category. It was identified that age, time of injury, mechanism of injury, activity done at the time of injury, affected body region and nature of injury are significant in determining length of stay. The findings of this study lead healthcare professionals to look at specific injury types and associated variables, which will lead to the development of more efficient treatment practices.

**Keywords:** Child care, Hospitalisation, Paediatric injuries

***Abstract No: 281*** ***ICT, Mathematics, and Statistics***

# DETERMINING HOSPITAL STAY DURATION FOR SICK CHILDREN: A CASE STUDY

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Childhood diseases are a significant concern in the world, affecting the development and well-being of young children. The main objective of the study was to assess the length of stay of paediatric hospitalization of sick children admitted to the Sirimavo Bandaranayake Specialized Children's Hospital (SBSCH) in Peradeniya, Sri Lanka. The dataset consisted of 104,757 paediatric patient admissions from 2019 to 2023, including the admission information such as admission number, age, gender, International Classification of Diseases code (ICD), date of admission and date of discharge. Among the total number of admissions, 58% were male patients. The preliminary results revealed that the number of patient admissions from 2020 to 2021 was significantly lower than in the other years. This could be due to the COVID-19 pandemic in Sri Lanka, which restricted people from gathering in public. However, the percentage of patient admissions per year with respect to gender was approximately the same for the period of study. Children under one year of age and school-aged children were the highest admitted patient category, reporting approximately 30% in each year. The most common disease type among children admitted was respiratory system diseases (14.96%), while other significant disease categories were injuries, infectious, factors influencing health status and digestive system problems. The average and the standard deviation of the length of stay in the hospital per admission were 3.06 days and 4.37 days, respectively. Mean comparison tests indicated that the length of hospital stay was statistically significant with respect to gender (3.11 days for males and 3.02 days for females) and the type of disease. A zero-truncated negative binomial regression model indicated that Age, Gender and Disease type were the most significant variables in determining the length of stay in the hospital. A chi-squared test for deviance indicated that the fitted model is significant compared to the null model ($p < 0.01$). The log count for the length of stay in days increases by 0.603 units for perinatal diseases, where it decreases by 1.457 for mental, behavioural and neurodevelopmental disorders. The log count for the length of stay decreases by 0.014 units for each one-year increase in age. The study provides information about the factors influencing the length of hospital stay for paediatric patients in SBSCH in Peradeniya, which could help healthcare providers optimize resource allocation and improve patient care outcomes.

**Keywords:** Child diseases, International classification of diseases code, Length of hospital stay, Paediatric admissions

***Abstract No: 296*** ***ICT, Mathematics, and Statistics***

# SHORTEST PATH IN MULTI-SOURCE SINGLE-GOAL SCENARIOS: AN A* ALGORITHM WITH DISTANCE TRANSFORM APPROACH

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Finding the shortest path in multi-source, single-goal scenarios remains a crucial challenge in various applications, such as robotics, drone navigation, and network routing. This study proposed a novel method combining the A* algorithm with Distance Transformation to compute the shortest path efficiently. While the traditional A* algorithm uses heuristic values and movement costs to determine the optimal path, it can be computationally intensive in environments with numerous obstacles. By incorporating Distance Transformation, the proposed algorithm refines heuristic calculations, which improves the accuracy by accounting for obstacle distribution and proximity, leading to more precise path estimation and faster convergence. The experimental results demonstrated that the combined approach significantly reduces computational time and memory usage while maintaining the accuracy of the pathfinding process. This method can be applied to a variety of spatial graphs, making it well-suited for real-world applications requiring efficient and fast pathfinding.

**Keywords:** A* algorithm, Distance transformation, Heuristic calculation, Multi-source single-goal, Shortest path

***Abstract No: 297*** ***ICT, Mathematics, and Statistics***

# SUPER EDGE MAGIC TOTAL LABELLING FOR TRIANGLE SNAKE GRAPH

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In graph theory, there are different types of techniques for graph labelling, such as radio labelling, harmonious labelling, graceful labelling, magic and antimagic labelling, etc. This study investigated a type of magic labelling called super edge-magic total labelling for triangle snake graphs. It was proved that the triangle snake graph can be labelled using super-edged magic total labelling. Let $|V(G)| = p$, $|E(G)| = q$, and $n$ be the number of triangles in that pattern, then the magic number was obtained as $k = p + q + 3 = 3(n + 2)$. Therefore, this study validates a new super edge-magic total labelling pattern for the triangle snake graph, opening avenues for further studies on similar graphs and potential real-world applications. Future work will explore extending these findings to other graph structures.

**Keywords:** Super edge magic total labelling, Triangular snake graph

***Abstract No: 298*** ***ICT, Mathematics, and Statistics***

# OPTIMAL PREMARITAL SCREENING RATE TO CONTROL THALASSEMIA TRANSMISSION

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Optimal control theory applies in a variety of scientific domains, especially in mathematical biology, for disease prevention and intervention. This study investigated a contextual problem of how to apply optimal control theory to identify a time-based strategy for premarital screening as a thalassemia (an inherited blood disorder) prevention method to control thalassemia transmission. Premarital screening identifies the thalassemia carrier state of parents, aiming at reducing the incidence of thalassemia in major newborns. The main objective of this study was to investigate the optimal rate of premarital screening to minimize dual-carrier marriages while minimizing the cost of implementing premarital screening in a certain population. The optimal control problem was as an age-structured two-sex population model with premarital screening as a time-dependent prevention method. The optimal control problem was derived, which includes the state equations, the adjoint equations, and the optimality condition that characterises the control. Existence and uniqueness of optimal control were established. The problem was numerically solved using an iterative procedure based on the forward-backward sweep method. The parameter values used for the simulations are referred Sri Lankan data. For the time periods $T = 1$ year, $T = 3$ years, and $T = 10$ years, numerical simulations indicate an increase in the number of thalassemia major newborns in the absence of control while in the presence of control, it decreases by 7.63%, 17.29%, and 54.68%, respectively. The effect of mandatory premarital screening program was also discussed. The results of this study will be beneficial to public health administration in disease control.

**Keywords:** Age-structured, Optimal control, Premarital screening, Thalassemia

***Abstract No: 299*** ***ICT, Mathematics, and Statistics***

# MATHEMATICAL MODELLING OF NILE TILAPIA FISH POPULATION DYNAMICS WITH RESTOCKING AND HARVESTING IN "MAELIYA" RESERVOIR

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Ensuring an adequate fish supply for growing populations is a significant challenge in most of the developing countries. Culture based fisheries is a widely used technique globally to enhance fish production. In Sri Lanka, reservoirs are stocked with fish fingerlings produced in fish-breeding centres managed by the National Aquaculture Development Authority (NAQDA). This research aimed to formulate a mathematical model to evaluate the population dynamics of the Nile tilapia population in the "Maeliya" reservoir, Kurunegala District, Sri Lanka. The study focused on restocking and harvesting Nile tilapia, which are capable of breeding in any natural water body. Gillnets are the primary fishing gear used in this reservoir, with mesh sizes ranging from 4 to 10 inches. For this study, gillnets with mesh sizes smaller than 5 inches were considered, as Nile tilapia are typically caught in gillnets with mesh sizes of 4, 4.5, and 5 inches. The necessary data for this research were obtained from NAQDA, while additional information was gathered through interviews with fishermen. The mathematical model was developed based on six stages of Nile tilapia, including eggs, fingerlings, mature adult fish at the initial stage, and three stages of mature fish caught by gillnets with mesh sizes of 4, 4.5, and 5 inches, respectively. The formulated model was solved using MATLAB, and the predicted values were compared with actual data. Additionally, the yield of Nile tilapia was analysed both with and without restocking fingerlings. The results indicated that restocking fingerlings increases and regulates the harvest.

**Keywords:** Culture based fisheries, Fish fingerlings, Gillnet, Nile tilapia

***Abstract No: 10*** ***Life Sciences***

# INDOLE 3-ACETIC ACID PRODUCING BACTERIA FROM ONION RHIZOSPHERE

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Onion (*Allium cepa* L.) is an important crop in Sri Lanka. It is important as a condiment, a leafy vegetable, and an ingredient in indigenous medicine. A recent study showed that the growth and quality of onion bulbs can be improved by exogenous application of Indole 3-acetic acid (IAA). Some phytohormones are known to improve human health. The current study aimed at isolating and identifying IAA-producing bacteria from the onion rhizosphere and incorporating them into plant-growth-promoting-rhizobacterial (PGPR) consortia. Rhizobacteria were isolated from the roots of onions grown in three main onion-growing areas in Sri Lanka, *viz*., Jaffna, Dambulla, and Angunakolapelessa. Both free-living and endophytic bacteria were isolated in nutrient agar. Hundred and twenty-six morphologically distinct strains were isolated and screened for their ability to synthesize IAA, with and without induction, by the externally added tryptophan (0.2% [w/v]), which is a precursor of IAA. Accumulated IAA in the culture broth was estimated spectrophotometrically at 535 nm following Salkowski's method. Twenty-one strains, including two endophytic bacterial strains, were found to be IAA producers. More efficient IAA production was obtained in tryptophan-induced cultures. Two strains, i.e., R1OJ2 and OD20 produced > 200 mg/L of IAA while ROJ10, ROJ7, ROD12, ROJ5, ROJ50, ROD16, ROD15, ROA10, and ROJ8 produced >100 mg/L when induced. None of these strains could produce > 100 mg/L without tryptophan but ROJ7, ROJ11, ROJ2, ROJ50, ROJ38, and ROD16 produced IAA around 50 mg/L. The endophytic strains, EOA7 and EOJ1, also showed high IAA production, 73.4 mg/L and 83.6 mg/L, respectively. According to a previous study, IAA at 50 mg/L promotes onion growth, while IAA at 200 mg/L increases phenol content, thus increasing its medicinal value. Hence, ROJ7, ROJ11, ROJ2, ROJ50, ROJ38, and ROD16 strains are good candidates for PGPR-consortium development, while ROJ2, ROD20, and ROA10 are good candidates for enhancing the medicinal value of onion.

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**Keywords:** Indole 3-Acetic acid, Onion, PGPR

***Abstract No: 18*** ***Life Sciences***

# FEEDING GUILD COMPOSITION OF BIRDS IN SELECTED URBAN, SUBURBAN, AND FOREST ECOSYSTEMS IN KANDY, SRI LANKA

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Presence of different feeding guilds of birds is an indicator of the overall health of an ecosystem. This study aimed to investigate the health of three ecosystems representing different urbanization levels, Udawattakele forest, Talwatta suburb with fragmented tree cover, and Kandy downtown with scattered trees, by analysing bird feeding guild composition. The encounter transect method was employed with two-kilometre transects weekly during activity peaks (0600h-0900h and 1500h-1800h) from May to December 2023 in each ecosystem. Field guides were used to identify birds and their feeding guilds. Data were analysed using BioDiversity Professional (*v.* 2). Shannon *H'* of Udawattakele, Talwatta, and Kandy downtown was 1.28, 1.44, and 0.58, and Shannon *J'* was 0.69, 0.82, and 0.50, respectively. Of the 22 feeding guilds recorded, 17 were from Udawattakele and Talwatta, and 10 were from Kandy downtown. Five were exclusively from Udawattakele, seven were shared by Udawattakele and Talwatta, five were shared by Talwatta and Kandy downtown, and five were shared by all (67.7% Bray-Curtis similarity between Udawattakele and Talwatta; 36.11% between these and Kandy downtown). Insectivores were the dominant feeding guild in Udawattakele (28%) and Talwatta (22%), while the least abundant in Kandy downtown (7%). The scavengers were dominant in Kandy downtown (29%), whereas low in Udawattakele and Talwatta (0% and 5%). High numbers of raptors in Udawattakele (7 species) and Talwatta (4 species) indicate healthy ecosystems with abundant prey species. Frugivores, nectarivores and granivores were found in all three ecosystems. The insectivore-frugivore guild was highly prevalent in Udawattakele (12%) and Talwatta (19%). Udawattakele and Talwatta showed 72.7% similarity in feeding guilds of endemic species while reflecting the above general pattern. Higher feeding guild diversity in Udawattakele and Talwatta indicates their stability and health, whereas Kandy downtown shows poor ecosystem health with lower feeding guild diversity and biotic homogenization.

**Keywords:** Frugivore, Insectivore, Raptor, Scavenger, Udawattakele

***Abstract No: 19*** ***Life Sciences***

# CHARACTERIZATION OF BACTERIAL ISOLATES FROM BREEDING WATER OF DENGUE VECTOR MOSQUITO, *Aedes albopictus*

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The microbial composition of mosquito breeding grounds, which varies according to microhabitat conditions, climatic factors, and geographical regions, plays a crucial role in larval development, fecundity, and host-pathogen interactions of mosquitoes. Considering the relatively high fitness and wider distribution of *Aedes albopictus* mosquitoes, we characterised the bacteria associated with their breeding grounds. Samplings were carried out from Kurunegala and Kandy districts in Sri Lanka (May to November 2023). Twenty-five water samples were collected and cultured on Luria Broth media (LB) and Nutrient agar plates (NA). Identified morphologies were sub-cultured, and 80% glycerol stocks were prepared for pure colonies. Molecular identification of the pure colonies was conducted by sequencing the 16s rRNA gene. Morphological identification, based on shape, size, colour, margin, opacity, and elevation, confirmed 20 different bacterial morphologies and molecular identification confirmed 17 different bacterial isolates. *Aeromonas hydrophila* was the most abundant bacteria observed in all breeding grounds (100%). The second most abundant was *Acinetobacter proteolyticus* (32%). The remaining bacterial composition was represented by three *Staphylococcus* spp. *viz., S. cohnii* (20%), *S. pseudoxylous* (12%), *Staphylococcus* sp. strain 20 (16%); *Bacillus subtilis* (20%); two *Fictibacillus* spp. *viz., F. phosphorivorans* (20%) and *F. halophilus* (12%); *Pseudomonas mosselii* (12%); *Citrobacter braakii* (28%); *Chromobacterium haemolyticum* (8%); *Exiguobacterium indicum* (28%); *Arhrobacter* sp. (8%); *Luteimonas terrae* (28%); *Micrococcus luteus* (24%) and *Deinococcus* sp. (12%). Two to eight different species were reported from each mosquito breeding site. A maximum of four to five distinct species were reported from the majority of *Aedes* mosquito breeding sites (64%). The findings identified the microbes that are commonly associated with *Aedes albopictus* mosquitoes, and further studies will be carried out using different culture media to assess the bacterial diversity in the breeding habitat water of *Aedes albopictus*.

*Financial assistance from the Multi-Disciplinary Research Grant (Grant No. 136) is acknowledged*

**Keywords:** Dengue vectors, Larval habitats, Microbiota

***Abstract No: 20*** ***Life Sciences***

# ADVERSE PSYCHOLOGICAL EFFECTS OF *KAMESHWARI MODAKA*: A CASE STUDY IN COLOMBO DISTRICT USING THE CHALLENGING EXPERIENCE QUESTIONNAIRE VIA ONLINE SURVEY

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"Kameshwari Modaka" (KM), an Ayurvedic drug traditionally used for its aphrodisiac properties, has recently been misused in Sri Lanka, particularly among youth seeking ecstasy-like effects. This study investigated the psychedelic experiences, specifically "bad trips", associated with KM misuse using the Challenging Experience Questionnaire (CEQ). From January to March 2024, an online survey gathered responses with a snowball sampling technique from 102 participants in the Colombo district (average age: 28.59 years; 96% male, 4% female). Results showed KM induces mild challenging experiences, including fear, isolation and, physical distress, with an average CEQ score of 21.31%. Most participants (60.8%) reported no or mild bad trip symptoms, but 13.7% experienced severe bad trips. Paranoia was significantly elevated compared to other serotonergic psychedelics ($p < 0.05$), suggesting potential psychological risks. KM's psychoactive effects are attributed to its high cannabis content, which can lead to acute psychosis and addiction in chronic use, especially with doses surpassing the therapeutic range of 3-6 g. Findings highlight the need for caution and regulatory measures in KM use, especially among younger demographics, despite the limitations of small sample size, lack of brand-specific data, recall bias, and variations in KM dosage of the present study. Further research is essential to explore demographic, psychological, and dosage-related factors influencing these adverse reactions. Clinical studies should validate findings and clarify KM's pharmacological mechanisms.

**Keywords:** Bad trips, Challenging Experience Questionnaire, "Kameshwari Modaka", Psychedelic

***Abstract No: 21*** ***Life Sciences***

# MORPHOLOGICAL CHARACTERIZATION OF TWO PROMISING LINES OF COMMON BEAN, *Phaseolus vulgaris* L.

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The common bean, *Phaseolus vulgaris* L., is widely grown in Sri Lanka. The Horticultural Crop Research and Development Institute (HORDI) at Gannoruwa, Sri Lanka, follows the "Variety Releasing Protocol (VRP)" to ensure the uniformity of new bean varieties before their market release. During this process, testing for uniformity based on morphological characters is an important aspect. CP-3 and CP-4 are two new bean accessions currently under Variety Adaptability Testing (VAT) by the HORDI. The objective of this study was to compare the morphological characteristics of these two selected bean accessions. Morphological characters in flowers, leaves, pods and seeds were studied using descriptors prepared by the Plant Genetic Resource Centre at Gannoruwa. Flower characters, including the number of flower buds per inflorescence and the colour of the standard and wing petals, were determined using the Royal Horticultural Society colour chart. Pod characters measured included length (cm), width (mm), the shape of cross-section, colour, curvature, suture strings, beak length, surface, and beak orientation. Ten replicates were evaluated for each parameter. Data were analysed using One-way ANOVA followed by Mann-Whitney pairwise test at a 95% confidence level ($p \leq 0.05$) using PAST statistical software. Results revealed that characteristics such as hypocotyl colouration, growth type, time of flowering, number of flower buds per inflorescence, the colour of standard petal, pod shape in cross-section, pod ground colour, pod beak position, pod wall fibre constrictions, texture of pod surface, seed colour and seed shape were similar in both bean accessions. In contrast, inflorescence length, pod length, width, suture strings, beak length, pods per inflorescence, seeds per pod, seed width, length and height were different between the CP-3 and CP-4 accessions. The pod length and width in CP-3 were significantly ($p \leq 0.05$) greater than those in CP-4, highlighting these parameters as important for distinguishing between the two accessions during the variety release process.

*Financial assistance from the Horticultural Crop Research and Development Institute (HORDI) at Gannoruwa is acknowledged*

**Keywords:** Accessions, Morphological characters, *Phaseolus vulgaris*

***Abstract No: 24*** ***Life Sciences***

# SILVER NANOPARTICLES SYNTHESIS USING EXTRA AND INTRA CELLULAR METABOLIITES OF *Aspergillus* sp. AND THEIR ANTIMICROBIAL POTENTIAL

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This study explores the potential of *Aspergillus* sp. to synthesize Silver Nanoparticles (AgNPs) and analyse their antimicrobial activity against selected food-borne pathogens. *Aspergillus* sp. was grown under different growth conditions [pH; 5.6, 7 and 8, media; Potato dextrose broth (PDB), Sobouraud dextrose broth (SDB) and Starch broth (SB)] for varying incubation periods (5 and 10 days) to evaluate their production potential for AgNP synthesis. Following incubation, both intracellular and extracellular metabolites were extracted. Intracellular metabolites were obtained by mixing 1 g of air-dried fungal biomass with sterile distilled water at a 1:30 ratio. The filtrate, excluding the fungal biomass, was used as the source of extracellular metabolites. Equal volumes (10 ml) of fungal extract and 1 mM $AgNO_3$ solution were mixed and incubated for 48 hrs under dark conditions to promote AgNPs synthesis. Synthesised AgNPs were characterised using UV-vis spectroscopy, FTIR and SEM, and their antimicrobial potential on selected food-borne pathogens was evaluated via the well-diffusion method. Intracellular metabolite-based AgNPs synthesised using pH 8 cultures in SDB and SB displayed absorbance peaks at 405-419 nm compared to AgNPs synthesised using extracellular metabolites under similar conditions (350-370 nm). FTIR analysis identified peaks at 3422 $cm^{-1}$ and 1650 $cm^{-1}$, corresponding to primary amine (N-H) stretching and amide (N-H) bending vibrations, confirming the protein involvement in AgNPs stabilization. SEM analysis showed AgNPs were spherical to cubic in shape with 84 nm–188 nm in size. Antimicrobial assays revealed that all the synthesised AgNPs exhibited inhibitory effects against *Escherichia coli* (diameter: 1.12 ± 0.08 – 1.40 ± 0.33 cm), *Enterobacter faecalis* (diameter: 1.12 ± 0.13 – 1.35 ± 0.13 cm) and *Salmonella typhi* (diameter: 1.16 ± 0.05 – 1.31 ± 0.05 cm). The results demonstrate the successful synthesis of AgNPs using *Aspergillus* sp., highlighting its potential as a fungal agent for AgNP synthesis. Further optimising fungal growth conditions is crucial to engineer AgNPs with tailored size, shape, and properties.

*Financial assistance from the University Grant Scheme (Grant No. NRPL/2023/04/S) is acknowledged*

**Keywords:** Antibacterial potential, *Aspergillus* sp., Characterization, Silver nanoparticles

***Abstract No: 30*** ***Life Sciences***

# A PRELIMINARY MORPHOLOGICAL STUDY ON THE DIVERSITY OF THE SPIDER GENUS *Mallinella* (ZODARIIDAE) IN SRI LANKA

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The zodariid genus *Mallinella* Strand, 1906, is represented by 228 species globally, including a single species, *Mallinella redimita*, from Sri Lanka, which is indicative of underestimated species diversity. This study aims to identify and describe species of *Mallinella* on the island based on their morphology. Fieldwork was conducted from 2023 to 2024 in 20 localities across 12 districts, covering all climatic zones of Sri Lanka. All spiders were collected from litter by sieving and hand collection. The collected spider specimens were preserved in 70% ethanol, identified, photographed, and illustrated using Olympus SZX7, Leica M205C, and Leica DM3000 microscopes using standard methodology. A total of 34 males and 33 females were collected. Five new species of *Mallinella* were recognized based on the differences in their genital morphology (Provisionally named *Mallinella* sp. A, *Mallinella* sp. B, *Mallinella* sp. C, *Mallinella* sp. D, and *Mallinella* sp. E). *Mallinella* sp. A is widespread across Central, Eastern, Northern, North Central, and North Western provinces, whereas *Mallinella* sp. B was specifically recorded from Galle District. *Mallinella* sp. C, *Mallinella* sp. D, and *Mallinella* sp. E were reported from Kandy, Badulla, and Rathnapura Districts, respectively, suggesting localized distributions for these species. The five new species belong to three currently recognized species groups of *Mallinella*, namely *redimita* (*Mallinella* sp. A), *annulipes* (*Mallinella* sp. B, *Mallinella* sp. D, and *Mallinella* sp. E), and *fasciata* (*Mallinella* sp. C). All five species of *Mallinella* are new to science and will be formally described in a future publication.

*Financial assistance from the National Institute of Fundamental Studies is gratefully acknowledged*

**Keywords:** Diversity, Morphology, Spiders, Sri Lanka, Zodariids

***Abstract No: 37*** ***Life Sciences***

# INTER-POPULATION VARIATION IN SEED CHARACTERISTICS AND GERMINATION BEHAVIOR OF *Vigna marina*

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The biggest obstacle of the next century will be climate change, which impacts agriculture, particularly soil health. Soil salinity, one of the main issues facing world agriculture, is exacerbated by the effects of climate change. Crop improvement employing crop wild relatives of domesticated crops is one of the solutions to this challenge. *Vigna marina*, a wild relative of *Vigna* found in coastal regions, may tolerate high salinity, making it a valuable genetic resource. Understanding its inter-populational variation is a key to conservation strategies. In this study, seeds from five different *V. marina* populations (Unawatuna, Mahamodara, Akurala, Negombo, and Thalpe) were used to determine inter-population variation based on seed morphometric parameters and germination behaviour under different salinity conditions (0, 100, 1000, 2000, 10,000, and 20,000 ppm NaCl solutions). Seed morphometric parameters were determined using 25 individual seeds per population, while four replicates of 25 seeds were used in germination experiments. Seed moisture content, seed shape index, and seed coat ratio in each population were significantly different from each other ($P < 0.001$). Seeds of all the populations showed reduced germination rates with increasing salinity. The highest cumulative germination percentage was observed when seeds were in 2000 ppm salinity compared to other salinity levels or distilled water across all the studied populations, demonstrating the halophytic nature of *V. marina*. Considering the median germination time ($T_{50}$), seeds collected from the Mahamodara population showed the highest germination rate ($T_{50} = 7.5$ days), while the Unawatuna population showed the lowest ($T_{50} = 11.25$ days) at 20,000 ppm. The study revealed that *V. marina* exhibits inter-populational variations in the parameters analysed, indicating possible genetic diversity between populations. Therefore, it is recommended to conserve a sufficient number of populations to maintain the total genetic diversity.

**Keywords:** Crop wild relative, Inter-populational variation, Salinity, *Vigna marina*

***Abstract No: 39*** ***Life Sciences***

# QUANTIFICATION OF HISTAMINE IN FOUR COMMERCIAL FOOD FISH SPECIES IN FISH MARKETS IN MAHARAGAMA, SRI LANKA

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Histamine, a biogenic amine, is synthesised from histidine which can potentially cause histamine fish poisoning, depending on individual histamine intolerance. This study quantified histamine levels in four commercially important and widely consumed fish species (n = 20 each) obtained from open markets in Maharagama, Sri Lanka, including frigate tuna (*Auxis thazard*), Indian scad (*Decapterus russelli*), skipjack tuna (*Katsuwonus pelamis*), and mackerel tuna (*Euthynnus affinis)*. Histamine quantification was performed with the HPLC-DAD system. Samples were taken from the fish head, muscle, gill, gut, and tail (5 g each) for analysis. Histamine concentrations in frigate tuna (head: 13.91 ± 0.05 mg/kg, muscle: 12.91 ± 0.27 mg/kg, tail: 12.21 ± 0.40 mg/kg) and Indian scad (head: 14.37 ± 0.12 mg/kg, muscle: 13.99 ± 0.01 mg/kg, tail: not detected) decreased from head to tail. In skipjack tuna (head: 19.81 ± 0.46 mg/kg, muscle: 27.17 ± 0.63 mg/kg, tail: 24.32 ± 0.55 mg/kg) and mackerel tuna (head: 19.54 ± 0.37 mg/kg, muscle: 24.91 ± 0.16 mg/kg, tail: 22.58 ± 0.11 mg/kg). The highest histamine concentrations were detected in the gut part of all species (frigate tuna: 17.91 ± 0.24 mg/kg, Indian scad: 15.17 ± 0.04 mg/kg, skipjack tuna: 29.36 ± 0.78 mg/kg, mackerel tuna: 26.42 ± 0.47 mg/kg). Histamine was not detected in the gills of frigate tuna and Indian scad, while in skipjack tuna and mackerel tuna, gill histamine concentrations were 14.67 ± 0.32 mg/kg and 13.47 ± 0.29 mg/kg, respectively. None of the samples exceeded the 100 mg/kg threshold set by Sri Lankan regulations. Despite these threshold values, to reduce the risk associated with high histamine levels, it is advisable to remove the guts and gills of fish before consumption. Skipjack tuna, in particular, tends to have elevated histamine levels and may present a greater risk, especially for those with histamine intolerance.

*Financial assistance from the Centre for Water Quality and Algae Research is acknowledged*

**Keywords:** Frigate tuna, Histamine, Indian scad, Mackerel tuna, Skipjack tuna

***Abstract No: 48*** ***Life Sciences***

# STORED PRODUCT PEST MANAGEMENT AWARENESS AND PRACTICES IN FOUR SELECTED DISTRICTS IN SRI LANKA

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Lack of awareness of proper hygiene and storage practices for grains contributes to increased insect pest attacks and substantial economic losses. The aim of this study was to understand the awareness and practices of communities from Ampara, Gampaha, Colombo, and Kandy Districts regarding stored product pests and their control. Residents from 100 households and 30 shop/warehouse owners from each district were interviewed using close-ended questionnaires. The grain consumption was highest in Ampara with different types of grains like "kurakkan", barley, "kollu" and "meneri". Polythene bags and plastic containers to store grains were high in all districts except Ampara. Nineteen percent of residents from Ampara used gunny bags for grain storage, while there was zero usage of gunny bags in the other districts. Additionally, floor storage was significantly higher ($\chi^2$ = 27.35, $p$ = 0.0001) in Ampara (32%), where the grains were more vulnerable to pest attacks. Over 90% of participants understood insect pests and the damage they cause. Grains were reported to be infected regardless of the place of purchase (supermarkets/retail stores). The majority of respondents from all districts stated that pests could be detected if grains are stored more than one month after purchase. Most stores purchased grains for a month or less (Colombo 63%, Kandy 58%, Ampara 50%, Gampaha 45%). According to retail sellers, grains could be stored for up to six months, and some warehouses could store up to one year without damage. Unlike households that did not use insecticides, a few of the warehouse owners revealed the use of Actellic 50EC (pirimiphos-methyl) fumigants to control pests. Both groups (85.75% residents and 90.18% shop owners) did not trust plant-based pest control methods. Ampara area needs improvement in grain storage practices. Further, storage of grains over a long period in shops and warehouses potentially increases the risk of pest attacks, causing a national issue. Therefore, awareness programs are essential to educate people on stored product pest management.

*Financial assistance from the PGIS Research Grant Programme 2020 (Grant No. PGIS/2020/12) is acknowledged*

**Keywords:** Grain storage, Insecticides, Storage methods, Stored product pests

***Abstract No: 53*** ***Life sciences***

# *Shigella, Salmonella,* AND Enteropathogenic *Escherichia coli* IN JUVENILE TREVALLY (*Caranx ignobilis*) FROM WESTERN SRI LANKA: MICROBIAL AND MOLECULAR ANALYSIS

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Marine fish are susceptible to contamination by pathogens through polluted water in their habitats or during handling, packaging, and processing. This study was designed to identify pathogenic bacteria (*Salmonella* spp., *Shigella* spp., and *Escherichia coli*) in the gut of *Caranx ignobilis* (trevally), focusing on the implications for human consumption. Sample collection was carried out from Negombo, Muthuwella, and Beruwela in the western coastal area of Sri Lanka, and five juvenile *C. ignobilis* from each location. The homogenized gut samples were spread onto individual MacConkey agar plates for the initial culturing step. Thirty-three bacterial colonies were identified and sub-cultured on McConkey media by streak plate method. Biochemical tests, including culturing on SIM agar, MR-VP, and Simmons citrate, were done to further identify and differentiate the bacterial species. The results indicated nine *Salmonella* strains., four *Shigella* strains., and four *E. coli* strains. The suspected colonies were further analysed via differential media (Xylose-Lysino-Deoxycholate agar and Chromogenic *E. coli* agar). Results demonstrated the presence of fourteen colonies of pathogenic bacteria, including nine *Salmonella* spp., four *Shigella* spp., and *E. coli.* The antibiotic sensitivity test was conducted with Chloramphenicol, Ampicillin and Erythromycin on the final fourteen isolated bacteria colonies. The resulted nine colonies were sensitive to Chloramphenicol with diameters of inhibition zones ranged from 10.30 mm to 30.30 mm, while all the colonies were insensitive to Ampicillin and Erythromycin. PCR conducted using genes *invA, invC, eaeA, ipaH,* and *bfpA* confirmed pathogenic bacteria as bands were observed for *Salmonella* spp. (*invA*) and *E. coli* (*eaeA*). The overall results of tests confirmed the presence of pathogenic bacteria in the gut of juvenile *C. ignobilis.* Therefore, implementing rigorous contamination control measures significantly decreases the health risk.

*Financial assistance from the Business Management School is acknowledged*

**Keywords:** *Caranx ignobilis, Salmonella, Shigella*

***Abstract No: 54*** ***Life Sciences***

# KEY BREEDING SITES OF *Aedes* MOSQUITOES IN THE MATARA DISTRICT, SRI LANKA

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Dengue is one of the major public health concerns in Sri Lanka. Due to the absence of a vaccine or any other promising drug, identifying and eliminating vector breeding sites remain the most important aspect of controlling disease transmission. *Aedes* vector breeding sites in Sri Lanka vary from district to district. Therefore, identifying prominent breeding sites within these districts is crucial. This study aimed to review common *Aedes* vector breeding places and temporal variation in these sites from 2020 to 2022 in the Matara District. *Aedes* vector larval surveillance was conducted monthly on all types of premises in Medical Officer of Health (MOH) areas in the Matara District in 2020, 2021, and 2022. The recorded data from the larval surveillance was combined and analysed independently to identify the main breeding areas for *Aedes aegypti* and *Aedes albopictus. Aedes aegypti*-positive containers found during the study period were 178 (9.2%), 331 (13.3%), and 490 (18.0%) in 2020, 2021, and 2022, respectively. Water storage (33.0%) and discarded containers (26.0%) were the prominent breeding sites for *Ae. aegypti* in the Matara District. In addition, tyres (11.0%), ornamental items (7.0%), pet feeding items (3.0%), and other miscellaneous items (13.0%) were found positive. *Aedes albopictus*-positive containers found during the study period were in 1749 (90.7%), 2187 (86.7%), and 2232 (82.0%) in 2020, 2021, and 2022, respectively. The primary breeding sites for *Ae. albopictus* were identified as water storage containers (30.0%), discarded containers (28.0%), ornamental items (12.0%), tyres (8.0%) and covering items (6.0%). *Aedes albopictus* was the dominant vector present in the Matara District. Water storage containers and discarded items were prominent breeding sites of both dengue vectors. Therefore, keeping water storage containers closed when not in use and maintaining a proper garbage disposal system may help reduce the dengue vector density in the Matara District.

**Keywords:** *Aedes*, Dengue disease, Matara District, Vector breeding sites

***Abstract No: 59*** ***Life Sciences***

# MORPHOLOGICAL AND MOLECULAR ANALYSIS OF MICROFILARIA AMONG DOGS IN SELECTED DIVISIONS IN THE KURUNEGALA DISTRICT, SRI LANKA

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Kurunegala district in Sri Lanka is an endemic region for canine filariasis with limitations in recent studies. The high vector density in Kurunegala and its large canine population enables the transmission of canine filariasis. Since all Sri Lankan canine filaria are zoonotic, they have the potential to spread and cause disease in human hosts, threatening the filariasis-free national status. The main objective of this study was to determine the overall microfilaria prevalence among dogs in Kurunegala. In addition, this study also aims to determine if there is an association between canine filariasis and factors like age, sex, and the urban/ rural nature of dog locations. A total of 70 blood samples (calculated using the Ministry of Health 1:6 dog to human population ratio) according to 3 criteria; age (< 1 yr., 1-3 yrs., and >3 yrs.), sex (male and female) and urban/ rural nature (based on population density), were collected from dogs in 14 veterinary divisions in Kurunegala selected by simple random sampling. All samples were subjected to morphological analysis by the modified Knott's test and Leishman stain. Positive microfilaria samples were used in molecular analysis targeting the *5.8S-ITS2-28S* region. A higher overall prevalence rate was observed in the Modified Knott's test (32.8%) relative to the Leishman stain (30.0%) due to it being a concentration technique. The main filarial parasite identified was *Dirofilaria repens*, which was confirmed by molecular characterization (Fragment size 484 bp). *Dirofilaria immitis* was not observed during this study. This study did not find a statistically significant association between the sex ($p$ = 0.179), urban/rural nature ($p$ = 0.088) and age ($p$ = 0.133) of dogs with the prevalence of canine filariasis. The continuous presence of canine filariasis at relatively high rates in this region highlights the need for greater disease surveillance, vector control methods, and awareness among dog owners.

*Financial assistance from the International Atomic Energy Agency (Grant No. 32032) is acknowledged*

**Keywords:** *Dirofilaria*, Dogs, Filariasis, Microfilariae, Sri Lanka

***Abstract No: 60*** ***Life Sciences***

# SHIFT IN SPECIES COMPOSITION AND DIVERSITY OF BEES IN A HIGHLY DYNAMIC AGRO-NATURAL LANDSCAPE AND ITS IMPACT ON CROP POLLINATION

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Bee pollinators play a crucial role in agroecosystems. The present study investigated the impact of habitat and resource availability on shifts in species composition and diversity of bees and crop yield. The research was conducted in a 16 × 16 m weedy area at the Meewathura Farm, Peradeniya, where no agrochemicals were applied. Within the central 10 × 10 m area, 76 plots (1 × 1 m) were demarcated for planting chili and eggplant, while the remaining 24 plots were planted with ornamental species. Each sampling plot was examined for 10 min from 0830 to 1130 hr to record bee species visiting flowers, their abundance and the number of open flowers. The observations were made weekly in the three areas; peripheral weedy, crop, and ornamental areas from June 2021 to May 2023 before, during, and after "Yala" and "Maha" seasons. Pollination experiments involving 25 sets of open and covered flowers were conducted, pods were harvested upon maturity, and yield was measured. Bee species richness increased from "Yala" to "Maha" 2021, remained stable from "Maha" 2021 to "Yala" 2022, and increased gradually from "Yala" to "Maha" 2022. Bee abundance differed significantly among the three areas ($p$ = 0.03). The relative abundance was higher in peripheral areas than in crop or ornamental areas over seasons and years. The pairwise comparison revealed a significant difference in the relative abundance of bees among peripheral and crop areas ($p < 0.001$) and peripheral and ornamental areas ($p < 0.001$) but not among crop and ornamental areas ($p$ = 0.63). *Ceratina binghami*, *Tetragonula iridipennis*, and *Hoplonomia westwoodi* were the most common bees in peripheral, ornamental, and crop areas, respectively. Bee species richness and abundance positively correlated with the number of open flowers ($r^2$ = 0.125, $p$ = 0.007 and $r^2$ = 0.887, $p < 0.001$). *Hoplonomia westwoodi* and *T. iridipennis* were the most abundant floral visitors of both chilli and eggplant flowers. Bee-visited crop flowers produced significantly heavier and bigger fruits with higher numbers of germinated seeds ($p < 0.001$). This study highlights the importance of diverse flowering weed species and eco-friendly inter-cropping agricultural practices to enhance bee diversity, ultimately enhancing crop production in an agro-natural landscape.

*Financial assistance from the National Research Council, Sri Lanka (Grant No. 20:010) is acknowledged*

**Keywords:** Agro-natural landscapes, Bee pollinators, Crop pollination, Floral resources

***Abstract No: 62*** ***Life Sciences***

# ANTIOXIDANT, ANTIDIABETIC, CYTOTOXIC AND PHYTOTOXIC PROPERTIES OF TWO MEDICINAL PLANTS, *Buchanania axillaris* AND *Curcuma longa*

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Medicinal plants are a rich source of bioactive compounds with potential applications in pharmaceuticals, nutraceuticals, and agrochemicals. This study aimed to assess the bioactivities of extracts from *Buchanania axillaris* leaves and rhizomes of *Curcuma longa*. They were collected domestically within the Kandy District, Sri Lanka. Plant material was air-dried and ground to obtain a homogenous powder using a grinder. The powdered samples were extracted into methanol by sonicating for 30 min. This procedure was repeated twice, and the filtrates were combined and evaporated to dryness using a rotary evaporator. The crude extracts were evaluated for antioxidant activity using triplicates for *2,2-diphenyl-1-picrylhydrazyl* (DPPH) radical scavenging assay, enzyme inhibitory activity against *α*-amylase, *α*-glucosidase, and lipase, and 10 nauplii for cytotoxicity through the brine shrimp lethality assay, and 10 seeds for phytotoxicity by the lettuce seed germination assay. The results demonstrated that *B. axillaris* exhibited potent antioxidant activity, with an $IC_{50}$ value of 0.03 ± 0.07 mg/L for DPPH radical scavenging activity, than *C. longa* (61.49 ± 0.57 mg/L). Positive control was ascorbic acid ($IC_{50}$ = 3.47 ± 0.45 mg/L). Both extracts displayed *α*-glucosidase inhibitory activity, with 100% inhibition at 1000 mg/L, indicating their potential in managing diabetes. *Curcuma longa* showed moderate *α*-amylase inhibitory activity, with an $IC_{50}$ of 465.81 ± 23.31 mg/L (Positive Control-Acarbose $IC_{50}$ = 8.87 ± 1.21 mg/L). Neither extract exhibited significant lipase inhibitory effects within the tested concentration range. The cytotoxicity assay revealed potent brine shrimp lethality for *C. longa*, with a $LC_{50}$ of 20.01 ± 3.14 mg/L, against the positive control, atropine, $LC_{50}$ = 88.60 ± 8.11 mg/L. *Buchanania axillaris* exhibited phytotoxic potency with $IC_{50}$ values of 520.97 ± 15.14 mg/L and 665.14 ± 20.54 mg/L, while *C. longa* exhibited $IC_{50}$ values of 625.29 ± 12.76 mg/L and 586.53 ± 9.32 mg/L, compared to the positive control, abscisic acid ($IC_{50}$ = 1.46 ± 0.19 mg/L and 1.85 ± 0.31 mg/L) for root and shoot inhibition, respectively, suggesting potential applications as natural herbicides. The findings indicate promising bioactivities of *B. axillaris* and *C. longa* extracts, suggesting further exploration for potential applications in pharmaceuticals, nutraceuticals, and agriculture.

**Keywords:** Antioxidant activity, *Buchanania axillaris*, *Curcuma longa*, Cytotoxicity, Enzyme inhibition

***Abstract No: 63*** ***Life sciences***

# BIOACTIVITIES OF METHANOLIC LEAF EXTRACTS OF *Adenanthera pavonina*, *Cynometra cauliflora* AND *Dregea volubilis*

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This study determines the bioactivities of the leaves of three abundantly distributed plants in Sri Lanka. Healthy leaves of *Cynometra cauliflora* (Fabaceae: "Naminan"), *Adenanthera pavonina* (Fabaceae: "Madatiya") and *Dregea volubilis* (Apocynaceae: "Anguna") were collected from Kandy District. The collected leaves were shade-dried, ground and extracted into methanol by sonication. Antioxidant ability by 2-2–Diphenyl-1-picrylhydrazyl (DPPH) radical scavenging and Ferric Reducing Antioxidant Power (FRAP) assays, $\alpha$-Amylase inhibitory activity, cytotoxicity against brine shrimps and phytotoxicity against lettuce seed germination were assessed for a concentration series ranging from 2000 mg/L to 31.25 mg/L. All assays were triplicated. Results of the DPPH radical scavenging assay revealed *C. cauliflora* has relatively strong activity ($IC_{50}$ 7.19 ± 0.15 mg/L) compared to the positive control: ascorbic acid ($IC_{50}$ 1.97 ± 0.02 mg/L), whereas *A. pavonina* ($IC_{50}$ 248.64 ± 0.02 mg/L) and *D. volubilis* ($IC_{50}$ 361.40 ± 0.09 mg/L) extracts showed moderate activities. Compared to the FRAP of positive control, Trolox (12.07 ± 0.03 µmol of $FeSO_4$/mg of the sample), the highest FRAP was observed in *C. cauliflora* (4.28 ± 0.02 µmol of $FeSO_4$/mg) followed by *A. pavonina* (0.05 ± 0.03 µmol of $FeSO_4$/mg) and *D. volubilis* (0.04 ± 0.03 µmol of $FeSO_4$/mg). *Cynometra cauliflora* ($IC_{50}$ 134.29 ± 5.24 mg/L) and *A. pavonina* leaves ($IC_{50}$ 365.03 ± 4.57 mg/L) have strong $\alpha$-amylase inhibition potential compared with the $IC_{50}$ of positive control: acarbose (45.99 ± 3.97 mg/L) whereas, *D. volubilis* resulted a weak activity (> 2000 mg/L). In the brine shrimp lethality assay, *C. cauliflora*, *A. pavonina*, and *D. volubilis* showed $LC_{50}$ of 880.07 ± 0.15 mg/L, 1900.42 ± 0.08 mg/L, and 109.95 ± 0.13 mg/L respectively. $K_2Cr_2O_7$ ($LC_{50}$ 35.16 ± 0.03 mg/L) was used as the positive control. In lettuce seed germination assay, compared to the inhibition of abscisic acid (shoot inhibition $IC_{50}$ 0.99 ± 0.35 mg/L, root inhibition $IC_{50}$ 1.11 ± 0.50 mg/L), only *C. cauliflora* resulted a moderate root inhibition (523.22 ± 0.05 mg/L) while other two extracts showed a weak inhibition (> 2000 mg/L). None of the crude extracts resulted an inhibition in the shoot elongation. Results from all assays were significantly different from the positive controls. However, as crude leaf extracts of *C. cauliflora* and *A. pavonina* may contain potent anti-diabetic compounds due to the strong potential to inhibit $\alpha$-amylase enzyme.

**Keywords:** *Adenanthera pavonina*, α-Amylase inhibition, Antioxidant activity, *Cynometra cauliflora*

***Abstract No: 66*** ***Life Sciences***

# PATHOGEN DIVERSITY OF *Ralstonia solanacearum* THAT CAUSES BACTERIAL WILT DISEASE IN TOMATO

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Bacterial wilt, caused by *Ralstonia solanacearum*, is a highly destructive disease affecting tomatoes worldwide. The objective of this study was to investigate the pathogen diversity of *R. solanacearum* in selected high tomato cultivation areas in Sri Lanka. Disease samples were collected from fields in Wattegama, Matale, Dambulla and Marassna. Stems of tomato plants showing wilt symptoms were tested for bacterial oozing. Causative bacteria were isolated on nutrient agar, and pathogenicity was confirmed through Koch's postulates. Pathogens were characterised using colony morphology, micromorphology, and biochemical tests including gram staining and the sugar metabolization test. For molecular characterization, bacterial DNA was extracted and amplified by PCR using specific primers. Altogether, 13 bacterial strains were isolated from the four field sites. All 13 strains showed positive results for the ooze test and Koch's postulates. The study identified two main bacterial types. Type 1 was dirty white, circular, smooth, raised, shiny colonies with entire margins and was gram-negative. Type 2 was white, circular, smooth, raised, shiny colonies with entire margins and was gram-positive. Type 1 bacteria showed typical characteristics of *R. solanacearum*. In the biovar testing, Dambulla strains D1, D2, and D4 metabolized maltose, glucose, mannitol, and sorbitol. Matale strain M3 and Wattegama strain P3_1 metabolized only glucose. A single strain C from Wattegama was amplified in PCR using Nmult 21: 1F forward primer with the primer sequence of 5′-CGTTGATGAGGCGCGCAATTT-3′. According to the standard biovar test, Dambulla strains D1, D2, and D4 were classified as biovar 3, while Matale strain M3 was classified as biovar 1. According to the PCR analysis, Wattegama strain C was classified as biovar 3, 4 or 5. Further, Type 2 bacteria may represent a different bacterial species that caused similar disease symptoms, such as wilting. Strain typing is useful for accurate disease diagnosis and the development of more effective, region-specific tomato varieties.

*Financial assistance from the National Research Council (Grant No. 18-91) is acknowledged*

**Keywords:** Bacterial wilt, Biovar, Pathogen, PCR, *Ralstonia solanacearum*

***Abstract No: 68*** ***Life Sciences***

# GREEN SYNTHESIS OF *Monsoon longifolium* LEAF EXTRACT-BASED SILVER NANOPARTICLES AND ANTIFUNGAL POTENTIAL AGAINST SELECTED FUNGAL PATHOGENS OF *Solanum melongena*

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Botanicals are extensively researched as alternatives to synthetic fungicides in plant disease management. The acetone extract of *Monodon longifolium* has exhibited significant antimicrobial activity *in vitro.* The lower stability, shorter storage life, and less efficient application of these phytochemicals compared to synthetic pesticides can pose challenges for farmers. Green synthesis of nano fungicides is considered as a substitute to address these limitations. The objective of this research was to synthesise *M. longifolium* based-silver nanoparticles (Ml-AgNPs) and characterize their antifungal potential against selected fungal pathogens of *Solanum melongena.* A solution of 1 mM silver nitrate ($AgNO_3$) was reduced by reacting with crude *M. longfolium* acetone extract dissolved in Dimethyl sulfoxide (150 ppm) at pH 8 by exposing to sunlight for 6 hrs synthesized Ml-AgNPs were collected through centrifugation and washed with distilled water. The morphology and chemical composition of Ml-AgNPs were analysed using UV-visible spectroscopy, Scanning Electron Microscopy and Fourier-Transform Infrared Spectroscopy (FTIR). Their antifungal properties were assessed against *Lasiodiplodia theobromae, Pseudopestalotiopsis theae* and *Diaporthe eugeniae, in vitro* (not replicated due to limited production of Ml-AgNPs) with *M. longifolium* crude extract at 2000 ppm which was used as the positive control. Ml-AgNPs synthesis was confirmed by a peak at 425 nm on the UV visible spectrum. In comparison to the *M. longifolium* leaf extract, the FTIR spectrum of the synthesized Ml-AgNPs displayed peaks at 3353.4 $cm^{-1}$, 1384.4 $cm^{-1}$, and 1142.4 $cm^{-1}$, indicating the presence of hydroxyl groups, alkanes, aromatic compounds, and carbonyl groups. Also, they were spherical in shape and nearly 80 nm in size. Growth inhibitions by synthesized Ml-AgNPs (150 ppm) against *L. theobromae*, *D. eugeniae,* and *P. theae* were 58.8%, 78.6%, and 83.5%, respectively. The highest and the lowest growth inhibitions by the crude extract were 81.8 ± 1.5% and 63.7 ± 0.6% against *P. theae* and *D. eugeniae,* respectively. These findings highlight the potential of Ml-AgNPs for managing fungal pathogens in *S. melongena*. Further research is required to increase production and assess their efficacy and sustainability in field conditions.

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**Keywords:** Fungal pathogens, Green synthesis, *Monoon longifolium*, Phytochemicals, Silver nanoparticles

***Abstract No: 73*** ***Life Sciences***

# FLAXSEED GEL MEDIA AS A NATURAL ALTERNATIVE TO COMMERCIAL MEDIA USED IN KIRBY-BAUER DISK DIFFUSION METHOD

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Microbial growth media is an important aspect of studying microorganisms in a controlled environment. A typical growth medium consists of water, a carbon source, a nitrogen source, and various macro and micronutrients. The Kirby-Bauer disk diffusion method is an antibiotic sensitivity test that aids clinicians in selecting suitable drug treatments against various microbial strains. This method involves culturing a microbial strain on growth media and observing its growth pattern in conjunction with antimicrobial drugs applied to the surface using diffusion disks. Seeds of *Linum usitatissimum* L. (flaxseeds) are nutrient-rich and primarily consist of proteins and soluble fibres, from which a mucilage layer can be extracted using water. The current study focused on determining the potential of flax mucilage/gel to be used as a natural alternative medium to Mueller-Hinton agar (MHA) used in the Kirby-Bauer disk diffusion method. The flax-gel was extracted from the whole flaxseeds with heated water (90-95 °C) at a ratio of 1:15 (seed:water). To increase the solidification of the flaxseed gel, 0.67 g of bacteriological agar and 0.15 g of anhydrous glucose as the carbon source were added for every 100 mL of flax-gel. The resulting flax-gel medium was used in the Kirby-Bauer disk diffusion method for four bacterial strains, *viz.*, *Pseudomonas aeruginosa*, *Bacillus cereus*, *Escherichia coli*, and *Staphylococcus aureus*, with the positive controls being MHA and Nutrient Agar. The effectiveness of the antibiotic sensitivity on tested media was statistically analysed based on the measured diameters of inhibition zones. The measured diameters from the flaxseed gel medium were similar to those from the MHA. This suggests that flax-gel media could be an alternative to MHA; however, further studies are needed to standardize its application.

**Keywords:** Antibiotic sensitivity testing, Bacteria, Flaxseed, Growth media, Mucilage

***Abstract No: 74*** ***Life Sciences***

# EXTRACTION OF MARINE BIO-PIGMENTS AND EVALUATION OF THEIR SUN PROTECTION FACTOR AND ANTIOXIDANT ACTIVITY

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Sunscreen has become a vital part of our daily routine for protection against harmful ultraviolet (UV) radiation and its implications, such as sunburn, skin cancer, and premature ageing. The use of synthetic UV filters in sunscreen causes adverse effects, including skin sensitization, carcinogenicity and genotoxicity. The marine waters host a vast diversity of propitious bacterial bio-pigments that are less toxic, more sustainable, and offer other biological activities. The current study aimed to explore the biological properties of marine bio-pigments as UV protectants. Marine bio-pigments were extracted and isolated from marine bacteria to assess the toxicity of the crude bacterial pigment via brine shrimp lethality assay. The radical scavenging activity was evaluated via the 2,2 Diphenyl-1-picrylhydrazyl (DPPH) method. The sun protection factor was investigated using the Mansur method. Red-pigmented bacteria were isolated from the west coast of Sri Lanka. According to standard morphological and biochemical protocols they were identified as *Bacillus* spp. The crude pigment was extracted by two solvents: surfactant sodium dodecyl sulphate (SDS) and methanol. The methanol pigment extract had a less toxic concentration (1.224 mg/mL) compared to the SDS extract (0.22 mg/mL). At their highest concentration, the maximum DPPH scavenging activity obtained for methanol and SDS extracts was 39.39% and 14.24%, respectively. The maximum Sun Protection Factor (SPF) values of methanol extract and SDS extract were 1.76 and 0.09, respectively. Both DPPH scavenging activity and SPF demonstrated an increase with the concentration of the extracts, showing higher values at their maximum concentrations. The choice of solvent affected their robustness with methanol extract exhibiting significant differences between its concentrations. The bioactive properties of marine bio-pigments propose themselves as promising alternatives to synthetic UV protectants.

**Keywords:** Bio-pigments, Marine bacteria, Sunscreen, Ultraviolet

***Abstract No: 76*** ***Life Sciences***

# ANTIFUNGAL EFFECT OF GREEN SYNTHESIZED ZINC OXIDE NANOPARTICLES AGAINST PLANT PATHOGENS *Fusarium* spp.

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This study evaluated the antifungal potential of green-synthesized zinc oxide nanoparticles (ZnO NPs) against plant pathogens of the *Fusarium* species. The synthesis process utilised *Mimosa pigra* leaves, which were dehydrated, pulverized, and extracted by mixing 8 g of dried leaf powder with 100 mL of double-distilled water. Zinc nitrate hexahydrate ($Zn(NO_3)_2 \cdot 6H_2O$) served as the precursor salt for the eco-friendly synthesis of ZnO NPs. The formation of ZnO NPs was confirmed through UV-visible spectroscopy, revealing a characteristic absorption peak at 356 nm. Scanning electron microscopy indicated a heterogeneous distribution of particle shapes and sizes, with an average particle size of 81 nm (range: 35-164 nm). The antifungal efficacy of the synthesized ZnO NPs was assessed using the poisoned food technique. ZnO NP concentrations of 0 (negative control), 50, 100, 500, and 1000 mg/L were incorporated into potato dextrose agar (PDA) plates. *Fusarium* species mycelial plugs (8 mm diameter) were inoculated into 9 cm diameter Petri dishes. All treatments were incubated at 28 ± 2 °C for seven days, with three replicates per treatment. Mycelial growth was measured, and statistical analysis was performed using one-way ANOVA, yielding a significant F-value of 43.93 ($p < 0.001$). Duncan's Multiple Range Test (DMRT) was applied as a post hoc analysis to identify significant differences in growth inhibition between treatments. ZnO NPs exhibited concentration-dependent inhibition of *Fusarium* species, with the highest inhibition (61.52%) observed at 1000 mg/L and 22.21% inhibition at 500 mg/L compared to the control. These findings indicated that green-synthesized ZnO NPs could be a sustainable approach for managing *Fusarium* infections in agricultural systems. Further research is warranted to elucidate the mechanisms of action and evaluate their potential for field applications.

*Financial assistance from The Open University of Sri Lanka (Competitive Research Grant No. 202003) is acknowledged*

**Keywords:** Antifungal activity, *Fusarium* species, Green-synthesized ZnO nanoparticles, Poisoned food technique

***Abstract No: 80*** ***Life Sciences***

# ANTIBIOTIC RESISTANCE PATTERN OF BIOFILM PRODUCING BACTERIA ISOLATED FROM WATER PLUMBING SYSTEMS

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Microbial biofilm is a three-dimensional complex community of microbial cells enclosed in a self-produced matrix that protects the microbes from the harsh environment, including antibiotics. As a result, biofilm bacteria could exhibit resistance to antibiotic treatments, leading to persistent infections that contribute significantly to morbidity and mortality rates. The objective of this study was to assess the antibiotic resistance of biofilm bacteria in water plumbing systems, i.e. distribution line (drinking water and scrapings) and drain line (wastewater and scrapings). Bacterial isolates were confirmed for biofilm production using the Tissue Culture Plate method, Congo red agar method and Tube method. The biofilm bacteria were classified into four groups i.e. group 1: coliform group bacteria excluding *Escherichia coli*; group 2: *Escherichia coli*; group 3: *Pseudomonas aeruginosa* and group 4: *Staphylococcus aureus* based on morphological and biochemical tests. These bacteria were tested for antibiotic susceptibility using the Kirby-Bauer disc diffusion method, with the following recommended antibiotics; Amoxicillin/Clavulanic acid, Ceftriaxone, Ciprofloxacin, Gentamicin, Tetracycline, and Cotrimoxazole. The results revealed that all the bacteria screened in this study were resistant to Amoxicillin/Clavulanic acid. Bacteria from groups 1 and 3 primarily exhibited resistance to Tetracycline and Cotrimoxazole, respectively. Meanwhile, bacteria from group 2 and group 4 showed resistance to both Gentamicin and Tetracycline. Additionally, some bacteria from all four groups demonstrated resistance to both Ciprofloxacin and Ceftriaxone. The antibiotic sensitivity patterns varied among each group based on the location of isolation (distribution line and drain line). However, no consistent correlation was observed within each group, likely due to their isolation from different areas of the water plumbing system, variations in nutrition levels, differences in biofilm formation efficiencies, and the presence of different strains of the same bacteria. These findings highlight the challenge posed by biofilm formation in water plumbing systems and the need for strategies to combat infections associated with biofilms.

*Financial assistance from the National Research Council of Sri Lanka (Grant No. NRC/IDG/22-037) is acknowledged*

**Keywords:** Antibiotic resistance, Antibiotic susceptibility, Biofilm producing bacteria, Water contamination

***Abstract No: 83*** ***Life Sciences***

# A PRELIMINARY STUDY OF NOCTURNAL BEETLE DIVERSITY AND THEIR FUNCTIONAL GROUPS ACROSS HABITAT TYPES IN DEENSTON, KNUCKLES, SRI LANKA

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Beetles represent a significant portion of Sri Lanka's biodiversity, with 115 families (ca. 3,033 species) documented, making them the largest faunal group on the island. However, little is known about their habitat preferences, related to their functional groups, which determine the assemblage structure of these mega diverse nocturnal beetles (Coleoptera) in the tropics. Here, we examined the diversity of nocturnal beetle assemblages in Deenston, Southeastern Knuckles region, and investigated the influence of different habitat types on their diversity. Additionally, we explored how these habitat types affect their general feeding groups. Field surveys were conducted in Deenston area during 2019 and 2020 including dry and rainy seasons (total 72 trapping events). Specimens were sampled using six UV-light traps, encompassing habitat types including central forest (CF), forest edge (FE) and abandoned plantation (AP). Beetles were identified up to family level and grouped according to feeding type (Herbivore, Predator, Scavenger, Fungivore, Moss feeders, Xylophagous). Assemblages were assessed for compositional similarity, diversity, and abundance within habitats. Overall, 1183 beetles were examined across 39 families. Beetle abundance and family richness were highest in the CF (49.79% and 39 families), followed by the FE (31.70% and 38 families) and AP (18.51% and 31 families). Family Chrysomelidae was the most abundant in both CF and FE habitats, while the abundance of Staphylinidae was higher in the AP habitat. The beetle assemblages in the CF and FE ecosystems exhibited less similarity to those found in the AP habitat. Shannon diversity value (H') and Evenness (E) resembled variation among different habitat; AP (H':2.60, E:0.75), FE (H':2.36, E:0.65), CF (H':2.43, E:0.66). Herbivorous and predators exhibited the highest diversity and abundance at 55.62% and 26.64%, respectively. The predominant composition of herbivorous beetles might be due to anthropogenic actions, with their occurrence higher in the less disturbed CF and decreases from the FE to the AP habitat. Predatory, fungivorous, and scavenger beetles were higher in the disturbed AP ecosystem. This indicates a loss of beetle abundance and richness and changes in beetle composition in disturbed environments.

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**Keywords:** Beetles, Deenston, Diversity, Habitat, Herbivorous

***Abstract No: 87*** ***Life Sciences***

# A MORPHOLOGICAL CHARACTER-BASED TAXONOMIC REVIEW OF THE GENUS *Sargassum* C. Agardh (PHAEOPHYTA) IN SRI LANKA

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*Sargassum* C. Agardh (1820) is the most species-rich genus within the family Sargassaceae. It is abundantly distributed in tropical and subtropical regions of the world. In Sri Lanka, *Sargassum* is recognized as the most economically important seaweed genus. However, the current taxonomic status of the genus *Sargassum* in Sri Lanka remains uncertain, as no valid taxonomic literature has been published with species-level identification since 1961. Therefore, this study aimed to address the six-decade gap in *Sargassum* taxonomy by analysing the morphological characters of *Sargassum* specimens collected from various coastal localities around Sri Lanka. The coastal regions of Sri Lanka; Southern, Northern, Western, and Eastern were explored for sample collection, resulting in the collection of nine specimens of *Sargassum*. For each collected specimen, 30 morphological characters were recorded, and photographs of the thallus morphology were taken. Voucher herbarium specimens were prepared for each collected specimen. Of the nine collected specimens, seven were identified as distinct species based on their unique morphological characters. Those seven species include *Sargassum aquifolium* (Turner) C. Agardh, *S. cymosum* C. Agardh, *S. vulgare* C. Agardh, *S. siliquosum* J. Agardh, *S. oligocystum* Montagne, *S. carpophyllum* J. Agardh and *S. natans* (Linnaeus) Gaillon. The other two specimens could not be differentiated due to their similar morphology. These results were confirmed by the Multiple Correspondence Analysis (MCA) based on the recorded morphological characters of the collected specimens. For the accurate identification of those two specimens, molecular characterization is needed. This study serves as a preliminary guide for understanding the morphological diversity of the *Sargassum* species in Sri Lanka, which will be important in future taxonomic research and for using *Sargassum* species in various economic aspects. However, further research is needed for more accurate identification and a comprehensive review of the genus *Sargassum* in Sri Lanka.

**Keywords:** Morphology, *Sargassum*, Sri Lanka, Taxonomy

***Abstract No: 89*** ***Life Sciences***

# MORPHOLOGICAL CHARACTERIZATION OF ANTHRACNOSE CAUSING PATHOGENS ISOLATED FROM COMMERCIALLY AVAILABLE PAPAYA IN THE KANDY DISTRICT

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Anthracnose, caused by *Colletotrichum* species, is a major post-harvest disease affecting tropical fruits, including papaya (*Carica papaya* L.). Pathogen variability can impact responses to fungicides and control methods, emphasising the crucial need to understand their diversity better. Despite identifying the causative pathogens, a knowledge gap remains regarding their morphological and biological traits in Sri Lanka. This study aimed to bridge this gap by isolating and characterizing *Colletotrichum* species from infected papaya fruits in the Kandy district, Sri Lanka. Representative samples of three commercially available papaya varieties of Red Lady (RL), Rathna (R), and Horana Hybrid (HH) were used in the study. Nine fungal pathogens from the diseased papaya fruits were isolated on Potato Dextrose Agar (PDA), and their single spore isolates were preserved for subsequent experiments. Pathogenicity tests were then conducted following Koch's postulates. Colony morphological characters were observed on seven-day-old cultures on PDA medium. Slide cultures of the isolates were prepared for observations of micro-morphological characters. The colonies of all the isolates were white, with an entire margin and flat elevation. All isolates exhibited a circular form except for one RL isolate, which displayed an irregular form. The colour of the colonies at sporulation varied, displaying black, brown, yellow and orange hues. The growth rate of seven-day-old isolates ranged from 0.48 – 0.83 cm/day. All conidia were hyaline and cylindrical with bluntly rounded ends, ranging in length from 9.7 to 16.5 μm and width from 1.8 to 5.2 μm. All hyphae were hyaline, with no significant variations. Based on the analysis of micro-morphological data and colony morphology, all isolates were identified as *Colletotrichum* spp., and the pathogen exhibited four distinct morphotypes. The findings suggest that further molecular research is needed to gain a more comprehensive understanding of the pathogen.

*Financial assistance from the Faculty of Natural Sciences of the Open University of Sri Lanka is highly acknowledged*

**Keywords:** Anthracnose, *Carica papaya*, Morphological characterization

***Abstract No: 90*** ***Life Sciences***

# PREVALENCE OF DYSMENORRHEA AND ITS ASSOCIATION WITH MENSTRUAL CYCLE CHARACTERISTICS AMONG FEMALE UNDERGRADUATES RESIDING IN HOSTELS OF THE UNIVERSITY OF SRI JAYEWARDENEPURA IN SRI LANKA

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Dysmenorrhea is characterized by painful menstruation and stands as a prevalent issue in women's gynaecological concerns. Despite its frequent occurrence, it remains underdiagnosed and underrated. This study was undertaken to assess the prevalence of dysmenorrhea and its association with menstrual cycle characteristics among female undergraduates residing in hostels of the University of Sri Jayewardenepura. An ethically approved cross-sectional study was conducted among 218 female undergraduates. Participants were selected through a simple random sampling method. Demographic data and menstrual cycle characteristics within the past two years were gathered through a self-administered questionnaire. Diagnosis of dysmenorrhea and severity grading were based on the assessment of WaLIDD score variables, including working ability, location, intensity, and duration of pain. Data were analysed using Pearson's chi-square test and Mann-Whitney U test. Study participants had a mean age of 23.75 (± 1.68) years. Among them, 215 (98.6%) had dysmenorrhea; 33 (15.1%) had mild dysmenorrhea, 139 (63.8%) had moderate dysmenorrhea, and 43 (19.7%) had severe dysmenorrhea. There were statistically significant associations between mild dysmenorrhea with passage of clots ($p$ = 0.03) and taking painkillers ($p$ < 0.001), moderate dysmenorrhea with length of the longest menstrual cycle within the past two years ($p$ = 0.019), and severe dysmenorrhea with passage of clots ($p$ = 0.002) and taking painkillers ($p$ < 0.001). There were no statistically significant associations between dysmenorrhea and the regularity of the menstrual cycle, age at menarche, family history, number of heaviest bleeding days, and number of sanitary napkins used ($p$ < 0.05). The study found a high prevalence of dysmenorrhea, surpassing comparable previous studies. Despite this high prevalence, most participants had not sought medical advice. Addressing this concern will significantly enhance the quality of life in female undergraduates, allowing them to achieve high in their academic and personal lives.

**Keywords:** Dysmenorrhea, Female undergraduates, Menstrual cycle, WaLIDD score

***Abstract No: 91*** ***Life Sciences***

# EFFECT OF FORMALIN TREATMENT ON BLOWFLY COLONIZATION, MAGGOT MASS AND RATE OF DECAY OF FISH CARCASSES

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Blowflies, also known as green bottles or carrion flies, play a vital role in forensic entomology by helping to determine decomposition patterns. They are crucial in entomo-toxicology, studying how drugs or toxins affect insect development and are invaluable in identifying substances in inebriated corpses. This study investigated how formalin, a chemical that preserves fish to prolong shelf life affects blowfly colonization, maggot mass development, and carcass decomposition rates. Five sets of six *Oreochromis* fish carcasses, three treated with 50 mL of 37% thin layer of formalin using a spray bottle, and three as controls were used. Each fish was placed outdoors on soil-filled trays, five meters apart, in a sunny location from 0800 to 1600 h from August 1st to November 30th, 2023. Blowfly visits were recorded at 30-minute intervals for two days, after which the carcasses were moved to a cage until maggots developed into pupae. Collected pupae were reared in glass jars covered with mesh until adult emergence. Carcasses were photographed daily to document decay. Data was analysed using IBM SPSS Statistics v26.0. Both groups of carcasses, experimental and control, were visited by *Chrysomya megacephala*, *Calliphora vicina* (Diptera: Calliphoridae) and *Sarcophaga* sp. (Diptera: Sarcophagidae), with the visitation rate being significantly low for the formalin-treated carcasses ($p < 0.001$). Of the colonized maggots, comparatively fewer pupae and adults emerged from the formalin-treated carcasses ($p = 0.007$). However, there was no difference ($p = 0.135$) in the rate of decay of the fish carcasses treated with formalin and the controls. The study reveals that formalin significantly affects fly visitation and also lowers the development of maggot mass on fish carcasses. However, formalin does not significantly affect the decay rate of fish carcasses, indicating that formalin impacts the initial stages of carcass decomposition, but its effect may diminish over time.

**Keywords:** Blowflies, Entomo-toxicology, Fish carcasses, Formalin, *Oreochromis*

***Abstract No: 93*** ***Life Sciences***

# MOLECULAR EPIDEMIOLOGICAL INVESTIGATIONS OF BOVINE THEILERIOSIS IN JAFFNA, SRI LANKA

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Bovine Theileriosis is a tick-borne infection causing economically significant diseases globally. Although the genetic diversity of *Theileria* in cattle has been studied to a certain extent in Sri Lanka, the association between Theileriosis and cattle demographic data is lacking in Jaffna. Therefore, this study aimed to identify *Theileria* species infecting cattle and its genotypes in the Jaffna District. Blood samples (n = 40) were collected from three small-scale cattle farms in Jaffna. Giemsa-stained blood smears were used to detect *Theileria* piroplasms microscopically while PCR was conducted to identify *T. orientalis* and *T. annulata* by amplifying gene regions of *MPSP* gene (776bp) and *Tams1* (785bp), respectively. Packed cell volume (PCV) was used to determine anaemia. Half of the cattle (20/40) were microscopically positive while 88% (23/26) were PCR positive for *T. orientalis*. Five were tested positive for both *T. orientalis* and *T. annulata*. PCR reported a significantly higher ($p = 0.001$) detection rate compared to microscopy and haematological (PCV) analysis. Sequencing and phylogenetic analyses revealed the presence of the apathogenic genotype *Type 5* of *T. orientalis*. Infection was significantly higher in females (82.5%) than in males (17.5%; Fisher's Exact test, $p = 0.04$). Only two individuals (5%) were anaemic (PCV < 24%), without any of them being symptomatic. The low prevalence of anaemia recorded by PCV can be associated with the low parasitaemia and pathogenicity of the genotype identified. This highlights the risk of under-detection of Theileriosis due to the lack of clinical signs and the significance of using molecular tools for effective diagnosis. Results confirm that immunocompromised lactating cattle are at a greater risk. This is the first record of *T. annulata* in Jaffna District.

*Financial assistance from the PGIS Research Grants (Grant No. PGIS/2022/01) is acknowledged*

**Keywords:** Anaemia, Packed cell volume, PCR, *Theileria annulata, Theileria orientalis*

***Abstract No: 96*** ***Life Sciences***

# DEVELOPMENT OF A COST-EFFECTIVE IN-HOUSE REAL TIME-PCR ASSAY TO DETECT *Clamydia trachomatis*

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*Chlamydia trachomatis* (CT) is a bacterium causing various infections primarily transmitted through sexual contact or from mother to child during childbirth. It encompasses 15 serovars categorized by antigenic variation, affecting different anatomical sites causing conditions ranging from ocular disease to sexually transmitted infections. CT's ability to evade immune responses and establish chronic infections, particularly asymptomatic in females, underscores its public health challenge. Objectives of this research include optimizing PCR for CT, analysing costs versus commercial kits, and standardizing protocol for reproducibility. The research details both conventional and real-time PCR techniques for CT detection. Three samples were analysed using a 25 µL reaction volume with master mix components, including 1X PCR buffer, 25 mM $MgCl_2$, 10 mM dNTP, primers, and Taq DNA polymerase. Negative controls (tubes 1 and 2) contained distilled water, and tube 3 with CT DNA. Thermal cycling conditions were initial denaturation at 94 °C for 5 mins (1 cycle), denaturation at 94 °C for 30 secs, annealing at 59 °C for 30 secs, extension at 72 °C for 1 min (30 cycles), and final extension at 72 °C lasted for 7 mins (1 cycle). Gel electrophoresis was performed on a 2% agarose gel stained with ethidium bromide alongside a 100 bp DNA ladder. Lane 1 showed no bands, indicating the presence of a negative control; lane 2 displayed faint bands below 100 bp, representing primer dimers; lane 3 exhibited a band confirming successful amplification of the DNA template. Real-time PCR validation included SYBR green dye, primers, and a CT DNA template in a Rotar-gene Q machine. Melting curve analysis identified ideal detection at 1.0 ng/µL and 0.1 ng/µL, with the lowest detection point determined as 0.005 ng/µL. The samples were run on a 2% agarose gel. The gel image was taken after 35 mins, and bands corresponding to the peaks obtained from the melting curve were observed. Cost analysis compared reagents for conventional PCR and real-time PCR. It confirmed real-time PCR's cost-effectiveness due to lower reagent requirements. Successful amplification and detection of CT DNA using real-time PCR have reduced end-point detection time and the need for post-PCR analysis. Real-time PCR demonstrated superior sensitivity and cost-effectiveness compared to conventional PCR for CT detection. Melting curve and gel electrophoresis confirmed its reliability. Future studies should focus on optimizing detection limits and incorporating internal controls for clinical applicability.

*Financial assistance from the International College of Business and Technology, Sri Lanka and Cardiff Metropolitan University, United Kingdom are acknowledged*

**Keywords:** *Chlamydia trachomatis*, Cost-effectiveness, Real-time PCR, Sensitivity

***Abstract No: 100*** ***Life sciences***

# ENTEROPATHOGENIC BACTERIA; *Escherichia coli, Shigella* spp. AND *Salmonella* spp. IN THE GUT OF *Decapterus russelli* (INDIAN SCAD MACKEREL) FROM THE COASTLINE OF WESTERN PROVINCE, SRI LANKA

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Though fish is a common food source for humans, fish gut can harbour pathogenic bacteria such as *Salmonella* spp., *Shigella* spp., and *Escherichia coli*, which may pose health risks. *Decapterus russelli* (Indian scad mackerel) is a common fish found in the Indian Ocean and along the coastal waters of Sri Lanka. This study investigated the presence of human pathogenic bacteria in the gut of *D. russelli*, their antibiotic resistance, and the association between the presence of pathogens and sampling sites. A total of 15 *D. russelli* individuals were collected to represent five from each of the three locations; Negombo, Beruwala, and Muthuwella. Extracted fish guts were homogenized separately, and 100 µL of each sample was cultured on MacConkey agar. After incubation at 37 °C for 24 hrs., 42 colonies with different morphologies were selected and sub-cultured. These colonies were subjected to further analysis with IMViC tests: Sulfideindole-motility (SIM) agar, Methyl red-Vogues Proskauer (MR-VP) broth and Simmon's citrate agar to determine different characteristics of Enterobacteriaceae. The suspected species were cultured on differential media. The study yielded seven *Salmonella* species, two *Shigella* species, and two enteropathogenic *E. coli* (EPEC) isolates. The antibiotic susceptibility test performed using Ampicillin, Erythromycin, and Chloramphenicol on Mueller-Hinton agar revealed that all seven *Salmonella* species, both *Shigella* species, and both EPEC samples were resistant to Ampicillin and Erythromycin. In contrast, two *Salmonella* species, and both EPEC isolates, were susceptible to Chloramphenicol while *Shigella* species showed an intermediate susceptibility. *Salmonella* species were found in all three locations and EPEC was present in both Beruwala and Negombo. However, *Shigella* species were exclusively found in the Beruwala samples. A Chi-square analysis ($p > 0.05$, likelihood ratio = 5.597) indicated no significant association between sample collection location and the presence of pathogenic bacteria.

*Financial assistance from the Business Management School is acknowledged*

**Keywords:** EPEC, Fish gut, Indian scad, *Salmonella* species, *Shigella* species

***Abstract No: 102*** ***Life Sciences***

# ANTIBACTERIAL POTENTIAL OF *Azadirachta indica* AND *Curcuma longa* EXTRACTS AGAINST SOME SELECTED MULTIDRUG-RESISTANT BACTERIA

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The emergence of multidrug-resistant bacteria has become a major global challenge to public health. Therefore, attention has been paid to explore alternative antimicrobial agents to overcome this challenge. This study aimed to compare the antibacterial efficacy of neem leaf (*Azadirachta indica*) and turmeric rhizome (*Curcuma longa*) extracts against selected multidrug-resistant bacteria; *Acinetobacter* species, *Coliform* species, Methicillin-resistant *Staphylococcus aureus* (MRSA), and *Pseudomonas aeruginosa*. The antibacterial efficacy of neem and turmeric was evaluated by performing disk diffusion and broth dilution methods. The plant extracts were prepared using the maceration method using 95% ethanol. The organisms were inoculated onto Muller Hinton agar plates with 0.5% McFarland turbidity standard for the selected microorganisms. Ciprofloxacin and Gentamicin discs were used as controls and applied along the plant extracts on the agar plates, which were then incubated at 37 °C for 24 hrs. The procedure was repeated three times to obtain the mean inhibition zone for each strain in the disc diffusion method. The minimum inhibitory concentration (MIC) of neem against MRSA was determined by the broth dilution method. An antibiotic sensitivity test was performed for control organisms in conjunction with these methods. Inhibition zones both in disc (± 8 mm) and well diffusion (± 9 mm) indicated a significant antibacterial activity of neem extract against MRSA. However, neem extract exhibited a MIC and minimum bacterial concentration of 20 mg/mL against MRSA, while turmeric showed no significant inhibitory activity. Other selected multidrug-resistant bacteria showed no significant inhibitory zones for both plant extracts. The results indicated that neem leaf extract has a significant antimicrobial effect against selected multidrug-resistant MRSA, whereas turmeric extract shows no significant effect on the aforementioned microorganisms. Further studies should focus on the impacts of neem extract concentration on its antimicrobial efficacy as it may serve as an effective alternative anti-microbial agent against multidrug-resistant MRSA.

*Financial assistance from the Kaatsu International University and Bandaranayke Memorial Ayurveda Research Unit are acknowledged*

**Keywords:** *Azadirachta indica*, *Curcuma longa*, MIC, MRSA, Multidrug-resistant

***Abstract No 103*** ***Life Sciences***

# *IN SILICO* MOLECULAR DOCKING REVEALS THE ANTIVIRAL POTENCY OF MORINGYNE FROM *Moringa oleifera* AGAINST INFLUENZA A VIRUS BY TARGETING NEURAMINIDASE

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Avian influenza A virus (IAV) is an RNA virus that causes a zoonotic infection and is responsible for periodic outbreaks of influenza (flu) in humans and livestock. The neuraminidase (NA) enzyme of IAV is currently targeted for treatment with available synthetic NA antagonists, such as Oseltamivir and Zanamivir. Due to the high mutation rate of RNA viruses, effective treatment of the disease with current antiviral drugs is challenging, necessitating the discovery of new potential antiviral drug candidates for effective treatment of IAV. *Moringa oleifera* is a perennial plant abundant in regions of South Asia, Africa, and Central America. *Moringa oleifera* plant body contains numerous bioactive compounds that exhibit important properties, including anti-tumor, anti-oxidant, anti-microbial, and anti-diabetic, that have been identified in previous studies. This study identified Moringyne (PubChem: 131751186), a hexose found in *M. oleifera*, as a potential IAV NA antagonist through *in silico* molecular docking. The IAV NA (PDB: 3TI6)-ligand docking of the active site was performed using AutoDock Vina, and the NA-ligand interactions were compared with Oseltamivir and Zanamivir. The results revealed that, except for the ARG118, SER246, and GLU276 residues, the remaining 14 amino acids involved in the interaction with NA are similar for both Oseltamivir and Moringyne. Additionally, ARG292, ARG371, and ASP151 of NA formed strong hydrogen bonds in all three drugs: Oseltamivir, Zanamivir, and Moringyne. Furthermore, Moringyne showed a binding affinity (-7.4 kcal $mol^{-1}$) with NA IAV, which is closer to Zanamivir (-7.9 kcal $mol^{-1}$) and greater than Oseltamivir (-6.7 kcal $mol^{-1}$). In conclusion, Moringyne may effectively inhibit IAV NA activity, affecting NA-mediated progeny virus escape and may indicate an effective IAV inhibitor. Further, pharmaceutical efficacy and safety need to be validated *in vitro* and *in vivo*.

**Keywords:** *In Silico*, Influenza, *Moringa oleifera*, Moringyne, Neuraminidase

***Abstract No: 112*** ***Life Sciences***

# IMPACT OF ANTHROPOGENIC ACTIVITIES ON WILDLIFE: A CASE STUDY OF THE FISHING CAT, *Prionailurus viverrinus* IN TWO PROTECTED HABITATS OF SRI LANKA

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The fishing cat, *Prionailurus viverrinus* is a medium-sized carnivorous species native to South and Southeast Asia, typically inhabiting areas adjacent to water bodies. The fishing cat was selected as the model species for the study due to its occurrence in both human-populated areas and pristine habitats. To examine the activity patterns and activity overlaps of fishing cats in two habitats, two passive infrared camera-trap were installed each in Colombo Ramsar Wetland City (CRWC) and Kumana National Park (KNP) between June 2021 and March 2024, targeting the water bodies. A total of 26 (out of 27) fishing cat camera footages were recorded in eight CRWC and 18 KNP footages. Google satellite imagery was used to identify the settlements inside the study areas. The time of footage capture of fishing cats, stray animals, and humans was used for the activity level ($a$) and overlap of activity ($\Delta 1$) analysis using kernel density estimation. The satellite images showed no human or commercial settlements inside the KNP. The activity overlap between the human-fishing cat and stray animal-fishing cat ($\Delta 1 > 0.2$) at CRWC was relatively higher than KNP. The fishing cats exhibited nocturnal activity at both study sites. The fishing cat at KNP had a higher level of activity ($a = 0.45$), whereas the fishing cat at CRWC displayed a lower level of activity ($a = 0.19$). The values demonstrated that the animals in the two study sites were active for 45% and 19% of the day, respectively. These findings revealed a significant decrease in the activity of the fishing cat at CRWC, suggesting that the anthropogenic activities may influence behavioural changes. This study offers insight into the impact of human activities and stray animals on wildlife habitats using fishing cats as a model species in Sri Lanka.

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**Keywords:** Activity overlap, Activity patterns, Behavioural changes, Camera trapping

***Abstract No: 116*** ***Life Sciences***

# ACTIVITY PATTERN VARIATIONS OF LARGE MAMMALS DURING THE 'PAADA YAATHRA' PILGRIMAGE IN KUMANA NATIONAL PARK, SRI LANKA

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Human activities inside protected areas can have an impact on wildlife. We conducted a camera trap survey to study the temporal variation of large mammal activity during varying human disturbances within Kumana National Park (KNP). Data were collected using seven camera traps placed along the traditional road used by the pilgrims attending the "Paada Yaathra" (PY) annual pilgrimage. A systematic random sampling method was followed to install the camera traps. The study site was divided into 2 × 2 $km^2$ plots, and traps were placed randomly within 300 m from the road inside the plot. All traps were placed 30 cm above the ground, approximately 3 m away from animal trails. Cameras were active 24 hrs a day for 48 days, from 27th May 2023 to 13th July 2023. This period was divided into three 16-day segments; before, during and after the PY period. Activity time was collected using the timestamp on the camera trap recordings. Collected data were used to generate activity graphs (overlap package in R 4.3.3) and calculate the activity overlap of each species before and during the PY, as well as after and during the PY. The activity overlap of detected *Panthera pardus kotiya, Melursus ursinus, Elephas maximus, Cervus unicolor, Axis axis, Sus scrofa,* and *Bubalus* sp. were analysed during the study. Among them, the lowest activity overlap was recorded for *Panthera pardus kotiya* in both comparisons: an activity overlap of 0.04 before and during the PY and 0.02 after and during the PY. This indicates a change in their activity that was not recovered even after the PY. The *Axis axis*, and *E. maximus* exhibited a high activity overlap in both comparisons. However, all large mammal species displayed reduced diurnal activity and increased nocturnal activity during the PY period compared to before and after PY. Understanding these changes in activity patterns during the PY period can help implement conservation efforts to reduce the negative interactions between large mammals and human pilgrims due to temporal activity overlaps.

*Financial assistance from the University of Sri Jayewardenepura and Rufford Small Grants (Grant No. 38961-2) are acknowledged*

**Keywords:** Activity overlap, Activity patterns, Behavioural changes, Camera trapping

***Abstract No: 119*** ***Life Sciences***

# PREVALENCE OF DEPRESSION AMONG UNDERGRADUATE STUDENTS: A CASE STUDY OF FIRST-YEAR UNDERGRADUATES OF A UNIVERSITY IN SRI LANKA

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University undergraduates are an important group of people for the future of a country. Therefore, their mental health is an important health concern. Students in the first academic year are at the threshold of the profession-targeted education where the transformation of the education system from school education to university education occurs. Depression is a common and serious mental disorder that affects nearly 300 million people worldwide. It may lead to a variety of emotional and physical problems among university undergraduates. It is found that depression causes people to feel a loss of energy, a change in appetite, sleep more or less, anxiety, reduced concentration, indecisiveness, restlessness, feelings of worthlessness, guilt, hopelessness and thoughts of self-harm or suicide. The objective of this study was to evaluate the prevalence of depression among first-year undergraduates. Additionally, it was focused on finding any significant associations between depression and its contributing factors. A cross-sectional study based on a self-administered questionnaire which contained questions to gather information on age, gender, hometown, type of accommodation, satisfaction with the degree program following, economic status, physical activities, alcohol and substance usage and relationship status was used on a random sample of undergraduates from the first academic year of nine faculties in a state university. The Peradeniya Depression Scale (PDS) was used along with the socio-demographic questionnaire to detect depression and factors associated with it among undergraduates. A total of 354 undergraduates participated in the study, and the overall prevalence of depression among them was 9.0% ($n$ = 32). According to the Chi-square test, depression was found to be significantly associated with a diminished level of satisfaction with the enrolled degree program ($p$ = 0.010) and lower monthly income of the family ($p$ = 0.047). A higher percentage of daily drug users (daily liquor users 28.5%, daily smokers 18.7% and 33.3% of daily other drug users) were found to be depressed. Further studies need to be conducted to identify other factors associated with depression. It is recommended to implement scheduled systematic screening for depression and promote counselling services among undergraduates.

**Keywords:** Addiction, Depression, Mental disorder, Prevalence

***Abstract No: 120*** ***Life Sciences***

# DIVERSITY AND SPATIAL DISTRIBUTION OF AVIFAUNA ALONG THE RECREATIONAL ROADS OF KUMANA NATIONAL PARK

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Kumana National Park (KNP) is a distinct protected area situated in the southeast coast of Sri Lanka and is known as a paradise for birds. This study is a comprehensive attempt to investigate the avifaunal diversity of KNP targeting both aquatic and terrestrial ecosystems along the recreational roads. Depending on the vehicle activities in the park, recreational roads were categorized into two categories as the main and inner recreational roads from May 2023 to February 2024. Visual encounter surveys were conducted along the recreational roads by establishing 500 m transects and fixed-point count stations. Bird counts were taken at two different times, in the morning (0600-1100 h) and evening (1300-1800 h). The relative abundance and Shannon diversity index (H′) were calculated to compare species composition and species diversity, respectively, across multiple sampling sites. A total of 136 bird species were recorded with a diversity of H′ = 4.15. The highest species diversity was recorded from the main recreational road (H′ = 4.06) compared to the inner recreational road (H′ = 3.60). The availability of a variety of water bodies, including villu, lagoons, and lakes bordering the main recreational road, could be a significant driver of this phenomenon. Water bodies sustain bird diversity by supplying important resources such as food, shelter, and nesting grounds. This observation was further supported by a high species diversity within the aquatic (H′ = 4.00) compared to the terrestrial ecosystems (H′ = 3.64). The diversity between the aquatic and terrestrial ecosystems was significantly different (Hutcheson t-test, $p < 0.05$). According to the relative abundance, the most abundant species was the little cormorant (*Microcarbo niger*) in aquatic ecosystems (relative abundance = 4.87%) and the little green bee-eater (*Merops orientalis*) within the terrestrial ecosystems (relative abundance = 6.85%). Despite the possible anthropogenic disturbances along the main recreational road, the rich avifaunal assemblage in aquatic ecosystems signifies the importance of conservation and management interventions to preserve these vital ecosystems in KNP.

*Financial assistance from the University of Sri Jayewardenepura is acknowledged*

**Keywords:** Aquatic ecosystems, Bird diversity, Recreational activities, Spatial distribution, Terrestrial ecosystems

***Abstract No: 121*** ***Life Sciences***

# SANDFLY VECTOR ABUNDANCE AND CUTANEOUS LEISHMANIASIS PREVALENCE IN MATARA, MATALE AND KEGALLE DISTRICTS IN SRI LANKA

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Leishmaniasis is a zoonotic vector-borne disease caused by the protozoan parasite *Leishmania* and has become a growing health problem in Sri Lanka. *Leishmania donovani* and *Phlebotomus argentipes* have been documented as the causative agent and possible vector, respectively. This study evaluated the prevalence of sandfly vectors and cutaneous leishmaniasis in three districts; Matara, Matale and Kegalle, in Sri Lanka, focusing on the relationship between vector abundance and disease prevalence in high, moderate, and low-risk areas. Disease prevalence records and epidemiology reports were obtained from respective MOH offices and Epidemiology Units of the Ministry of Health. Adult sandfly sampling was carried out covering high-risk (Kekanadura in Matara), moderate-risk (Dambulla in Matale), and low-risk (Rambukkana in Kegalle) areas. Using light traps, sandfly samples were collected from 1800 to 2300 h monthly from March 2023 to April 2024. Collected individuals were identified up to the generic level and separated according to gender and feeding status. Out of the 809 sandflies, a total of 795 individuals were *Phlebotomus* species (27% males and 73% females: fully engorged 29%, partially engorged 51%, and non-engorged 20%). Fourteen individuals were *Sergentomyia* species (43% males, and 57% females: fully engorged 25%, partially engorge 37.5%, and non-engorged 37.5%). There was no significant difference in the abundance of sandflies over the sampling period ($p = 0.310$) and between the study sites ($p = 0.100$). The highest total leishmaniasis cases were reported from Matale ($n = 376$), followed by Matara ($n = 208$) and Kegalle ($n = 56$). Significant differences were not observed in the monthly prevalence of leishmaniasis cases, but the study sites showed significant variations in disease prevalence ($p < 0.001$). There was no significant correlation between leishmaniasis cases and sandfly abundance (Matale: $r = 0.085$, $p = 0.783$; Matara: $r = 0.312$, $p = 0.300$; Kegalle: $r = 0.074$, $p = 0.811$). High sandfly abundance in low-risk areas (Kegalle) suggests the potential emergence of cutaneous leishmaniasis in such regions, emphasizing the need for future studies to explore the relationship between prevalence and vector abundance in broader regions.

*Financial assistance from the Postgraduate Institute of Science, University of Peradeniya, Sri Lanka* (*Grant No. PGIS/2022/02) is acknowledged*

**Keywords:** Cutaneous, Disease prevalence, Leishmaniasis, *Phlebotomus*, Vector-borne diseases

***Abstract No: 123*** ***Life Sciences***

# EFFECT OF SKIN MICROBIAL COMPOSITION OF CATTLE ON BITING PREFERENCE OF MOSQUITOES

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Host selection and biting site preference of blood-feeding insects depend on the host-derived signals, specifically from volatile compounds produced by the metabolic activities of skin microbes. This study aimed to examine the effect of the skin microbiota composition of cattle (*Bos* sp.) on the biting site preference of mosquitoes. Mosquito biting behaviour was observed on three adult cattle across two study locations in the Kandy District (Pallethalawinna, and Sandasiri Dunuwila area), from 1700 h to 2000 h, from July to September 2023. Each cow was sampled six times, and a total of 18 observations were made to record the number of mosquitoes landing on different body sites of cattle. Skin microbial samples were collected from different body sites using sterile cotton swabs. Collected skin microbes were cultured in nutrient broth for 24 hrs. Nutrient agar plates were prepared for different dilutions of the bacterial cultures to visualize the bacterial composition. Isolated colonies on agar plates were identified based on morphological differences. Results indicated a significant difference in mosquito biting preferences across different body parts of cattle ($p = 0.001$). Mosquitoes most preferred the area above the knee [32.5% (249 mosquitoes)], followed by the moderately preferred neck [8.0% (61 mosquitoes)]. The thigh area was least preferred [3.5% (27 mosquitoes)], while the nostril-to-eye region was not bitten by any mosquitoes. The microbiome composition included 18 distinct bacterial morphologies across the four body sites. Five morphologies were unique to the most preferred site, while another five were found in the least preferred sites. Two morphologies were common across all four sites. Additionally, two unique morphologies were identified in moderately preferred and none-bitten sites. These findings revealed a varied mosquito-biting preference with the skin microbiome composition.

*Financial assistance from the Multi-Disciplinary Research Grant (Grant No. 136), awarded by the University of Peradeniya, Sri Lanka, is acknowledged*

**Keywords:** Blood feeding, Body odour, Host selection, Mosquitoes, Skin microbiome

***Abstract No: 127*** ***Life Sciences***

# INSECTICIDAL POTENTIALS OF PLANT POWDERS AGAINST PESTS OF STORED GRAINS; *Sitophilus oryzae* (RICE WEEVIL) AND *Callosobruchus maculatus* (COWPEA WEEVIL) IN SRI LANKA

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Due to the negative impacts of synthetic insecticides, there is a pressing need for alternative, eco-friendly approaches to control pests of stored grains. This study aimed to investigate the effectiveness of powders of *Syzygium aromaticum* leaves, *Allium sativum* cloves, and *Olax zeylanica* leaves against *Sitophilus oryzae* and *Callosobruchus maculatus,* pests of stored grains. Smooth plant powder was prepared by grinding the dried leaves/cloves. Hundred healthy adults of each pest species (25 per replicate) from laboratory stock cultures were exposed to five concentrations (1%, 2%, 4%, 6%, and 8% w/w) of each plant powder, mixed in 100 g of disinfected grains in plastic containers covered with muslin cloth, and mortalities were recorded after every 24 hrs until 12 days. Log-probit curves were constructed, and the lethal concentration ($LC_{50}$) and lethal time ($LT_{50}$) required to kill 50% of the population were obtained by regression analysis. When treated with ≥ 2% *O. zeylanica*, both *S. oryzae* and *C. maculatus* exhibited 100% mortality within 24 hrs, and the $LT_{50}$ values were 10 hrs and 8 hrs, respectively. *Allium sativum* and *S. aromaticum* treatments demonstrated relatively low toxicity, as indicated by their high $LT_{50}$ values, with 12 days required to achieve 100% mortality in both pest species. Although the toxicity effect between *A. sativum* and *S. aromaticum* against *S. oryzae* was not significant ($p = 0.806$), *S. aromaticum* showed higher toxicity against *C. maculatus*, with a $LC_{50}$ of 0.85% and a $LT_{50}$ of 1.4 days at 2%, compared to *A. sativum*, which had a $LC_{50}$ of 4.9% and a $LT_{50}$ of 3.4 days at 2%. However, 100% mortality of *C. maculatus* was observed within 24 hrs when a high concentration, i.e. 8%, was used. The overall results revealed an effective toxicity against both pests in the order of *O. zeylanica* > *S. aromaticum* > *A. sativum*. Further studies would explore the repellence and synergistic effects of these plant products for pest management.

*Financial assistance from the PGIS Research Grant Programme 2020 (Grant No. PGIS/2020/12) is acknowledged*

**Keywords:** *Allium sativum*, Insect pest control, *Olax zeylanica*, Pests of stored grains, *Syzygium aromaticum*

***Abstract No: 136*** ***Life Sciences***

# ISOLATION OF ABIOTIC STRESS TOLERANT RHIZOBIA INHABITING *Mucuna bracteata* FROM SELECTED LOCATIONS OF PUTTALAM DISTRICT, SRI LANKA

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The symbiotic relationship between legumes and *Rhizobium* significantly aids in the growth and development of crops by promoting biological nitrogen fixation in nitrogen-depleted soil. *Rhizobium* is a group of soil bacteria that form mutualistic relationships with leguminous plants like *Mucuna bracteata*, which exhibit high nitrogen fixation ability. However, only a few studies have focused on the identification of stress-tolerant rhizobial populations inhabiting *M. bracteata*. A total of 35 rhizobial strains that are resilience to environmental stresses were isolated from the root nodules of *M. bracteata* from seven locations (Madampe, Dankotuwa, Wijayakatupotha, Pallama, Puttalam, Kumarakattuwa, and Bangadeniya) in Puttalam District, Sri Lanka. The isolated rhizobial strains were subjected to different physiological conditions such as temperature (25 °C-45 °C), drought (polyethylene glycol 8000 concentrations, 0.1% - 0.4%), pH (3.0 - 9.0), and salinity (NaCl concentrations, 0.1% - 3.0%). Stress-tolerant rhizobial strains were selected based on statistical analysis of spectrophotometric absorbance measurements. Due to high salinity levels in seven sites, rhizobial strains showed a high growth at 1% salt concentration and less tolerance with increasing salt concentrations. The rhizobial strains showed optimal growth at 35 °C because the Puttalam district temperature varies from 20 °C to 36 °C. Except for *Pallama* and *Kumarakattuwa* sites, most of the rhizobial strains showed high absorbance under varied drought conditions. *Rhizobium* growth was hindered at pH 3.0 and 4.0 but it increased up to pH 7.0 because of the optimum growth of rhizobia at soil pH 6.0 - 7.0. Among these isolates, 16 isolates exhibited tolerance to more than two physiological conditions, with nine isolates identified as the best tolerant rhizobial strains. These most tolerant strains can be cross-inoculated with crop legumes to remedy the widespread use of chemical nitrogen fertilizers.

**Keywords:** Biological nitrogen fixation, *Rhizobium*, Stress tolerance

***Abstract No: 140*** ***Life Sciences***

# SMALL-SCALE ORNAMENTAL FISH FARMERS' KNOWLEDGE ON DISEASE OCCURRENCE AND TREATMENTS IN ANURADHAPURA DISTRICT, SRI LANKA

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Lack of proper knowledge of disease identification and treatment is one of the leading causes of disease outbreaks in the ornamental fish industry. The study aimed to assess the small-scale fish farmers' knowledge of disease identification, treatment preparation, and application in ornamental fish farms in Anuradhapura District, Sri Lanka. Sixty ornamental fish farmers of the Anuradhapura District were interviewed using a structured questionnaire from March to May 2024. The experience of fish farmers varied between 2 - 30 years, and the majority had three (21.6%), five (18.3%), and ten (16.7%) years of experience. Groundwater was the primary water source (62.2%) for the fish farms. Koi (*Cyprinus carpio*) was the commonly cultivated species (15.9%), followed by goldfish (*Carassius auratus*) (14.3%), guppy (*Poecilia reticulata*) (13.9%), and molly (*Poecilia sphenops*) (10.6%). Anchor worm (*Lernaea* sp.) infection (22.4%) was the most reported disease followed by *Argulus* sp. (20.6%), white spot (*Ichthyophthirius multifiliis*) (18.8%), bacterial fin rot (15.8%), "abdominal" dropsy (8.5%), bacterial gill infection (6.1%), sleepy koi disease (3.6%), bacterial skin infection (1.2%), *Trichodina* sp. (1.2%), monogenean infection (1.2%), and scale disease (0.6%). The present study revealed the use of methylene blue and Trichlorfon (*Neguvon*) by fish farmers for most diseases without considering the pathogen. However, the majority (91.4%) did not use proper measurements or recommended treatments for a particular disease, though they had a basic knowledge of disease diagnostics. This study highlights the importance of obtaining proper training on management practices, disease detection, and treatment by small-scale ornamental fish farmers in the Anuradhapura District.

**Keywords:** Disease outbreak, Disease treatments, Fish farmer's knowledge, Fish parasites, Ornamental fish

***Abstract No: 147*** ***Life Sciences***

# PREVALENCE AND ASSOCIATED FACTORS OF OVERUSE INJURIES AMONG TRADITIONAL DANCE PRACTITIONERS OF THREE PROVINCES OF SRI LANKA

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Sri Lankan traditional dancing is performed in both recreational and professional aspects for many ages. It is a unique regime of physical activity which is trained and performed in an artistic and aesthetic nature. This study was conducted to determine the prevalence and association of overuse injuries among traditional dance practitioners of Sri Lanka. It was a descriptive cross-sectional study that included 312 traditional dance practitioners from the respective provinces of the origin of traditional dancing using a simple random sampling method. There were 103 Kandyan Traditional Dance Practitioners (KTDP) from Central Province, 103 Sabaragamuwa Traditional Dance Practitioners (STDP) from Sabaragamuwa Province and 106 Low Country Traditional Dance Practitioners (LTDP) from Southern Province. Data was collected using three pre-tested interviewer-administered questionnaires. The questionnaires were the socio-demographic questionnaire, the Self-Estimated Functional Inability because of Pain (SEFIP) questionnaire, and the Oslo Sports Trauma Research Center Overuse Injury (OSPRTOI) questionnaire. In the KTDP group, there were 47% knee injuries, 32% back injuries and 21% shoulder injuries. There were 47% knee injuries, 32% back injuries and 21% shoulder injuries in STDP. In LTDP, 28% of knee injuries, 30% of back injuries and 42% of shoulder injuries were recorded. According to Pearson's correlation test, the amount of training hours per day showed a significant correlation between back ($p < 0.05$, $r = 0.44$) and knee ($p < 0.05$, $r = 0.29$) injuries. The number of training days per week showed a significant correlation between the back ($p < 0.05$, $r = 0.42$) and shoulder ($p < 0.05$, $r = 0.37$) injuries, while the number of sleeping hours showed a significant correlation between all three injuries. The prevalence of overuse shoulder injuries is high in LTDP, while overuse back and knee injuries are prevalent in KTDP and STDP. Factors such as the number of training days, training hours, and sleeping hours may be associated with these overuse injuries.

**Keywords:** Overuse injuries, Sleeping hours, Traditional dance practitioners, Training days, Training hours

***Abstract No: 152*** ***Life Sciences***

# IMPACT OF PEER PRESSURE ON BODY IMAGE SATISFACTION AMONG UNDERGRADUATES IN THE COLOMBO DISTRICT, SRI LANKA

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Peers are a notably powerful social force that impacts one's behaviour. Peer pressure refers to the influence exerted by a peer group on its members to conform to group norms and expectations. In today's society, body image concerns have become a prominent issue, particularly among university students. Body image satisfaction denotes the extent to which individuals feel satisfied with their body image. The current study investigated the impact of peer pressure on body image satisfaction among undergraduates in the Colombo District, Sri Lanka. A descriptive cross-sectional study was conducted with a sample of 303 undergraduates (125 males and 178 females) selected through convenience sampling from state and non-state universities in the Colombo District. Data was collected via self-administered online surveys using the Adopted Peer Pressure Scale (PPS) and the Adopted Body Image Questionnaire (BIQ). Statistical analyses, including linear regression, were performed using SPSS version 27. Ethical approval was obtained from the Ethical Review Committee of KIU (KIU/ERC/22/053). Peer pressure significantly predicted body image satisfaction ($b$ = -0.101, $p < 0.001$, $R^2$ = 0.059). This study reveals that higher levels of peer pressure were associated with body image dissatisfaction among undergraduates. Conversely, lower peer pressure correlates with body image satisfaction. These findings underscore the importance of addressing peer dynamics in interventions aimed at improving body image satisfaction in the undergraduate population. Addressing peer pressure can foster a healthier, more supportive environment that promotes positive body image and overall well-being among students.

**Keywords:** Body image satisfaction, Colombo district, Peer pressure scale, Undergraduates

***Abstract No: 156*** ***Life Sciences***

# IMMUNOHISTOCHEMICAL ANALYSIS OF EXPRESSION OF β-CATENIN IN THE PROGRESSION OF ORAL DYSPLASIA TO ORAL SQUAMOUS CELL CARCINOMA

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Oral dysplasia is a precancerous condition of the oral mucosa, representing an acute, intermediate stage in the development of oral cancer. With only 40–50% of patients having a survival of five years after diagnosis, it carries crucial challenges in the field of public health and oncology. There has been a growing amount of evidence indicating that the Wnt/β-catenin pathway is elevated in oral cancer. However, the degree of this pathway's activation in different stages of oral carcinogenesis is poorly understood. Therefore, this study was aimed to address this knowledge gap by investigating the expression of β-catenin as a potential key player in the progression of oral dysplasia into the oral squamous cell carcinoma (OSCC) stage. A retrospective, case-control study was conducted using 60 archived oral samples collected from patients diagnosed with oral dysplasia and OSCC, with 12 samples representing each group of mild, moderate and severe epithelial dysplasia, 12 representing OSCC, and 12 samples representing healthy oral mucosa. A well-established protocol of immunohistochemistry (IHC) using anti-β-catenin antibodies was used to analyse the clinical tissue samples. Our findings indicate an increasing expression pattern of β-catenin in the cytoplasmic area stained when mild epithelial dysplasia progresses to the OSCC stage ($p < 0.05$). A similar increase is also observed in the nuclear area stained, with a counterinitiative drop at the OSCC stage. This is contrary to the membranous area stained, where no significant difference was observed ($p > 0.05$) among groups. These well-established relationships supported by statistically significant results obtained using one-way ANOVA analysis helped to designate β-catenin as one of the signature molecules in the progression of oral dysplasia. Therefore, this study holds the promise of improving early detection, risk assessment, and intervention strategies for oral dysplasia, thus potentially transforming the landscape of oral cancer prevention and patient care.

**Keywords:** Malignant transformation, Oral cancer, Oral dysplasia, Sub-cellular localization, Wnt/β-Catenin pathway

***Abstract No: 159*** ***Life Sciences***

# DEVELOPMENT OF AN LC-MS/MS METHOD FOR THE DETECTION OF PREDNISOLONE DOPING USING HUMAN FINGERNAILS

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Sports doping detection mainly relies on urine and blood samples. Nails are less commonly used, even though they can provide long-term drug use, due to challenges in preparation and pulverization. This study developed a Liquid Chromatography-Tandem Mass Spectrometry (LC-MS/MS) method to detect prednisolone in human fingernails. Nails from volunteers not administered with prednisolone were ethically collected, cleaned, dried, and pulverized for analysis. The extraction of prednisolone was optimized for solvent type, extraction frequency, and shaking rate. The optimized sample preparation was followed by cleaning of Nail clippings by vortexing at 2200 rpm using ultrapure water at 50 °C for 75 secs, drying at 50 °C for 80 mins, cutting into small pieces, and subjected to methanol extraction by shaking for 18 hrs at 300 rpm. LC-MS/MS analysis used a biphenyl column (100 mm × 2.1 mm, 2.7 μm) with a binary gradient of acidified (0.1% formic acid) acetonitrile and an aqueous phase to identify prednisolone. The run time for the LC-MS/MS method was 7.50 minutes. The retention time of prednisolone was 2.18 minutes. The method was validated according to International Council for Harmonization (ICH) guidelines, showing strong linearity ($R^2$ > 0.99) and high specificity with no carryover. Within-run accuracy and precision were ± 3.24% and 3.76% coefficient of variation (CV), respectively, while between-run accuracy and precision were ± 4.18% and 3.5% CV, respectively. LOD and LOQ were 0.0003 mg/L and 0.00154 mg/L, respectively. Using a cost-effective pulverization setup, the validated The LC-MS/MS method effectively detected prednisolone in fingernails. Further studies with prednisolone-doped nails are needed to advance nail-based doping detection in sports and forensics.

**Keywords:** Doping, LC-MS/MS, Nail extraction, Prednisolone

***Abstract No: 162*** ***Life Sciences***

# ANTIBIOTIC RESISTANCE IN *Pseudomonas* spp. FROM KINNIYA AND WAHAWA HOT SPRINGS, SRI LANKA

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*Pseudomonas* are opportunistic pathogens that can cause human diseases. Hot springs are rich sources of thermophilic microorganisms adapted to natural geothermal environments. This study focused on identifying antibiotic-resistant genes (ARG) in selected *Pseudomonas* species isolated from the two hot springs, Kinniya (KY) and Wahawa (WH), Sri Lanka. Antibiotic sensitivity tests ($n$ = 17) were conducted using the Kirby-Bauer disk diffusion method for aminoglycosides (kanamycin, gentamycin, and streptomycin) and quinolone ciprofloxacin. A real-time PCR technique was employed to detect resistance genes associated with aminoglycosides, phosphotransferase and acetyltransferase genes (*aph(3')-VI, aac(6')-I,* and *aac(3')-II*), as well as quinolone resistance genes (*gyrA,* and *parC*). Of the 17 strains (*Pseudomonas* sp., $n$ = 11; *Pseudomonas aeruginosa*, $n$ = 6), *Pseudomonas* sp. from KY displayed resistance to all antibiotics, while WH only resisted gentamycin and streptomycin. *Pseudomonas* sp. (75.54%) exhibited resistance to multiple drugs more frequently than *Pseudomonas aeruginosa* (25.33%). The most frequently identified ARG was *gyrA* (66.66%), particularly in KY isolates. Notably, *aac(3')-II* and *gyrA* were detected in 100% of WH isolates, whereas *gyrA* is the commonly found quinolone-resistance gene, and *aac(3')-II* is the aminoglycoside resistance gene. Findings reveal that antibiotic-resistant *Pseudomonas* isolates were less common in the WH than in the KY. The KY hot spring is more urbanized and populated by tourists than the WH. The KY isolates carry antibiotic-resistance genes, including all aminoglycoside-modifying enzymes and fluoroquinolone-resistant enzymes. However, WH isolates carry the aminoglycoside-modifying enzymes *aac(3')-II* and enzymes responsible for fluoroquinolone resistance: *gyrA* and *ParC*. The *gyrA* gene was commonly found among the selected two quinolone-resistance genes and *aac(3')-II* for aminoglycoside resistance. Monitoring anthropogenic activities regularly and thoroughly is critical to prevent the spreading of antibiotic resistance among environmental microbial communities.

**Keywords:** Aminoglycosides, Antibiotic resistance, Hot spring, *Pseudomonas* spp., Quinolone-resistance

***Abstract No:*** **163** ***Life Sciences***

# *IN SITU* INVESTIGATION OF MICROPLASTIC-ASSOCIATED BACTERIAL COMMUNITIES IN SURFACE WATER OF KANDY LAKE, SRI LANKA: ABUNDANCE, COMPOSITION, AND BACTERIAL DIVERSITY

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Microplastics (MPs) have become a major concern due to their widespread environmental presence. Kandy Lake, a renowned landmark in the heart of Kandy, suffers from severe pollution. This study focused on MP contamination in Kandy Lake and aimed to characterize associated microorganisms. Water samples were collected from Kandy Lake: six samples from inlets and two samples each from the lake and the main outlet. From each collection point, a 100 mL sample was collected and filtered through a 5 mm metal sieve, followed by Whatmann Glass Membrane filters (0.7 µm nominal pore size). Microplastic particles were manually sorted and identified based on their morphological characteristics. Particles were then transferred to autoclaved distilled water and shaken for 1 hour at 170 rpm in an orbital shaker to detach bacterial cells. These MP suspensions were cultured on Luria Bertani agar and incubated at 37 °C for 24 - 48 hrs to isolate bacterial cultures. Genomic DNA was extracted from pure cultures using a modified cetyltrimethylammonium bromide method and amplified using universal bacterial primers targeting the *16S rRNA* gene. A commercial sequencing service sequenced the amplified DNA products and deposited them in GenBank under accession numbers PP708094–PP708113. The average abundance of MPs ranged from 11.6 - 13.0 MP particles/L, with the highest concentrations observed at the lake's outlet. Raman spectroscopy data from the inlet and lake sites identified polystyrene as the predominant type of microplastic, while polypropylene was the dominant type at the outlet. Surface water samples were dominated by fibres, together with black-coloured MPs ranging from 3 - 5 mm in size. The cultured bacteria yielded 20 identified species, classified into four major groups. Six were identified as potential pathogens, belonging to the genera *Bacillus*, *Achromobacter*, *Stenotrophomonas*, *Acinetobacter*, *Burkholderia*, and *Serratia*. The study reveals a significant presence of microplastics in Kandy Lake, which carry potential pathogenic microorganisms, highlighting the exigency for intervention to address microplastic pollution in the lake.

**Keywords:** Abundance, Culturable bacteria, Kandy Lake, Microplastic, *16S rRNA* gene

***Abstract No: 164*** ***Life Sciences***

# MODERN BIOFILM-BASED BIO-ORGANO-MINERAL FERTILIZER FACILITATES SUSTAINABLE PRODUCTION OF HIGH-QUALITY RICE

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Heavy dependency on chemical fertilizers (CF) in paddy (*Oryza sativa* L.) cultivation needs to be addressed through novel approaches such as biofilm biofertilizers (BFBF), which have shown their potential to improve grain quality and productivity. The present study was designed to investigated the potential of BFBF in organic rice cultivation by combining with modern bio-organo-mineral fertilizers (BOMF). A field experiment was conducted in Ampara, Anuradhapura, Polonnaruwa and Puttalam districts in Sri Lanka during the wet season in 2023/2024. Three previously optimized fertilizer treatments *viz*., (a) BOMF practice (500 kg NPK BOMF/ha + 2.5 L BFBF/ha), (b) hybrid practice (225 kg PK BOMF/ha + 62.5 kg CF N/ha + 2.5 L BFBF/ha), and (c) CF practice (340 kg CF NPK/ha, as recommended by the Department of Agriculture, Sri Lanka), were used along with a (d) control (no fertilizer). Treatments were applied in 10 × 10 $m^2$ rice plots in a block design with three replicates in each site spread over 6.4 ha. Grain yields were utilised to calculate the Sustainable Yield Index (SYI). Rice grain samples were analysed for primary metabolites using FTIR diagnostic bands, i.e. Carbohydrate: 960-1130 $cm^{-1}$, Protein: 1600-1700 $cm^{-1}$, and Lipid: 1710-1765 $cm^{-1}$. The results indicated that the hybrid practice produced significantly higher yields ($p < 0.05$) compared to both BOMF and CF practices, which yielded comparable results. The SYI increased with BOMF and hybrid practices (0.49 and 0.60, respectively), compared to the CF-alone practice (0.36), indicating their potential to enhance the yield in a sustainable manner. In addition, the hybrid practice exhibited a significant ($p < 0.05$) increase in carbohydrate, protein, and lipid contents by 31%, 14%, and 3%, respectively, in rice grains compared to the CF practice. In conclusion, replacing CFs with organic inputs such as BOMF and BFBF not only promotes sustainable grain production but also enhances the nutritional quality of rice, thereby opening a new avenue for eco-friendly organic rice cultivation.

**Keywords:** Biofilm biofertilizer, Hybrid fertilizer, Seed primary metabolites, Sustainable yield index

***Abstract No: 167*** ***Life Sciences***

# BIOFILM BIOFERTILIZER-BASED MODERN BIO-ORGANO-MINERAL FERTILIZER PRACTICES UNVEIL THE POTENTIAL FOR ORGANIC RICE CULTIVATION

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Rice (*Oryza sativa* L.) cultivation in Sri Lanka heavily relies on chemical fertilizers (CF), which raises significant concerns for both human health and the environment. This study investigated the effect of biofilm biofertilizer (BFBF)-based modern bio-organo-mineral fertilizers (BOMF) on the growth and yield of rice in organic farming. Field trials were conducted in Anuradhapura, Puttalam, Polonnaruwa, and Ampara districts in Sri Lanka, employing four treatments i.e. (a) BOMF practice (500 kg NPK BOMF/ha + 2.5 L BFBF/ha), (b) hybrid practice (225 kg PK BOMF/ha) + CF N (62.5 kg/ha) + (2.5 L BFBF/ha), (c) CF practice (340 kg CF NPK/ha, as recommended by the Department of Agriculture, Sri Lanka), and (d) control (no fertilizer) in a complete block design with three replicates in each location. Plant samples were collected at the 50% flowering stage and analysed for shoot dry weight (SDW) and root dry weight (RDW). Grain yield was measured at harvest. After confirming the normality of the data, ANOVA followed by Tukey's HSD test was performed to compare the means. The results revealed a significantly ($p < 0.05$) higher yield (9,056 kg dry weight/ha) produced by the hybrid practice, while BOMF (5,874 kg dry weight/ha) and CF (5,394 kg dry weight/ha) practices produced comparable yields. As such, the hybrid practice showed about 67% increase in grain yield compared to the CF practice. In addition, the two practices with BOMF showed significantly ($p < 0.05$) higher RDWs compared to the CF practice and the control, with no differences in SDWs across the treatments. In conclusion, BOMF practice exhibited the potential to replace the conventional CF-only practice to mitigate some consequences of the high usage of CF in rice cultivation. Comprehensive field trials are required to confirm these findings.

*Financial assistance from the Ministry of Education (Research and Innovation Division) in Sri Lanka (Grant No. 2507) is acknowledged*

**Keywords:** Biofilms, Modern fertilizers, Sustainable agriculture

***Abstract No: 168*** ***Life Sciences***

# MORPHOLOGICAL VARIATIONS AND LENGTH-WEIGHT RELATIONSHIPS OF BULLET TUNA, *Auxis rochei* IN COASTAL WATERS OF SRI LANKA

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The sustainability of Sri Lanka's capture fishery is under threat due to overfishing and improper fishing practices. Therefore, effective fisheries management, including accurate identification of fish stocks, is crucial. This study focused on the morphological identification of bullet tuna, *Auxis rochei* from three fishery harbours: Beruwala, Galle, and Negombo, Sri Lanka. Given the migratory nature of bullet tuna, it is essential to determine whether they constitute a single stock due to their cross-boundary movements. A total of 140 fish samples were collected and 31 morphological variables were assessed. The most recently collected 38 specimens were used for truss network analysis. Using a measuring board and vernier calliper, 21 morphometric variables, truss measurements, and meristic variables were recorded. Principal Component Analysis (PCA) and factor analysis revealed significant population differences. MANOVA results showed a statistically significant distinction in 21 morphometric characters ($p < 0.05$) and eight meristic characters ($p < 0.05$). Additionally, ANOVA revealed a significant difference among the three localities ($p < 0.05$). PCA of meristic data showed that the first two principal axes explained 38.79% of total variability. A truss network of 15 measurements and eight landmarks showed significant differences across the three locations ($p < 0.05$). Length-weight relationships indicated Galle had a higher allometric coefficient ($b = 4.23$), suggesting faster weight gain relative to length, while Negombo ($b = 1.5$) and Beruwala ($b = 1.24$) exhibited weaker allometric relationships. Condition factors close to 1 suggested that the health of tuna populations is good across all sites (Galle = 0.998, Negombo = 0.977, Beruwala = 0.976). The morphometric differences indicated that the fish populations may have diverged due to genetic differences or environmental factors. The study concluded that the samples collected from Negombo, Beruwala, and Galle represent distinct fish stocks. However, following up with DNA molecular analysis to confirm the stock differences is recommended.

**Keywords:** *Auxis rochei*, Condition factor, Meristic characters, Morphometric characters, Truss measurements

***Abstract No: 170*** ***Life Sciences***

# BROAD-SPECTRUM CYTOTOXIC POTENTIAL OF *Zanthoxylum rhetsa* AGAINST VARIED CANCER CELL LINES

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The study of phytochemicals in medicinal plants is becoming popular due to their numerous pharmacologic effects. With their molecular level processes, natural compounds with anticancer properties can target reactive oxygen species signalling, induce apoptosis, reverse multidrug resistance, and produce anti-malignancy medicines. The objective of this study was to evaluate the broad-spectrum cytotoxic potential of four distinct extracts of plant parts of *Zanthoxylum rhetsa* (Indian prickly ash) against a variety of human cancer cell lines. The dried-plant powder of the leaf, bark, thorn, and bark-thorn was extracted using methanol. The cytotoxicity was determined against four cancer cell lines by the 3-(4, 5-dimethylthiazol-2-yl)-2, 5-diphenyltetrazolium bromide (MTT) assay, and subsequently, the cancer cell colony formation ability was determined by clonogenic assay. The resulting $IC_{50}$ values of all four extracts ranged from 0.006 ± 0.002 mg/mL to 0.014 ± 0.017 mg/mL against the RD sarcoma cell line, 0.004 ± 0.002 mg/mL to 0.014 ± 0.003 mg/mL against the DLD1 colon cancer cell line, 0.005 ± 0.001 mg/mL to 0.01 ± 0.004 mg/mL against the MCF7 breast cancer cell line, 0.018 ± 0.001 mg/mL to 0.035 ± 0.004 mg/mL against the HeLa cervical cancer cell line and 0.015 ± 0.004 mg/mL to 0.030 ± 0.009 mg/mL against the Vero cell line (non-cancerous). The colony-forming capacity of the extracts decreased with increasing $IC_{50}$ concentrations. A remarkable inhibition of colony formation was observed with the thorn extract at $5 \times IC_{50}$ against the HeLa cell line with zero surviving cancer colonies. Similarly, the thorn extract showed potent cell toxicity against the RD cell line as well, with a low survival fraction of 9.9%. Previous studies have identified alkaloids, flavonoids, and phenolic compounds in *Z. rhetsa* as key contributors to its cytotoxic effects, potentially through apoptosis induction and tumour growth inhibition. These encouraging findings *in vitro* bolster the potential of *Z. rhetsa* as a natural source for the development of novel medicinal compounds against cancer.

*Financial assistance from the General Sir John Kotelawala Defence University (Grant No. KDU/RG/2021/CARE/007) is acknowledged*

**Keywords:** Cancer cell lines, Clonogenic assay, MTT assay, *Zanthozylulm rhetsa*

***Abstract No: 186*** ***Life Sciences***

# COMPARATIVE BIOACTIVITY ASSESSMENT OF *Garcinia mangostana* PERICARP AND *Gymnema sylvestre* LEAVES: ANTIOXIDANT POTENTIAL, ENZYME INHIBITION AND CYTOTOXICITY

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Plants are a rich source of bioactive compounds that can help prevent non-communicable diseases by neutralizing free radicals in the body and acting as enzyme inhibitors. This study evaluated the bioactivity of methanolic extracts from *Garcinia mangostana* pericarp, and *Gymnema sylvestre* leaves. Crude extracts were investigated for antioxidant activity using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging assay and ferric reducing antioxidant power (FRAP) assay. In addition, α-amylase inhibitory assay, brine shrimp lethality assay, and lettuce seed germination assay were performed to assess their potency as pharmaceuticals. The DPPH assay demonstrated higher free radical scavenging activity for *G. mangostana* with a lower $IC_{50}$ value of 8.76 ± 0.06 mg/L, and *G. sylvestre* had a lower activity with an $IC_{50}$ value of 264.97 ± 3.51 mg/L, compared to ascorbic acid as the positive control ($IC_{50}$ = 1.90 ± 0.01 mg/L). *Garcinia mangostana* showed higher antioxidant activity by the FRAP assay with a value of 2290.91 ± 3.67 µmol $FeSO_4$/g, while *G. sylvestre* showed a lower antioxidant capacity (393.91 ± 8.15 µmol $FeSO_4$/g) compared to Trolox as the positive control (12070.12 ± 0.30 µmol $FeSO_4$/g). Furthermore, *G. mangostana* showed high amylase inhibitory activity, with an $IC_{50}$ value of 61.46 ± 2.55 mg/L while *G. sylvestre* showed comparable activity with an $IC_{50}$ value of 75.40 ± 2.00 mg/L compared to acarbose as the positive control ($IC_{50}$ =15.97 ± 0.58 mg/L). A higher brine shrimp lethality was observed for *G. mangostana* extracts with an $LC_{50}$ of 38.32 ± 1.53 mg/L, whereas *G. sylvestre* showed lower lethality with an $LC_{50}$ of 583.25 ± 23.33 mg/L against $K_2Cr_2O_7$ as the positive control (34.40 ± 0.30 mg/L). Only *G. mangostana* showed phytotoxicity by the lettuce seed germination assay with an $IC_{50}$ of 462.22 ± 4.84 mg/L and 221.41 ± 23.09 mg/L for root and shoot, respectively. These results highlight a higher antioxidant potential and effective enzymatic inhibition of *G. mangostana* compared to *G. sylvestre*. However, the higher brine shrimp lethality of *G. mangostana* necessitates consideration of its dosage and application in pharmaceutical formulations.

**Keywords:** Amylase inhibition, DPPH assay, FRAP assay, Methanolic extract

***Abstract No:191*** ***Life sciences***

# PRELIMINARY INVESTIGATION OF DIVERSITY AND ABUNDANCE OF MOSQUITOES IN NATURAL BREEDING SITES IN AMBALANTOTA MOH AREA, SRI LANKA

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Mosquito-borne illnesses, particularly dengue, have become more frequent in Sri Lanka despite ongoing vector control efforts. Studies on the mosquito species and breeding sites of various mosquito species are few and are confined to a few areas of the country. Understanding these vector dynamics is essential to determine the potential for disease transmission and implementing effective vector control strategies. The present study aimed to investigate the diversity and habitat preferences of mosquitoes in selected natural breeding sites in the Ambalantota MOH area of the Hambantota district. Six different breeding sites; a rock pool, burrow pit, connected pool, tree hole, paddy field and a natural pool selected based on the previous entomological records, were surveyed within the month of December 2022. Larval sampling was conducted using a dipper and a pipette, and five dips were performed at each site. Collected larvae were observed under a compound microscope and identified up to species level using standard taxonomic keys. Data were analysed using PAST statistical software version 4.0. Mosquito larvae were present in all observed breeding sites. A total of 147 larvae belong to 6 different species; *Aedes vittatus* (44.9%), *Ae. albopictus* (24.5%), *Culex whitmorei* (0.7%), *Cx. tritaeniorhynchus* (14.3%), *Anopheles pallidus* (6.1%) and *Ae. macdougalli* (9.5%) were identified. Shannon Weiner (H') diversity observed was 0.97, 0.96, and 0.86 from the connected pool, rock pool and burrow pit, respectively. *Culex tritaeniorhynchus* which is the main vector of Japanese encephalitis was recorded only from rock pool (26.9%) and burrow pit (30.7%) while *Ae. albopictus*, which is a vector of dengue, was recorded from a connected pool (41.2%) and tree hole (87.8%). The three species; *Ae. vittatus, Ae. macdougalli* and *C. tritaeniorhynchus* were identified in rock pool while *Ae. vittatus, C. whitmorei*, and *C. tritaeniorhynchus* were identified in the burrow pit. *Aedes vittatus* was reported from all selected breeding sites, while *Ae. albopictus* reported only from the connected pool and tree hole. The co-existing patterns of different mosquito species should be further studied extensively to identify the most preferred breeding habitats of these mosquito species.

**Keywords:** Breeding habitats, Habitat preference, Mosquito species, Vector control

***Abstract No: 197*** ***Life Sciences***

# EFFECT OF DIETARY AZOLLA (*Azolla pinata*) SUPPLEMENTATION ON PERFORMANCE OF GROWING PIGS

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The study was conducted to evaluate the effect of supplementing different levels of Azolla on the growth performance of growing cross-bred pigs. Sixty-day-old large white crossbred pigs (n = 100) were randomly assigned to four dietary treatments, with five replicates per treatment and five pigs per replicate, using a completely randomized design. The experimental diets consisted of a basal diet supplemented with Azolla at 0% (T1), 10% (T2), 15% (T3), and 20% (T4) levels. Growth performance and morphometric changes were assessed throughout the study (90 d). Statistical significance was determined using ANOVA, and mean separation was conducted using the Tukey test. Pigs fed with T3 (18.4 ± 0.03 kg) and T4 (18.2 ± 0.03 kg) showed significantly higher feed intake compared to those on T1 and T2 diets. The highest weight gain (1.3 ± 0.12 kg) was observed in pigs fed T2, with a significantly lower feed conversion ratio (1.2 ± 0.10) compared to other treatment groups. The body length of pigs was significantly greater in T2 (834.8 ± 20.31 mm) and T3 (820.8 ± 20.31 mm) compared to pigs fed with T4. The highest palate length (243.5 ± 13.17 mm), thorax circumference (565.7 ± 10.58 mm) and shank circumference (311.4 ± 18.44 mm) were observed in pigs fed T2 compared to T4. The cost of feed per kilogram of live weight produced was significantly lower ($p < 0.05$) in all Azolla-supplemented groups. This cost-effectiveness highlights the economic benefits of integrating Azolla into pig diets. In conclusion, supplementing 10% Azolla in the commercial grower ration improves growth performance in growing large white crossbred pigs while reducing production costs. Further research could explore optimal inclusion levels and long-term effects on pig health and productivity.

**Keywords:** Cost-effective, Economic benefits, Large white cross-bred pigs, Growth performance, Pig nutrition

***Abstract No: 205*** ***Life Sciences***

# ENDOPHYTIC DIAZOTROPHS MAINTAIN CHLOROPHYLL CONTENT IN ORGANIC RICE UNDER MODERN BIOFILM-BASED BIO-ORGANO-MINERAL FERTILIZER PRACTICE

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Photosynthesis is crucial for food and oxygen production on Earth. Plant endophytes improve photosynthetic efficiency by boosting chlorophyll content, which increases with biofilm biofertilizer (BFBF) application in rice (*Oryza sativa* L.). This study aimed to investigate this relationship through field experiments in Anuradhapura, Puttalam, Ampara, and Polonnaruwa districts. Three treatments were employed: (a) Bio-organo-mineral fertilizer (BOMF) practice (500 kg NPK BOMF/ha + 2.5 L BFBF/ha), (b) Chemical fertilizer (CF) practice (340 kg CF NPK/ha), and (c) control (no fertilizer), using a randomized complete block design with three replicates. Plant samples were collected at the 50% flowering stage and analysed for total counts of endophytic bacteria (TEB), endophytic diazotrophs (ED), endophytic fungi (EF), and leaf chlorophyll content. One-way ANOVA and Tukey's HSD test were performed for mean comparisons and correlation analysis. Results revealed that the highest TEB and ED were observed in the control, and they were significantly ($p < 0.05$) reduced with the CF alone application. The BOMF practice showed significantly ($p < 0.05$) higher TEB and ED compared to the CF practice, indicating a facilitative effect of restoring the plant microbiome. The EF was significantly ($p < 0.05$) higher in the BOMF practice than the other two practices. Chlorophyll content was comparable across all three treatments. Chlorophyll content was negatively correlated with TEB ($r = -0.810$, $p = 0.008$) and EF ($r = -0.881$, $p = 0.002$) only in the CF practice, indicating a potential negative impact of CF on endophytes. It can be concluded that applying BOMF could increase the abundance of ED, TEB, and EF, thereby increasing the ability of plants for diazotrophic $N_2$ fixation and maintaining the chlorophyll content, even without CFs. Further research using the $^{15}N$ isotopic technique is recommended to confirm the relative contributions of fertilizer-N and fixed-N for chlorophyll production in rice.

*Financial assistance from the Ministry of Education (Research and Innovation Division) in Sri Lanka (Grant No. 2507) is acknowledged*

**Keywords:** Biofilms, Chemical fertilizer, Endophytes, Rice, Nitrogen fixation

***Abstract No: 208*** ***Life Sciences***

# EFFECT OF BIOFILM BIOFERTILIZERS ON THE WATER USE EFFICIENCY OF LOWLAND RICE (*Oryza sativa* L.)

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High water consumption in rice (*Oryza sativa* L.) cultivation challenges sustainable agriculture, particularly in the face of climate change. Biofilm biofertilizer (BFBF) has been reported to improve soil organic matter and offers the potential to improve water conservation in agroecosystems. This study aimed to investigate the impact of BFBF on the water usage of rice by conducting a pot experiment using two varieties: wetland (At 314) and upland (Bg 251). Two fertilizer practices were tested: (a) chemical fertilizer (CF) at 340 kg NPK $ha^{-1}$, recommended by the Department of Agriculture, Sri Lanka, and (b) BFBF at 225 kg NPK $ha^{-1}$ + 2.5 L BFBF $ha^{-1}$. Three water regimes were applied: (a) flooded, (b) field capacity, and (c) 65% field capacity, using three-factor factorial completely randomized design with three replicates. The amounts of water required to maintain the water regimes were recorded daily. Total water usage, net assimilation rate (NAR), relative growth rate (RGR), and 100-grain weight were measured. Data were analysed using a factorial ANOVA followed by Tukey's HSD test. The results highlighted that water usage in the wetland variety was significantly ($p < 0.05$) reduced by 8-12% with the application of BFBF, while water usage remained comparable between both fertilizer practices in the upland variety. Both varieties showed comparable NAR and RGR across fertilizer practices. The 100-grain weight decreased with increasing water stress in all varieties and fertilizer practices. Results suggest that water usage was comparable in both CF and BFBF practices in upland rice. In wetland rice, BFBF application significantly reduced water usage without affecting grain yield, indicating a promising strategy for efficient water management in agriculture. Further research under field conditions with larger plot sizes is recommended to confirm these results

*Financial assistance from the Microbial Biotechnology Unit of the National Institute of Fundamental Studies is acknowledged*

**Keywords:** Biofilm biofertilizer, Net assimilation rate, Relative growth rate, Rice varieties

***Abstract No: 209*** ***Life Sciences***

# DEMOGRAPHIC FACTORS ON CLINICALLY IMPORTANT MICROFLORA IN DENTURE BIOFILMS USING PCR TECHNIQUE

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Edentulism, the loss of natural teeth in humans, is a pressing global public health issue, especially affecting older adults. Removable complete dentures commonly address this problem but are also prone to microbial colonization, forming biofilms. These biofilms act as reservoirs for potentially pathogenic microorganisms, posing risks of systemic and localized diseases. This study employed a culture-independent PCR-based method to investigate the prevalence of clinically significant microorganisms in complete denture biofilms and the impact of demographic factors on their prevalence. Samples were collected from 35 denture wearers without any diagnosed clinical implications at the Dental Teaching Hospital, Peradeniya, with relevant demographic data gathered via questionnaires. The study included 10 male and 25 female participants, aged 56-85, who had used complete dentures for over one year. DNA was directly extracted from the biofilm samples scraped from the adherent denture surface. PCR using species-specific primers targeting the *16S rRNA* gene for bacteria and the *KER1* gene for *Candida albicans* was performed. *Streptococcus mutans* (28/35), *Porphyromonas gingivalis* (24/35), *Helicobacter pylori* (8/35), *Escherichia coli* (25/35), *Candida albicans* (11/35), and *Staphylococcus aureus* (29/35) were identified within the biofilms. Statistical analyses revealed associations between demographic factors (sex, age, denture age, and hygiene) and microbial colonization. Visual assessment of denture plaque accumulation was used to evaluate denture hygiene. Significant associations were found between poor denture hygiene and higher prevalence of *S. mutans, H. pylori, P. gingivalis*, and *E. coli* ($\chi^2$ of 5.62, 9.35, 4.81 and 12.45, respectively), as well as between older denture age and increased presence of *S. mutans, P. gingivalis*, and *H. pylori* ($\chi^2$ of 11.22, 5.74 and 5.1, respectively). A positive correlation was noted between denture age and hygiene ($r = 0.47$, $p < 0.05$), while sex showed no significant association with denture hygiene ($r = 0.03$, $p > 0.05$). These findings emphasize the importance of regular denture maintenance and hygiene in preventing microbial-related complications among older adults.

**Keywords:** Denture hygiene, DNA barcoding, Edentulism, Microbial biofilms, Oral microbiome

***Abstract No: 210*** ***Life Sciences***

# *IN-VITRO* CYTOTOXIC ACTIVITY OF *Elaeocarpus serratus* AND *Artocarpus heterophyllus* PLANT LEAF EXTRACTS

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Cancer is one of the main causes of disease and death worldwide, hence the continuous search for new therapeutic agents is essential. This study examined the ability of leaf extracts of *Elaeocarpus serratus* ("Veralu") and *Artocarpus heterophyllus* (Jackfruit) to kill cancer cells *in-vitro*. A hot aqueous extract, macerated aqueous and macerated methanol extracts were prepared with dried mature leaf samples, which were then tested using the 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) assay for cytotoxic activity against two human cancer cell lines; MCF-7 (breast cancer) and HepG2 (liver cancer). The results indicated that, in a dose-dependent manner, both extracts showed notable cytotoxic effects. *Artocarpus heterophyllus* extracts exhibited lower $IC_{50}$ values when compared to *E. serratus* ($p < 0.0001$) as 27.48 µg/mL, 18.63 µg/mL, and 5.67 µg/mL for hot water, macerated aqueous, and methanol extracts, respectively, against the MCF-7 cell line. The *A. heterophyllus* leaf extract showed low $IC_{50}$ values against the HepG2 cell line but the values for some extracts were much higher compared to the MCF7 cell line. The $IC_{50}$ values were 22.07 µg/mL, 47.07 µg/mL and 54.01 µg/mL for hot water, macerated water, and macerated methanol extracts, respectively. The *E. serratus* leaf extracts showed somewhat less potent results for both cell lines, whereas the most potent result was for the aqueous macerated extract against the MCF7 cell line with $IC_{50}$ of 90.59 µg/mL. The methanol extract of *A. heterophyllus* showed anti-inflammatory activity with an $IC_{50}$ of 32.94 µg/mL in the Human Red Blood Membrane Stabilization assay. In comparison, the Ibuprofen standard showed an $IC_{50}$ of 4.92 µg/mL. The same extract also exhibited an $IC_{50}$ of 4.07 µg/mL in the ABTS assay (2,2′-azino-bis-(3-ethylbenzothiazoline-6-sulfonic acid)) while the ascorbic acid standard showed an $IC_{50}$ of 0.30 µg/mL. These results indicate that *Artocarpus heterophyllus* leaf extract could be promising as a potential source of anti-cancer compounds; however, more research, including *in-vivo* studies and the identification of the active components, is needed to fully understand the therapeutic potential.

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**Keywords:** Anticancer activity, *Artocarpus heterophyllus*, *Elaeocarpus serratus*, HepG2, MCF-7

***Abstract No: 212*** ***Life Sciences***

# BIOACTIVITY OF *Strychnos potatorum* SEEDS AND DERIVED PRODUCT: ANTIOXIDANT, ANTI-INFLAMMATORY AND CYTOTOXIC PROPERTIES

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*Strychnos potatorum* is widely recognized for its medicinal and industrial applications due to its bioactivity, which includes antioxidant, anti-inflammatory, and anti-microbial properties. This study evaluated the bioactivity of *S. potatorum* seeds, and a product derived from the seeds was evaluated. Ethanolic extracts were subjected to bioassays *in vitro*. The total phenolic content (TPC) was measured by the Folin-Ciocalteu assay, and the seed extract showed a TPC value of 0.58 ± 0.05 GAE/g, while the product showed a TPC of 0.68 ± 0.13 GAE/g ($p > 0.05$). The total flavonoid content (TFC) was determined by the aluminum chloride colorimetric method, in which the TFC values for the seed extract and the product were 0.12 ± 0.01 QE/g and 0.30 ± 0.06 QE/g, respectively ($p < 0.05$). The antioxidant activity was determined by the 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay, where a maximum radical scavenging value of 70.48% ± 1.86 at 1 mg/mL was found for the seed extract. A similar value was obtained for the product extract; 70.70% ± 0.93 at 1 mg/mL ($p > 0.05$), while ascorbic acid which was the standard showed 75.55% ± 2.18 (1 mg/mL). The Human Red Blood Cell Membrane Stabilization (HRBC) assay was conducted, and the anti-inflammatory results depicted 78.41% ± 3.13 for the seed extract and 83.16% ± 1.73 for the product extract for 1 mg/mL ($p > 0.05$). Standard Ibuprofen showed a value of 5-diphenyltetrazolium bromide (MTT) assay against the HepG2 liver cancer cells. The seed extract showed a maximum cancer cell inhibitory value of 37.19% ± 0.80 at 1 mg/mL, and the product showed a value of 40.18% ± 0.90 at 1 mg/mL ($p > 0.05$). The product generally showed higher bioactivity than the seed extract, although the differences were not always statistically significant. The bioactivity of the derived product is similar to that of the raw seeds, highlighting the potential health benefits of the derived product.

**Keywords:** Anti-inflammatory, Antioxidant, Cytotoxicity, *Strychnos potatorum* product, *Strychnos potatorum* seeds

***Abstract No: 214*** ***Life Sciences***

# ANTI-DIABETIC, ANTI-INFLAMMATORY AND GC-MS PROFILE ANALYSIS OF *Schleichera oleosa* (KON) SEED EXTRACT

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The medicinal properties of *Schleichera oleosa* (Lour.) Oken, commonly called "Kon", has been acknowledged and utilised in traditional medicine for its wide-ranging therapeutic effects. This study was carried out to determine the fatty acid content in *S. oleosa* seeds. Gas Chromatography-Mass Spectroscopy (GC-MS) was employed to identify and quantify fatty acid content, while its biological activities were determined using Alpha-amylase inhibition using the dinitrosalicylic acid (DNS) method. Anti-inflammatory activity was assessed by bovine serum albumin method for the methanolic extract, as well as for the hexane, ethyl acetate and aqueous fractions. The results were expressed as mean ± SD using GraphPad Prism 7.4 ($n$ = 3). The results were analysed by one-way ANOVA followed by Tukey's multiple comparison tests, and $p < 0.05$ was considered statistically significant. The analysis identified 13 major fatty acids, with Eicosanoic acid exhibiting the highest significant percentage (39.16 ± 5.64). 9-Octadecenoic acid, Hexadecanoic acid and 9,12-Octadecadienoic acid were also detected as 36.81% ± 2.39, 10.84% ± 1.40 and 6.98% ± 2.29, respectively. The anti-inflammatory potential of *S. oleosa* seed extract was significant, while no antidiabetic activity was observed against the alpha-amylase enzyme. The crude methanolic seed extract exhibited better anti-inflammatory activity at 81.68 ± 0.45 due to the presence of Eicosanoic acid and other fatty acid derivatives, with 82.34 ± 0.22 for Diclofenac as the standard. Our results suggest that *S. oleosa* seed extract is a promising source of natural compounds with anti-inflammatory properties, making it suitable for potential therapeutic, nutraceutical, and functional food applications.

*Financial assistance from the Science and Technology Human Resource Development Project (STHRD), Ministry of Higher Education, Sri Lanka, funded by the Asian Development Bank (Grant No. R2RJ4) is acknowledged*

**Keywords:** Antidiabetic, Anti-Inflammatory, Gas chromatography-Mass spectroscopy, *Schleichera oleosa* seed extract

***Abstract No: 221*** ***Life Sciences***

# ISOLATION, CHARACTERISATION AND TOXICITY PROFILE OF A MARINE BACTERIAL BIOPIGMENT: POTENTIAL NATURAL FOOD COLOURING AGENT

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The inherent colour in food degrades during storage and processing, leading to the use of synthetic food colourants. These colourants have been reported to pose health and environmental risks due to their acute toxicity. Biopigments synthesised by marine bacteria emerge as a promising alternative to synthetic food colourants. In the absence of reported studies conducted in Sri Lanka, the present study aimed to investigate the possibility of incorporating marine bacterial crude biopigments as food colouring agents. A marine chromogenic bacterial isolate exhibiting yellow in the visible light spectrum, was isolated from surface marine water samples collected from Fish Pier, Sri Lanka. Biochemical and morphological identification assays confirmed the identity of the bacterial isolate as *Micrococcus* sp. The intracellular crude pigment was extracted using ultrasound-assisted, 99% (v/v) ethyl alcohol. The extracted crude pigment was characterised using UV-spectrometry in the visible region (350-700 nm) and found to comprise carotenoids. The animal model, *Artemia salina* nauplii, was used to assess the toxicity profile of the extracted crude pigment. For comparison, a commercial food colouring agent was tested under the same conditions as the pigment extract. Hydrogen peroxide [3% (v/v)] was used as the positive control, while distilled water was the negative control. According to Meyer's and Clarkson's toxicity indices, the $LC_{50}$ value (required for 50% mortality) for the ethanolic extract of the crude pigment (2790 mg/mL) and the $LC_{50}$ value for the commercial food colouring agent (10 mg/mL) showed no cytotoxic effects, with the crude pigment having a lower $LC_{50}$ value than the commercial food colouring agent. The findings of this study suggest that the ethanolic extract of the marine bacterial isolate, *Micrococcus* sp., can be used as a non-toxic food colouring agent.

**Keywords:** Biopigments, Chromogenic bacteria, Food colourants, Toxicity

***Abstract No: 228*** ***Life Sciences***

# BOOSTING PENICILLIN ACTIVITY USING *Coriandrum sativum* SEED EXTRACTS AGAINST METHICILLIN-RESISTANT *Staphylococcus aureus*

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The rise of antibiotic resistance, particularly among methicillin-resistant *Staphylococcus aureus* (MRSA), underscores the urgent need for novel strategies to enhance antibiotic efficacy. *Coriandrum sativum* L. is an aromatic herbaceous plant with traditional medicinal uses. This study investigated the ability of *C. sativum* seed extracts to boost penicillin activity against MRSA. The primary objective was to evaluate the antibacterial activity of crude seed extracts of *C. sativum* against pathogenic bacteria and compare their effectiveness alone and in combination with penicillin against MRSA. Dried *C. sativum* seeds were sequentially extracted with hexane, dichloromethane, ethyl acetate, methanol, and water using a Soxhlet apparatus, and their antibacterial activity was determined using the disk diffusion method. Ciprofloxacin (2 mg/mL) and DMSO were used as positive and negative controls, respectively. The interaction between seed extracts and penicillin was tested using MRSA as the model organism. Results showed that hexane, dichloromethane, ethyl acetate, and methanol extracts significantly inhibited the growth of *Staphylococcus aureus* (ATCC 25923), MRSA (clinical isolate) and *Escherichia coli* (ATCC 25922), with inhibition zone diameters (IZD) exceeding 10 mm, while the aqueous extract showed limited activity (IZD > 23 mm), inhibiting only *E. coli*. None of the extracts was effective against *Pseudomonas aeruginosa* (ATCC 27853). Ciprofloxacin inhibited all the tested organisms, showing an IZD >32 mm, while DMSO was inactive against all the tested organisms. Notably, combining half and one-fourth the concentration of penicillin's minimum inhibitory concentration (MIC) with ethyl acetate extract of *C. sativum* also at half MIC demonstrated enhanced inhibition of MRSA (IZD > 7 mm). This interaction suggests that *C. sativum* extracts can potentiate penicillin's efficacy as a promising strategy to counteract antibiotic resistance. The study concludes that seed extracts of *C. sativum* possess notable antibacterial activity and can be used to enhance the efficacy of penicillin against MRSA. Further research should focus on isolating and characterizing the active phytochemicals in *C. sativum*, investigating their interactions with other antibiotics to develop formulations to incorporate *C. sativum* extracts into clinical applications.

**Keywords:** Antibacterial resistance, *Coriandrum sativum*, Drug interaction, MRSA

***Abstract No: 243*** ***Life Sciences***

# $Na^+$ TRAFFICKING AT DIFFERENT TISSUE LEVELS REVEALS POSSIBLE SALINITY TOLERANCE MECHANISMS IN Bw400 RICE VARIETY

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Rice is particularly vulnerable to salinity during the seedling stage, making it essential to broaden the genetic diversity for salinity tolerance. Although Bw400 is a moderately salt-tolerant rice variety, the mechanisms underlying this tolerance remain unknown. To identify the salinity tolerance mechanisms of Bw400, an experiment was conducted using a randomized complete block design involving Bw400, FL478 (salt-tolerant), and Bg352 (salt-sensitive) rice varieties. Two hydroponic systems containing Yoshida nutrient medium were used for 14 days, with one system treated with NaCl at 12 dS/m to impose salinity stress, while the other served as the control. After 12 days of salinization, the $Na^+$ content, fresh and dry weights of roots, shoots, and leaves, root length, and shoot height were measured. The relative response of each parameter was calculated by comparing it with the corresponding control. Data were analysed using GLM and Dunnett's multiple comparison in MINITAB. Leaf width, length, and chlorophyll content were measured three times per day under stress. The rate of reduction in chlorophyll content varied in the order of Bg352 > Bw400 > FL478. The whole-plant $Na^+$ concentration was highest in Bg352 (2,147 mmol/kg), followed by Bw400 (1,871 mmol/kg) and FL478 (1,384 mmol/kg). Relative water content ($p$ = 0.565) and root length ($p$ = 0.171) were not significantly different. $Na^+$ accumulation (out of the total accumulation) in the roots of Bg352, Bw400, and FL478 was 23.7%, 33.6%, and 13.5%, respectively, while in the shoots, it was 45.6%, 27%, and 42%. The youngest leaf accumulated the highest amount of $Na^+$ (368.5 mmol/kg) in Bw400 compared to 169.5 mmol/kg in Bg352 and 124.3 mmol/kg in FL478. Although the leaves and roots of Bw400 accumulate more $Na^+$ than both Bg352 and FL478, the plant still tolerates salinity. Further studies are needed to uncover the biological mechanisms and associated genes responsible for this tolerance.

*Financial support provided by UNESCO/OWSD is gratefully acknowledged*

**Keywords:** Bw400, Physiological mechanisms, Salinity tolerance, Sri Lanka

***Abstract No: 249*** ***Life Sciences***

# MORPHO-MOLECULAR CONFIRMATION OF *Ganoderma sichuanense* (GANODERMATACEAE, BASIDIOMYCOTA) FROM SRI LANKA

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*Ganoderma*, a globally distributed genus of wood-decaying fungi, is a significant contributor to the global economy. *Known* as bracket or shelf fungi, *Ganoderma* species belong to the family Ganodermataceae and order Polyporales. It has been used medicinally in Asia for over 2,000 years and is now industrially cultivated, making a substantial economic impact primarily due to its medicinal benefits rather than its nutritional value. They are not classified as edible mushrooms due to their thick, corky, and rigid fruiting bodies. Despite the rich biodiversity of Sri Lanka, the diversity of *Ganoderma* species has yet to be comprehensively recognized. Accurate identification of wild mushrooms is crucial for understanding their biodiversity and ecological functions. This study aimed to bridge this gap by identifying and recording new *Ganoderma* species in Sri Lanka. Field surveys were conducted in Kandy District to collect *specimens*, which were then subjected to detailed macroscopic and microscopic examinations. The molecular phylogenetic analysis of the internal transcribed spacer (*ITS*) gene sequence of *Ganoderma* species was employed to ensure accurate species identification. The results of the phylogenetic analysis confirmed the presence of *G. sichuanense* in Sri Lanka, a species known for its medicinal properties. Although several publications have mentioned the presence of *G. sichuanense* in Sri Lanka, this is the first report with a complete description and phylogenetic analysis of the species. Identifying the *Ganoderma* species enhances the understanding of the fungal biodiversity of Sri Lanka. This finding underscores the rich fungal biodiversity on the island and provides the foundation for future studies on their ecological roles and medicinal potentials.

*Financial assistance from the Tropical Microbiology Research Foundation is acknowledged*

**Keywords:** *Ganoderma sichuanense*, Macrofungi, Medicinal value, Polyporales, Wood decaying fungi

***Abstract No: 250*** ***Life Sciences***

# ENTOMOLOGICAL SURVEILLANCE FOR EFFECTIVE DENGUE CONTROL IN URBAN SETTING: A CASE STUDY FROM COLOMBO MUNICIPAL COUNCIL, SRI LANKA

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Dengue is a major public health issue in Sri Lanka, particularly in the densely populated Colombo Municipal Council (CMC) area. This study aimed to assess entomological indices, identify critical breeding sites and to conduct risk assessments for each premise selected from Medical Officers of Health (MOH) areas. Entomological surveys were conducted from January to June 2024 following sentinel sites, routine and spot survey protocols. Maligawaththa ward from MOH D2B, Wanathamulla ward from MOH D3 and Narahenpita ward from MOH D4 were selected as sentinel sites. Areas that recorded high number of dengue patients for the last five years were selected as routine sites. Spot surveys were conducted upon reporting of dengue patients. Premise Index (PI) and Container Index (CI) were calculated for all MOH areas, while the Breteau Index (BI) was calculated for three sentinel sites. The survey covered 5,439 premises and examined 48,856 containers, of which 323 (5.9%) premises were positive for *Aedes* larvae (*Ae. aegypti*: 82.3%, *Ae. albopictus*: 17.7%). High positivity rates were observed in non-residential premises (62.7%), including government institutions (84.2%), construction sites (80.0%), schools (71.1%), and religious places (63.3%). Among the container types, construction materials had the highest proportion of wet containers (20.4%), while discarded items had the highest proportion of dry containers (27.6%). *Aedes* larval-positive containers followed the order of water-storing items (19.5%), wet floors (16.8%), and kitchen-associated containers. An increase in outdoor and discarded containers (62.9%) was observed during the latter part of sampling compared to the first quarter (37.1%). A gradual increase in entomological indices was observed from May, with the PI approaching 10 and the BI surpassing 5, coinciding with the initial dengue peak in the CMC. A higher *Ae. aegypti*, larval-positive containers were observed compared to *Ae. albopictus* ($t = 4.27$, $p = 0.0006$). The high-risk premises and specific container types identified by this study have laid a strong foundation for targeted dengue control interventions.

**Keywords:** Bretau Index, Container Index, Dengue, Entomological survey, Premise Index

***Abstract No: 252*** ***Life Sciences***

# EYEGLASS USAGE, MAINTENANCE HABITS, AND AWARENESS OF BACTERIAL CONTAMINATION: A SURVEY-BASED STUDY IN SRI LANKA

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Potential eye infections resulting from unhygienic eyeglass usage practices and a lack of awareness are critical factors to consider. This study aimed to investigate eyeglass usage, maintenance, and awareness of bacterial contamination among eyeglass wearers in Sri Lanka. A cross-sectional online survey was carried out from May to June 2024, and participants included aged 18 years and older. The questionnaire covered demographic information, types of eyeglasses and usages, cleaning habits, awareness of bacterial infections, health issues, and knowledge of antibacterial products. The demographic profile of 322 respondents revealed a predominantly young cohort aged 18 to 35 years (53%) with a university-level education (61%). Prescription glasses were the most popular type of eyewear (73%), followed by sunglasses (24%), computer glasses (20%), and safety glasses (12%). Usage frequency varied, with 34% wearing glasses constantly, 52% as needed, and 14% rarely. For cleaning, 63% of respondents use microfiber cloths, 38% use water and soap, and 11% use commercial alcoholic products. The results may be mutually inclusive, as respondents could use multiple types of eyewear and cleaning methods. A significant association was found between gender and the impact of hygienic habits on preventing bacterial contamination on eyeglasses ($\chi^2$ = 5.956, $p$ = 0.020). Most respondents (63%) were aware of bacterial contamination on eyeglasses, and the primary sources of contamination were environmental exposure (66%) and manual contact (63%). Sixty-one percent of respondents knew unclean eyeglasses could cause eye infections, and 38% used antibacterial products. A significant association was reported between good hygiene practices and the level of discomfort in wearing eyeglasses ($\chi^2$ =14.03, $p$ = 0.001). For eyeglass hygiene and eye health information, 63% of respondents rely on the internet, while 54% consult with eye care professionals. The importance of public health campaigns on eyeglass hygiene is emphasized by 65% of respondents, suggesting the need for greater awareness and education on effective eyeglass maintenance.

*Financial assistance from the University of Peradeniya (Grant No. 136) is acknowledged*

**Keywords:** Antibacterial products, Bacterial contamination, Eyeglasses, Eye infections, Hygiene practices

***Abstract No: 255*** ***Life Sciences***

# SIGNIFICANCE OF INTRASPECIFIC TRAIT VARIABILITY IN TRAIT-BASED COMMUNITY ASSEMBLY

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The link between plant traits and resource gradients has greatly enhanced our understanding of plant community assembly. While plant trait variation encompasses both interspecific and intraspecific differences, ecological research generally considers that intraspecific variations (ITV) are negligible compared to interspecific variations (BTV). However, growing interest in ITV has revealed its significant role in plant community assembly. A direct comparison between BTV and ITV in plant species is lacking, especially in tropical rainforests. This study compared the inter and intra-specific variations of four key leaf traits, *viz.*, Leaf area (LA), Specific leaf area (SLA), Leaf dry matter content (LDMC), and Leaf thickness (LT) in 15 dominant tree species across two topographic habitats (ridge and valley) in the Sinharaja tropical lowland rainforest. Trait data from 30 randomly selected individuals (1-5 cm DBH) were collected for each species from the ridge and valley. It was hypothesized that while BTV would be greater than ITV, ITV would still show substantial variation across topographic habitats. The contribution of intraspecific variability in traits relative to total trait variation was quantified using a linear model, and the coefficient of variation (CV) was used to compare the BTV and ITV across two habitats. The coefficient of Variations for between-species in LA, SLA, LDMC, and LT were 5.70-, 4.00-, 5.83-, and 16.69- fold higher than their CV of within-species variation, respectively. This confirmed that trait values vary more between than within species. However, intraspecific variations explained 35%, 18%, and 13% of the total variation of SLA, LDMC, and LA across two habitats, respectively, supporting the hypothesis that significant role of ITV in plant community assembly. Intraspecific variation adjusts species' responses to environmental gradients, allowing them to thrive in various habitats. This study provides new evidence emphasizing the importance of intraspecific variation in trait-based community assembly in tropical lowland rainforests.

*Financial assistance from the Plant-soil feedback project and the ForestGEO Sinharaja projects are acknowledged*

**Keywords:** Elevation gradient, Functional traits, Trait variations, Tropical lowland rainforests

***Abstract No: 265*** ***Life Sciences***

# EFFECTIVENESS OF THE PEPPER PLANT DISTRIBUTION PROGRAM THROUGH REGIONAL ANALYSIS OF SURVIVAL RATES IN SRI LANKA

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Black Pepper (*Piper nigrum*, Piperaceae) is an important commodity in international trade, significantly contributing to the export revenues of major producers such as Vietnam, India, Indonesia, Malaysia, and Sri Lanka. Known as the "king of spices", it is one of the most widely used spices in the world, valued for its pungency, aroma, and spicy flavour. In Sri Lanka, pepper is cultivated in the wet and intermediate zones and has made a significant contribution to the country's export income. The Department of Export Agriculture plays a vital role in promoting pepper cultivation through various programs. This study evaluated the effectiveness of the new cultivation program introduced and assessed the production rates in both wet and dry zones. A survey was conducted to analyse the survival rate of pepper plants distributed in 2022 across 15 districts, using a stratified random sampling method to select fields. Data were collected to determine the survival percentage of plants and the yield in metric tons across districts. The results revealed significant variability in survival rates, with Galle achieving the highest rate at 99.65%, followed by Kalutara at 95.73% and Ratnapura at 93.43%. Conversely, Polonnaruwa (25.84%), Hambantota (26.57%), and Ampara (43.93%) exhibited the lowest survival rates. Overall, 77.72% of the introduced plants survived. The plants introduced in Ratnapura, Kegalle, and Kurunegala generally showed better survival rates. This study highlights the need to identify best practices from high-performing districts while addressing the reasons for low survival rates in other areas. It is recommended to implement targeted interventions in districts with lower success rates.

**Keywords:** Cultivation, *Piper nigrum*, Plant-survival, Yield

***Abstract No: 266*** ***Life Sciences***

# TOXIC TRACE ELEMENTS (CADMIUM AND ARSENIC) IN SRI LANKAN COMMERCIAL RICE (*Oryza sativa L.*)

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Toxic trace element (TTE) contamination in dietary items, such as rice (*Oryza sativa* L.), poses a significant food safety concern, as even trace amounts of these elements can be harmful to human health. The bioavailability of TTEs is closely monitored in many countries to ensure compliance with statutory toxicological threshold values and permissible levels. This study investigated the presence of cadmium (Cd) and arsenic (As) in commonly consumed Sri Lankan rice varieties and assessed the potential for chronic dietary exposure to these toxic trace elements through rice consumption. A total of 54 ($N$ = 54) husked rice, representing the ten most commonly consumed varieties in Sri Lanka, were sampled at selected dedicated economic centres, from which 25 ($n$ = 25) analytical composites were homogenized, lyophilized and stored at -20 °C. An analytical portion of ~ 0.2 g lyophilized grain powders underwent microwave-assisted high-pressure acid digestion and was profiled using inductively coupled plasma mass spectrometry. Results were expressed as mg/kg on a wet-weight basis (mg/kg ww). Toxicological assessment was conducted using WHO-JECFA Codex Alimentarius Maximum Permissible Values, Provisional Tolerable Monthly Intake ($Codex_{PTMI}$) and European Food Safety Authority guidelines ($EFSA_{TWI}$) considering national per-capita consumption rates. The mean ± SD and median (IQR) Cd and As concentrations of rice grains were 0.126 ± 0.417, 0.033 (0.063) and 0.055 ± 0.030, 0.050 (0.036) mg/kg ww, respectively, which were below the Codex MPLs. Only one sample exceeded the Codex $_{PTMI}$ for Cd. Twenty percent of samples exceeded the Cd-$TWI_{EFSA,}$ indicating potential chronic dietary exposure to Cd. The red pericarp grains accumulated higher amounts of both Cd and As than the white pericarp varieties ($p_{Cd}$, $p_{As} > 0.05$). Traditional varieties showed lower As ($p_{As} > 0.05$) but higher Cd values ($p_{Cd} > 0.05$) compared to improved varieties. The parboiled grains of "Nadu" and "Samba" had higher element concentrations than the non-parboiled "Kekulu" varieties, irrespective of the pericarp colour. Approximately 20% of rice samples in Sri Lanka, especially among the red pericarp and improved varieties, exceeded the EFSA threshold for Cd.

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**Keywords:** Accumulation, Heavy metals, Human consumption, Rice, Toxic trace elements

***Abstract No: 269*** ***Life Sciences***

# PLANT DIVERSITY IN ORGANIC AND CONVENTIONAL RICE FARMING: A CASE STUDY FROM MALSIRIPURA, KURUNEGALA DISTRICT, SRI LANKA

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Use of chemical fertilizers in conventional farming contributes significantly to many environmental issues including biodiversity loss, whereas organic farming practices enhance agro-biodiversity by promoting a healthier ecosystem and enhanced ecosystem services. This study investigates the effects of organic (using organic fertilizer and other organic methods) and conventional farming (using chemical fertilizer, weedicides, pesticides and other conventional methods) on plant diversity in selected paddy fields in the intermediate climatic zone of Sri Lanka, during "*Maha* season". Vegetation sampling was conducted in rice fields (representing 12 quadrats per field, inside fields and along field bunds), covering three growth phases of rice: vegetative (V), flowering (F), and ripening (R) using pin frame method. During V, F, and R stages, the organic paddy recorded a total plant abundance of 730, 1322, and 986 individuals, while conventional paddy recorded 429, 874, and 1349 individuals, respectively. Nearly 42%, 46% and 4% in organic paddy and 43%, 43% and 7% in conventional paddy were of native, exotic and endemic plant species, respectively. Although 100% of plants belonged to weeds in conventional paddy, only 80% of plants in organic paddy were weeds. The species richness was 13, 15, 15 in organic paddy and 7, 9 and 6 in conventional paddy for V, F and R stages, respectively. Shannon-Wiener diversity indices were 0.44 ± 0.55, 0.68 ± 0.40 and 0.31 ± 0.42 in organic paddy, 0.35 ± 0.36, 0.57 ± 0.41 and 0.44 ± 0.49 in conventional paddy, for the three phases, respectively. Species richness was significantly higher in organic than conventional farming in all phenophases. However, Shannon-Weiner Diversity Indices did not significantly vary among conventional and organic fields for the *Maha* season. Conventional farming had greater evenness in all three phases (V = 0.178, F = 0.261, R = 0.191) than organic farming (V = 0.171, F = 0.258, R = 0.103). The highest value of Simpsons' Diversity index was reported in organic farming at F phase (5.07) followed by V (4.50) and R (3.45), and in conventional farming, the highest was recorded for R (3.77), followed by F (3.75) and V (2.72). *Cyperus rotundus* was the most abundant species (excluding *O. sativa*) in both paddy fields during all phenophases. The study underscores that while farming practices influence plant species richness, they do not significantly impact plant diversity.

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**Keywords:** Chemical fertilizer, Diversity indices, Organic fertilizer, Paddy field ecosystem, Paddy phenophases

***Abstract No: 289*** ***Life Sciences***

# EFFECT OF RICE VARIETY ON REPRODUCTIVE SUCCESS AND GRAIN CONSUMPTION OF MAIZE WEEVILS, *Sitophilus zeamais* (COLEOPTERA: CURCULIONIDAE): A PRELIMINARY STUDY

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*Sitophilus zeamais* (Motschulsky, 1855), commonly known as the maize weevil, is a destructive pest that frequently occurs in stored grains, including rice. The substrate variety can affect the reproductive success and population dynamics of these pests. The aim of this study was to investigate the effect of rice variety on the reproductive success of *S. zeamais* and to evaluate the rate of consumption of rice by *S. zeamais*. The eleven rice varieties in Sri Lanka, including four organic and seven non-organic, were used. Three pairs of newly emerged *S. zeamais* were introduced into 20 g of disinfected rice of each variety per replicate (3 replicates per rice variety) and observed for one month. Except for "Suwandal" (9 individuals), the total number of weevils in organic rice was relatively high, with an average of 72, 53, and 18 from "Kuruluthuda", "Pachchaperumal", and "Maavi", respectively. The highest average weight loss of organic grains was observed in "Kuruluthuda" (4.64%). Regardless of the progeny size, the weight loss in "Pachchaperumal" and "Maavi" was almost similar (~ 2.5%). The results revealed that the reproductive success of *S. zeamais* was low in non-organic varieties compared to organic ($p$ = 0.019), except "Samba", which showed a considerable population after one month ($n$ = 9 weevils) with 0.36% weight loss. The total number of weevils observed in "Red-raw rice", "White-basmati", and "Naadu" were 7, 7, and 6, respectively. No population increase was reported in "Red-basmati", "Keerisamba", and "White-raw rice". Except for Samba, a non-considerable grain weight increase was observed in "White-basmati" (2.27%) and "White-raw rice" (1.34%), suggesting that the weight increase was due to the eggs laid by the introduced weevils. The study suggested that the organic rice varieties are more vulnerable to *S. zeamais* attacks, and chemicals used for storing grains delay the reproduction of *S. zeamais*.

*Financial assistance from the PGIS Research Grant 2020 (Grant No. PGIS/2020/12) is acknowledged*

**Keywords:** Organic rice, Reproduction, Rice varieties, *Sitophilus zeamais*

***Abstract No: 293*** ***Life Sciences***

# EFFECT OF pH ON THE DEVELOPMENT OF THE PRIMARY DENGUE VECTOR, *Aedes aegypti*

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*Aedes aegypti* is the primary vector of many viruses that cause diseases such as dengue, zika, yellow fever, and chikungunya. The development of mosquito larvae depends on factors such as larval density and breeding water pH and temperature. The aim of this study was to examine the impact of pH on the growth and development of larvae of *A. aegypti* under laboratory conditions. Ten first instar larvae obtained from laboratory colonies of *A. aegypti* were introduced to each buffer solution of pH 5, 6, 7, 8 and 9 (three replicates per pH) with distilled water as the control. The observations were taken for thirteen days. The results indicated that both highly acidic (pH = 5) and highly basic (pH = 9) solutions were lethal to *A. aegypti* larvae, where all the larvae were dead by the end of the 3rd and 5th day, respectively. Only 20% and 16% completed their life cycles at pH 6 and 8 buffer solutions, respectively, showing intermediate survival rates. The optimal growth of *A. aegypti* was observed at pH 7, with 46% of larvae emerging as adults. *Aedes aegypti* completed their life cycle within 10 days at neutral pH condition. Slightly extended developmental periods were observed at pH 6 and pH 8 (12 days and 13 days, respectively). The pH range of 6-8 could be considered as the ideal pH range for the development of *A. aegypti*.

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**Keywords:** *Aedes aegypti*, Developmental timing, Growth, pH, Vector-borne diseases

***Abstract No: 294*** ***Life Sciences***

# PRELIMINARY STUDY ON SELECTED BLOOD BIOCHEMICAL PARAMETERS IN ADOLESCENTS FROM THE KOPAY MEDICAL OFFICER OF HEALTH, JAFFNA, SRI LANKA

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Adolescence is the transitional stage of development between childhood and adulthood. It is a critical period for establishing healthy habits, including diet, exercise, and lifestyle choices. The study was aimed at determining the nutritional status of adolescents (from 17-19 years old) based on selected biochemical parameters from the Kopay Medical Officer of Health (MOH), Jaffna District. Data collection was made from 70 adolescents. Blood samples were collected for the analysis of haematological indices using the cyanmethemoglobin method and serum albumin concentration using the calorimetric bromocresol green method. Ethical clearance for the study was obtained from the Ethics Review Committee, Faculty of Medicine, University of Jaffna. Out of the total 70 adolescents, 38 were females (54.3%). The mean age of the male and female adolescents was 17.73 ± 0.8 and 18.35 ± 0.7 years, respectively. Mean serum albumin concentrations of males and females were 4.048 ± 0.2 and 3.986 ± 0.2 g/dl, respectively. Protein deficiency of males and females was 3.13% ($n$ = 1) and 15.79% ($n$ = 6), respectively. The mean haemoglobin (HB) concentration of the male adolescents was 13.72 ± 2.4 g/dl with a range of 7.2 g/dl to 16.9 g/dl. The HB concentration of female adolescents was 12.23 ± 2.0 g/dl, with a range of 6.1 g to 16.1 g/dl. Among them, 37.14% ($n$ = 26) were with anaemia, while 7.7% ($n$ = 2) had severe anaemia. The mean of HCT, MCV, MCH and MCHC levels of the male and female adolescents were 40.24% ± 6.9, 85.95 ± 8.4 fl, 27.90 ±3.3 pg and 32.42 ±1.7 g/dl, respectively. Of the total adolescents 3.13% ($n$ = 1) males and 10.5% ($n$ = 4) females were affected with both iron deficiency anaemia and protein deficiency. The study revealed a prevalence of anaemia and protein deficiency among adolescents (aged 17-19) in the Kopay MOH area, with iron deficiency anaemia being more common than protein deficiency.

**Keywords:** Adolescents, Albumin, Anaemia, Haemoglobin, Nutritional status

***Abstract No: 5*** ***Physical Sciences***

# FLUORIDE REMOVAL EFFICACY OF ACTIVATED CARBON PREPARED BY ENVIRONMENTAL BENIGN CHEMICAL ACTIVATION METHOD

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This study investigated how well-activated carbon made from coconut coir can remove fluoride. Ferric chloride ($FeCl_3 \cdot 6H_2O$) was used as an activating agent. Coconut coir, an abundant and sustainable material in Sri Lanka, was first cleaned, dried, and impregnated with $FeCl_3 \cdot 6H_2O$ to enhance its adsorption properties. The impregnated coir was then carbonized at 250 °C for 1 hr to improve its porosity. After carbonization, excess $FeCl_3 \cdot 6H_2O$ was removed by immersing the activated carbon in 1.0 M HCl and heating it at 80 °C, followed by multiple washes with deionized water until the pH was neutral (pH 7). This process ensured that the activated carbon was free from residual chemicals that could affect its adsorption capacity. To evaluate the fluoride removal efficiency, batch adsorption experiments were conducted. In these experiments, 5 g of the prepared activated carbon was added to 100 mL of a 100 ppm fluoride solution, and the mixture was stirred at 400 rpm. Fluoride concentrations were monitored using a colorimetric method, where absorbance was measured with a UV-Vis spectrophotometer. A calibration curve was constructed to accurately quantify the fluoride concentration in the treated water samples. The adsorption kinetics showed that 75% fluoride ions were removed within the first 35 mins of the experiment, and equilibrium was achieved after 60 mins. The data were analysed using the Langmuir adsorption isotherm, which confirmed that fluoride was adsorbed onto the surface of the activated carbon in a monolayer fashion. The optimized conditions for effective fluoride removal included a carbonization temperature of 250 °C, a contact time of 60 mins, and a 5 g dose of activated carbon. The results demonstrated that coconut coir-derived activated carbon is a cost-effective and sustainable solution for removing high fluoride level than that of the value stipulated by the WHO from groundwater, offering a practical alternative to conventional methods such as reverse osmosis and ion exchange, particularly in resource-limited countries like Sri Lanka.

**Keywords:** Activated carbon, Carbonization, Coconut coir, Groundwater treatment

***Abstract No: 13*** ***Physical Sciences***

# DETERMINATION OF ANTIOXIDANT ACTIVITY OF SRI LANKAN GREEN TEA BY THERMAL REGULATION

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Green tea, derived from leaves of *Camellia sinensis*, is well known for potential health benefits attributed to its antioxidant properties. Recent research on Assam green tea of India suggests that roasting leaves at 270 ℃ for four minutes would be ideal to preserve a maximum of antioxidants. There are two steps involving thermal treatment in green tea production. Locally, fixation is carried out in the range of (50 - 85) ℃ and final drying is carried out at 100 ℃. Although studies have been published regarding the effect of roasting temperature on antioxidant activity, none are related to that of Sri Lankan green tea. The aim of this study was to investigate whether antioxidants could be preserved better by roasting and drying leaves at temperatures different from the typical range used in local industries. The experimental procedure involved roasting leaves at seven different temperatures in the range of 50-150 ℃ for 10 min and measuring the antioxidant activity using established bioassays; 2,2-diphenyl-1-picrylhydrazyl (DPPH) and ferric reducing antioxidant power (FRAP) assays. Total phenolic content (TPC) and total flavonoid content (TFC) were separately quantified using the Folin Ciocalteu method [pyrogallol equivalent (PE)] and $AlCl_3$ colorimetric method [quercetin equivalent (QE)] respectively. The UV absorbance data provided insights about the compounds that could be susceptible to $\nu\lambda_{max}$ value of epigallocatechin gallate pursuant to literature. There was a 40% decrease in area between UV spectra of samples processed at 50 ℃ and 100 ℃, clearly suggesting the degradation. The highest antioxidant activity was observed in samples processed at 50 ℃ in both fixation and final drying. Overall, the findings underscore fixation at 50 ℃ (DPPH: $IC_{50}$ = 12.23 ppm; FRAP: 184.68 µg $Fe^{2+}$/mg; TPC: 464.43 µg PE/mg; and TFC: 575.15 µg QE/mg) and drying at 50 ℃ (DPPH: $IC_{50}$ = 15.36 ppm; FRAP: 193.48 µg $Fe^{2+}$/mg; TPC: 536.74 µg PE/mg; and TFC: 235.15 µg QE/mg) would retain a maximum of antioxidants. However, final drying is industrially carried out at 100 ℃ (DPPH: $IC_{50}$ = 35.15 ppm, FRAP: 112.28 µg $Fe^{2+}$/mg, TPC: 427.28 µg PE/mg and TFC:159.15 µg QE/mg) which decreases the amount of antioxidants compared to drying at 50 ℃. The results of the study could be further optimized by considering roasting time, production yield, moisture content and sensory evaluation before recommending 50 ℃ ($IC_{50}$ = 15.36 ppm) for the final drying.

**Keywords:** Antioxidant activity, Sri Lankan green tea, Temperature regulation, Thermal degradation

***Abstract No: 22*** ***Physical Sciences***

# PHENOLIC AND FLAVONOID CONTENTS AND FERRIC REDUCING ANTIOXIDANT POWER OF DIFFERENT SOLVENT EXTRACTS OF DEFATTED SEED KERNEL FROM *Terminalia catappa* L. FRUITS

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*Terminalia catappa* L., known as Indian almond or tropical almond, is a versatile tree species native to tropical regions, including Sri Lanka. In this study, the total phenolic content (TPC), total flavonoid content (TFC), and ferric reducing antioxidant power (FRAP) of defatted residues of kernels from purple and yellow cultivars of *T. catappa* were evaluated. Defatted residues were obtained after the micro screw-press oil extraction. Then, it was sequentially extracted with hexane, dichloromethane (DCM), and methanol, respectively. The TPC, TFC, and FRAP were analysed using relevant assays. Among the extracts, methanol extracts exhibited the highest TPC, with the yellow cultivar showing the highest content (9.52 ± 0.18 mg GAE/g), with no TPC detected in hexane extracts. With regard to TPC, significant differences ($p < 0.05$) were observed between the methanol extracts of two cultivars. Among the extracts, the hexane extracts (12.65 ± 0.04 – 49.06 ± 2.64 mg CE/g) exhibited the highest TFC values, followed by the DCM extracts (10.02 ± 0.06 – 26.61 ± 1.94 mg CE/g), while the methanol extracts (3.29 ± 0.08 – 12.02 ± 0.70 mg CE/g) showed the lowest. Between the cultivars, the yellow cultivar exhibited higher TFC when compared to the purple cultivar in all extracts. The FRAP assay results showed that values were detected only for the methanol extracts; the purple cultivar showed a higher value (0.40 ± 0.02 mmol $FeSO_4$/g) than the yellow cultivar (0.34 ± 0.01 mmol $FeSO_4$/g). The FRAP value of the methanol extract was significantly ($p < 0.05$) lower than that of ascorbic acid (41.23 ± 0 mmol $FeSO_4$/g). These findings underscore the impact of solvent choice on extracting efficiency and antioxidant activity of *T. catappa* kernels.

**Keywords:** Ferric reducing antioxidant power, *Terminalia catappa* L., Total flavonoid content, Total phenolic content

***Abstract No: 41*** ***Physical Sciences***

# ANTIBACTERIAL AND ANTIFUNGAL ACTIVITIES OF LOCALLY AVAILABLE FOUR DUCKWEED VARIETIES IN SRI LANKA

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The overuse of synthetic antibiotics has caused multidrug-resistant pathogens, a major health issue. Secondary metabolites of plants are effective alternatives to combat antimicrobial resistance. This study aimed to evaluate and compare the antibacterial and antifungal properties of plant extracts (water, 60% EtOH, and 70% EtOH) obtained from four duckweed varieties, including *Spirodella polyrhiza* (SP), *Landoltia punctata* (LaP), *Lemna purpusilla* (LP), and *Lemna minor* (LM) owing to their rich content of secondary metabolites. The antimicrobial effectiveness of the extracts was assessed using the agar disc diffusion method. Each extract (20, 10, 5 mg/mL) was tested against bacteria; *Staphylococcus aureus* and *Escherichia coli* as well as fungi; *Aspergillus niger* and *Candida albicans*. Zones of inhibition were compared with amoxicillin for antibacterial activity and itraconazole for antifungal activity as reference standards. The SPSS MANOVA analysis showed significant differences ($p < 0.05$) in zones of inhibition against examined microbes among solvent extracts and duckweed varieties. The results indicated that the most effective inhibition ($p < 0.05$) of *A. niger* growth was observed (10.667 ± 0.577 mm) in SP 70% EtOH at 20 mg/mL. For *C. albicans*, the highest ($p < 0.05$) inhibition (31.000 ± 1.000 mm) was observed in LaP 70% EtOH at both 5 mg/mL and 20 mg/mL concentrations. These values were comparable to the inhibition by itraconazole at 0.125 mg/mL (33.000 ± 1.000 mm). The most notable ($p < 0.05$) antibacterial effectiveness against *S. aureus* (23.000 ± 1.000 mm) was observed with LaP 70% EtOH at 20 mg/mL. In contrast, SPW at 20 mg/mL demonstrated the highest inhibition activity against *E. coli* (17.333 ± 1.155 mm), which is comparable to the effectiveness of amoxicillin at 0.5 mg/mL (18.333 ± 0.577 mm). The results show that SP and LaP exhibited significantly greater ($p < 0.05$) antimicrobial activity compared to other duckweed varieties. Future studies could focus on isolating and identifying the active compounds responsible for these activities.

**Keywords:** Anti-bacterial activity, Anti-fungal activity, Disc diffusion method, Duckweeds, Zone of Inhibition

***Abstract No: 45*** ***Physical Sciences***

# ANTIOXIDANT POTENTIAL OF BARK COLUMN FRACTIONS OF *Stereospermum suaveolens*

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Antioxidants are molecules that primarily slow down or prevent oxidation reactions. Their application in pharmacology is valuable to improve current treatments for diseases. Medicinal plants are a rich source of biologically active compounds such as flavonoids, phenolic compounds, *etc*., which may be responsible for their antioxidant activities. This study aimed to investigate the antioxidant activity of the column chromatographic fractions of crude extracts of *Stereospermum suaveolens* bark. The extraction was performed using ultrasound sonication, followed by fractionation with silica gel column chromatography. The antioxidant activity test was carried out using 2, 2-diphenyl-1-picrylhydrazyl (DPPH) assay with 200 µg/mL fraction solutions, and L-Ascorbic acid was used as the standard. Thin-layer chromatography was performed to analyse the chemical profile. Methanolic bark extracts of *S. suaveolens* yielded seven fractions, with radical scavenging percentages ranging from 13.22% to 82.51%. The test results further depicted that the third and fourth fractions possessed high antioxidant activities with the percentage radical scavenging activity of 82.51% and 56.27%, respectively, whereas other fractions showed weak antioxidant activities. However, the standard L-Ascorbic acid exhibited the highest antioxidant activity compared to bark fractions (92.83%). However, the radical scavenging activities of all active bark fractions were lower than that of L-Ascorbic acid as a positive control. The study concluded that most active fractions demonstrated good antioxidant activity, worthy for further study to isolate specific compound/s which is/are responsible for antioxidant activity.

**Keywords:** Antioxidant activity, Bark extracts, *Stereospermum suaveolens*

***Abstract No: 64*** ***Physical Sciences***

# *IN VITRO* ANTIOXIDANT, CYTOTOXIC, PHYTOTOXIC AND *α*-AMYLASE INHIBITORY POTENTIAL OF FOUR SRI LANKAN MEDICINAL PLANTS

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Plants are rich in secondary metabolites that have many physiological effects. This study determined the bioactivities of four widely distributed plants in Sri Lanka. Leaves of *Canna indica* (Cannaceae/Buthsarana), *Muntingia calabura* (Muntingiaceae/Jam), *Piper betle* (Piperaceae/Nagawalli) and *Pongamia pinnata* (Leguminosae/ Karada) were collected from Kandy, Sri Lanka. They were shade-dried, ground and extracted into methanol by sonication. The antioxidant potential of crude extracts was determined by 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging and ferric reducing antioxidant power (FRAP) assays, antidiabetic activity by *α*-amylase inhibitory assay, cytotoxicity by brine shrimp lethality assay and phytotoxicity by the lettuce seed germination assay. The results revealed that *M. calabura* has a strong antioxidant potential ($IC_{50}$ 6.84 ± 0.12 mg/L) compared to the positive control, ascorbic acid ($IC_{50}$ 1.97 ± 0.06 mg/L). The $IC_{50}$ values of *C. indica*, *P. betle* and *P. pinnata* were 1085.72 ± 100.5 mg/L, 49.86 ± 3.15 mg/L and 182.92 ± 21.34 mg/L respectively. When compared to the positive control, Trolox (12.07 ± 0.30 µmol/$dm^3$ $FeSO_4$/g), none of the crude extracts resulted in high FRAP values ranging between 0.2 – 1.8 µmol/$dm^3$ $FeSO_4$/g. In *α*-amylase inhibitory assay, leaves of *M. calabura* resulted in an $IC_{50}$ of 84.43 ± 2.32 mg/L with no significant difference with positive control, acarbose ($IC_{50}$ 45.99 ± 3.97 mg/L). The $IC_{50}$ values of *P. betle* and *P. pinnata* were 796.00 ± 43.67 mg/L and 1394.94 ± 101.23 mg/L, while no activity was detected for *C. indica*. In the brine shrimp lethality assay, *M. calabura*, *P. betle*, and *P. pinnata* showed $LC_{50}$ of 540.01 ± 6.76 mg/L, 856 ± 14.72 mg/L and 771.04 ± 8.55 mg/L, respectively, while *C. indica* resulted in 0% lethality. Whereas the positive control, $K_2Cr_2O_7$, resulted in $LC_{50}$ 35.16 ± 4.22 mg/L. In the phytotoxicity assay, the $IC_{50}$ for root inhibition of *M. calabura*, *C. indica*, *P. betle* and *P. pinnata* were 319.21 ± 10.35 mg/L, 63.9 ± 4.30 mg/L, 70.98 ± 1.42 mg/L and 297.59 ± 8.97 mg/L respectively. The $IC_{50}$ of shoot inhibitions were 704.72 ± 9.92 mg/L, 265.09 ± 12.57 mg/L, 178.13 ± 8.87 mg/L and 470.78 ± 14.62 mg/L respectively. The positive control, abscisic acid, had a root inhibition of 0.29 ± 0.03 mg/L and shoot inhibition of 0.25 ± 0.01 mg/L. These results revealed that *M. calabura* crude extract has strong antioxidant and antidiabetic activity, and *C. indica* leaves have strong root inhibition potential.

**Keywords:** Anti-diabetic activity, Antioxidant activity, *Canna indica*, *Muntingia calabura*, Phytotoxicity

***Abstract No: 65*** ***Physical Sciences***

# DETERMINATION OF ANTIOXIDANT AND ENZYME INHIBITORY ACTIVITIES OF *Osbeckia octandra* L., *Cissus quadrangularis*, AND *Vitex negundo* IN SRI LANKA

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Medicinal plants have gained much attention for their therapeutic properties and diverse pharmacological effects. They are widely used in herbal healthcare practices for treating diseases. This study investigated three selected medicinal plants in Sri Lanka, traditionally used for digestive issues, bone ailments, and inflammatory conditions, to assess their *in vitro* bioactive potential: antioxidative, anti-hyperglycaemic, anti-obesity, and cytotoxic properties. Dried powdered samples of leaves from three medicinal plants, namely *Osbeckia octandra* L. ("Heen bovitiya"), *Cissus quadrangularis* L. ("Heeressa"), and *Vitex negundo* L. ("Nika") was extracted with methanol (MeOH) via ultrasonication, followed by rotary evaporation to obtain crude extracts. The extracts were evaluated for total phenolic content (TPC) and total flavonoid content (TFC), which were separately quantified using the Folin Ciocalteu method [pyrogallol equivalent (PE)] and $AlCl_3$ colorimetric method [quercetin equivalent (QE)] respectively. Among the extracts, *O. octandra* possessed the highest TPC (291.69 ± 11.41 mg of GAE/g) and TFC (2.48 ± 0.17 mg of CE/g) values. Further, *O. octandra* exhibited the highest antioxidant activity in both FRAP assay (7268.00 ± 95.6 mmol $FeSO_4$/g), positive control Trolox (13447.00 ± 19.80 mmol $FeSO_4$/g) and the DPPH radical scavenging assay ($IC_{50}$ = 11.43 ± 0.79 mg/L; positive control ascorbic acid; $IC_{50}$ = 3.46 ± 0.45 mg/L). Furthermore, of the three plants, only *O. octandra* exhibited minor inhibitory activity against α-amylase ($IC_{50}$ = 1129.8 ± 140.2 mg/L, positive control acarbose, $IC_{50}$ = 8.51 ± 0.67 mg/L). All three extracts showed significant α-glucosidase inhibitory activity at a concentration of 1000 mg/L, in which the *O. octandra* extract showed the highest inhibition of 99%. However, none of the extracts showed lipase inhibitory activity or brine shrimp lethality. Based on the findings, *Osbeckia octandra* L. demonstrated the most promising antioxidant potential among the three medicinal plants studied, which has the potential to be developed as an ingredient in functional foods and as an alternative remedy for managing non-communicable diseases.

**Keywords:** Antioxidant activity, Bioactivities, Enzyme inhibition, "Heen bovitiya", Medicinal plants

***Abstract No: 70*** ***Physical Sciences***

# IMPACT OF POST-ANNEALING TEMPERATURE ON SILVER BISMUTH SULFIDE QUANTUM DOT-SENSITIZED SOLAR CELLS FABRICATED BY SUCCESSIVE IONIC LAYER ADSORPTION AND REACTION METHOD

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Nontoxic semiconductor materials are becoming increasingly used for solar cell fabrication and among them, silver bismuth sulfide ($AgBiS_2$) is a forefront ternary semiconductor material. $AgBiS_2$ nanocrystal has a high absorption coefficient, high mobility, and tunable bandgap. In this study, the performance of $AgBiS_2$ quantum dot-sensitized solar cells was investigated based on post-annealing temperature. $AgBiS_2$ quantum dots (QDs) were deposited on a $TiO_2$ mesoporous layer using the successive ionic layer adsorption and reaction (SILAR) method, with the optimal number of SILAR cycles being determined to be three. After deposition, $AgBiS_2$ QDs solar cells were kept overnight and subsequently annealed at 50, 100, 150 and 200 °C for one hour on a hotplate in ambient air. Raising the annealing temperature to 100 °C increased the short-circuit current density, open-circuit voltage, and fill factor. However, further increasing the annealing temperature resulted in degradation of solar cell performance. The cell with the configuration of FTO/m-$TiO_2$/$AgBiS_2$/polysulfide-electrolyte/$Cu_2S$-brass plate annealed at 100 °C has the maximum power conversion efficiency of 0.6%. The observed variations in solar cell performance of FTO/m-$TiO_2$/$AgBiS_2$/polysulfide-electrolyte/$Cu_2S$-brass plate electrodes have a direct relationship with the post-annealing temperature of $AgBiS_2$ QDs. Transmission electron microscopy study showed the formation of $AgBiS_2$ QDs with crystalline phases of 200 and 220 for the pre-annealed $AgBiS_2$ QDs at 100 °C, and Energy-dispersive X-ray spectroscopy data validated the presence of Ag, Bi, and S on the $TiO_2$ mesoporous layer. X-ray diffraction analysis revealed that post-annealing of $AgBiS_2$ film enhanced the 111 and 222 crystalline phases, while the 200 and 220 crystalline phases increased up to 100 °C and subsequently decreased. UV-Vis spectra revealed that increasing the annealing temperature up to 100 °C increased the absorption of $AgBiS_2$ QDs, whereas above 100 °C absorbance was reduced and the absorption peak was red shifted by 70 nm.

**Keywords:** $AgBiS_2$, Crystallinity, Nontoxic, Post-annealing

***Abstract No: 75*** ***Physical Sciences***

# BEYOND ULTRAVIOLET: OXYGEN-VACANT $ZrO_{2-x}$ FOR VISIBLE-IR-LIGHT-DRIVEN WATER SPLITTING

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Solar energy conversion through photocatalysis offers a promising solution for the rising global demand for clean and sustainable energy. Low-cost, efficient photocatalysts for water splitting have emerged as a viable path for clean hydrogen production, driven by significant advancements in recent decades. Reduced transition metal oxides with oxygen vacancies (OV) have proven to be candidates for studying the hydrogen evolution reaction (HER) and oxygen evolution reaction (OER) in photocatalytic water splitting. Their photocatalytic ability originates from the ideal properties of a narrow band gap and the existence of favourable trap states within the forbidden band due to the presence of OVs, which can facilitate the adsorption and activation of water molecules, promoting the HER. In this work, photocatalytic hydrogen production of highly reduced and oxygen-deficient $ZrO_{2-x}$was investigated under visible and IR light. The $ZrO_{2-x}$ catalyst was synthesized by treating the $ZrO_2$ with $NaBH_4$ and annealing at 550 $^oC$ and 850 $^oC$ in a nitrogen atmosphere. Hydrogen evolution rates of 28.98 μmol $g^{-1}$ $h^{-1}$ and 3.50 μmol $g^{-1}$ $h^{-1}$ under Vis-IR illumination at an intensity of 100 mW $cm^{-2}$ were noted for the 850 $^oC$ and 550 $^oC$ heated $ZrO_{2-x}$ catalysts, respectively. Scanning electron microscopy analysis revealed micro-sized catalyst particles. Energy-dispersive X-ray spectroscopy confirmed the successful incorporation of Boron dopants within the $ZrO_2$ lattice. The concentration of dopants and the concentration of OVs have increased in the 850 $^oC$ catalyst compared to the 550 $^oC$ catalyst. The presence of these dopants and OVs is expected to promote the formation of small polarons, potentially leading to improved light absorption and charge separation. The current results warrant further studies on the photocatalytic activity of reduced $ZrO_2$.

**Keywords:** Hydrogen evolution rates (HER), Oxygen-vacancies, Photocatalysts, Reduced-compounds, $ZrO_2$

***Abstract No: 81*** ***Physical Sciences***

# COMPUTATIONAL STUDIES ON STABILITY OF EIGHT COORDINATED COMPLEXES FORMED BY Zr(IV) AND Hf(IV) WITH BIDENTATE LIGANDS

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Extracting ultra-pure forms of either Zr or Hf is challenging due to the coexistence of Zr(IV) and Hf(IV) in their natural source of minerals and their similar chemical properties. In a mixed ligand environment, Zr(IV) and Hf(IV) can form complexes with different combinations of ligands with significant stability differences. If the ligand combination of the most stable complex formed by Zr(IV) or Hf(IV) differs from the other, it is possible to separate Zr(IV) and Hf(IV) through selective precipitation or fractional crystallization. Hence, developing an environmentally friendly, efficient and cost-effective separation method is possible. In this study, density functional theory (DFT) calculations were carried out to find suitable mixed bidentate-ligand systems to separate Zr(IV) and Hf(IV). According to the initial DFT calculations on the stability of possible eight coordinate complexes formed by Zr(IV) and Hf(IV) with commonly available bidentate ligands; acetylacetonate (acac), glycine (gly), malonate (mal) and oxalate (ox), Zr(IV) complexes are more stable than Hf(IV), for all except acac complexes. The stability of possible mixed ligand complexes formed by Zr(IV) and Hf(IV) with different ratios of acac (primary ligand) and other bidentate ligands (secondary ligands) were calculated. Based on the calculations, the most stable complexes for acac-ox mixed ligand systems are $[Zr(ox)_4]^{4-}$ and $[Hf(ox)_4]^{4-}$, and for acac-mal combinations, are $[Zr(mal)_4]^{4-}$ and $[Hf(mal)_4]^{4-}$. However, for an acac-gly system, the most stable complex for Hf(IV) is $[Hf(acac)_4]$, while for Zr(IV), $[Zr(acac)_4]$ is the least stable complex. The most stable complex for Zr(IV) is $[Zr(acac)(gly)_3]$. The calculated stability data indicates that in an acac-gly system, Zr(IV) shows preferential ligation of gly while Hf(IV) prefers acac, which may allow for the development of efficient and environmentally friendly separation process for the production of ultra-pure forms of Zr and Hf from the zircon deposits available in Sri Lanka in the future.

*Financial assistance from the Asian Office of Aerospace Research and Development (Grant No. FA2386-23-1-4036) is acknowledged*

**Keywords:** Acetylacetonate, DFT, Glycine, Hafnium, Zirconium

***Abstract No: 94*** ***Physical Sciences***

# COMPARISON OF THE ELECTROCHEMICAL PERFORMANCE OF p-$Cu_2O$ AND n-$Cu_2O$ ANODE MATERIALS SYNTHESIZED BY ELECTRODEPOSITION TECHNIQUE FOR RECHARGEABLE LITHIUM-ION BATTERIES

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$Cu_2O$ has gained attention for the anode application of the rechargeable Lithium-Ion Battery (LIB) than the other competing materials due to its high theoretical capacity (375.0 mAh/g), good capacity retention, affordability, non-toxicity and ease of storage. The crystallinity, morphology and interfacial properties between the current collector/anode and anode/electrolyte are crucial for the electrochemical performance of $Cu_2O$ electrodes. The aforementioned properties can be optimized by the synthesis method. A simple, low-cost, and convenient electrodeposition technique, which is a promising technique that enhances crystallinity with favourable morphology and interfacial properties for electrode materials, has not been studied. This study aimed to investigate the possibility of using p-$Cu_2O$ and n-$Cu_2O$ anode materials for LIBs synthesized by the electrodeposition technique. The favourable morphology of synthesized p-$Cu_2O$ and n-$Cu_2O$ enhanced the contact area of the active materials with the electrolyte, facilitating Li ion diffusion. Mott-Schottky plots confirmed the formation of p-type and n-type conductivity in $Cu_2O$ with dopant densities of $2.0685 \times 10^{17}$ $cm^{-3}$ and $2.9692 \times 10^{17}$ $cm^{-3}$, respectively. The electron densities are more crucial for the conversion mechanism reaction during the charging and discharging process. Therefore, n-$Cu_2O$ attributes better conversion mechanism reactions than p-$Cu_2O$. Current-voltage characterizations of p-$Cu_2O$ and n-$Cu_2O$ electrodes confirmed the Ohmic contact in between the anode and current collector. The p-$Cu_2O$ and n-$Cu_2O$ electrodes exhibited a high initial specific discharge capacities of 533.0 mAh/g and 623.9 mAh/g at a rate of C/5, respectively. The electrodes showed a specific discharge capacities of 143.2 mAh/g and 203.4 mAh/g with Coulombic efficiencies of 99.9% and 98.7% after 50 cycles for p-$Cu_2O$ and n-$Cu_2O$, respectively. Altogether, this study revealed that n-$Cu_2O$ has better electrochemical performance than p-$Cu_2O$. Hence, n-$Cu_2O$ has a potential for the anode application in next-generation high-performance LIBs.

**Keywords:** Anode materials, Electrodeposition, Li-ion battery, n-$Cu_2O$, p-$Cu_2O$

***Abstract No: 101*** ***Physical Sciences***

# TEMPERATURE PROFILE OF PULSATING STAR- CC ANDROMEDAE

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The variable star, CC Andromedae is a $\delta$-Scuti type, a short-period pulsating star with a main pulsation period of 0.1249078 days in the constellation Andromeda. Using the 50 cm telescope with a spectrograph at Mount Abu Observatory, Rajasthan, India, the star has been observed in spectroscopy across the whole pulsation cycle with more than 700 low-resolution spectra in the visible region throughout three consecutive days on December 10 to 12, 2016. The initial data reductions, such as flat fielding correction and extraction of spectra, were done using the astronomical software, Image Reduction and Analysis Facility (IRAF). Utilizing the Argon lamp as a reference, the wavelength calibration was done. The spectra were normalized instead of doing flux calibration and spectral lines such as $H_\alpha$, $H_\beta$ and $H_\gamma$ were taken accurately. The equivalent width of a spectral line represents the energy emission of that particular wavelength. Utilizing the Boltzmann equation, the excitation temperature of the pulsating star was calculated by analysing the equivalent width of hydrogen line profiles ($H_\alpha$, $H_\beta$ and $H_\gamma$). The light curve of CC Andromedae was observed using photometry data obtained from the Transiting Exoplanet Survey Satellite (TESS) mission. The obtained excitation temperature profile was synchronized with the observed light curve of CC Andromedae. The temperature variation was in phase with the brightness variation of the star. Selecting Hydrogen lines with larger wavelength differences gave clearer excitation temperature profiles. This correlation provides further insight into the characteristics and behaviours of CC Andromedae with deeper comprehension.

**Keywords:** $\delta$-Scuti stars, Excitation temperature, Hydrogen line profiles, Pulsating star

***Abstract No: 109*** ***Physical Sciences***

# QUASI-SOLID STATE CADMIUM SULFIDE QUANTUM DOTS EMBEDDED PHOTOVOLTAIC CELLS WITH GEL ELECTROLYTE

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Quantum dots (QDs) are semiconductor nanoparticles exhibiting unique optical and electrical properties due to quantum confinement, which differ from those of the bulk material because of their nano-size. Quantum dot-sensitized solar cells (QDSSCs) belong to the third generation of solar cells and incorporate QDs into the photoanode, acting as photosensitizers. The structure of a QDSSC consists of a photoanode, an electrolyte and a counter electrode. The present study is focused on the preparation of quasi-solid state QDSSC with new polysulfide gel polymer electrolytes. A polysulfide electrolyte is used because it is more suitable for Cadmium Sulfide **(**CdS) quantum dot solar cells compared to other common electrolytes like $I^-/I_3^-$. In this study, multilayer Titanium Dioxide ($TiO_2$) photoanodes were fabricated using spin coating and doctor blade methods on Fluorine-doped Tin Oxide substrates. $TiO_2$ acts as the nanostructured metal oxide semiconductor layer, which mediates the electron transportation through the photoanode. CdS QDs, which are the light-harvesting species, were gradually grown on the mesoporous $TiO_2$ films using Successive Ionic Layer Adsorption and Reaction (SILAR) method. The room temperature conductivity of gel polymer electrolyte was 20.78 Ms/cm, and it increases with temperature. The cell performances were investigated by applying 10 SILAR cycles of CdS to the photoanode. In this study, 2-layer and 4-layer $TiO_2$ photoanodes were used with polysulfide gel electrolyte along with a Platinum counter electrode. The maximum efficiency of 0.76% was observed in CdS QDs-embedded solar cells with a 4-layer $TiO_2$ photoanode, with an open circuit voltage ($V_{oc}$) of 0.49 V and a short circuit current density ($J_{sc}$) of 3.71 mA/cm$^2$. The maximum efficiency of the cells fabricated with a 2-layer $TiO_2$ photoanode was 0.71% together with $V_{oc}$ of 0.40 V and $J_{sc}$ of 4.70 mA/cm$^2$. The higher efficiency of cells with a 4-layer $TiO_2$ photoanode demonstrates that increasing the number of $TiO_2$ layers enhances solar cell efficiency.

*Financial assistance from the University Research Council, University of Peradeniya (Grant No. 346) is acknowledged*

**Keywords:** Cadmium Sulfide Quantum dots, Gel polymer electrolytes, Polysulfide electrolytes, Solar cell

***Abstract No: 117*** ***Physical Sciences***

# PARTICLE SIZE OF ALUMINIUM OXIDE NANO-FILLER ON THE PERFORMANCE OF DYE-SENSITIZED SOLAR CELLS AND PROPERTIES OF GEL-POLYMER ELECTROLYTES

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In recent years, research on the influence of nano-composite gel polymer electrolytes on the performance of Dye-Sensitized Solar Cells (DSSCs) has obtained great attention. In this study, Aluminium Oxide ($Al_2O_3$) nanoparticles of different sizes were integrated into the poly-iodide-based gel-polymer electrolyte to investigate the filler size dependence on the conductivity of the electrolyte. The performance of DSSCs, offering a novel approach to improve the properties of the poly-iodide-based electrolyte for better efficiency, was also investigated. $Al_2O_3$ nanoparticles (Sigma-Aldrich) with average particle sizes of 15 nm, 75 nm and 300 nm were added to the gel-polymer electrolyte and stirred for 15 min at 100 ℃. The $Al_2O_3$ filler content was kept fixed at 15 wt% relative to the polymer (polyethylene oxide) weight. The nanocomposite gel-polymer electrolytes were sandwiched between the photo-sensitized multi-layer (6-layer) Titanium Dioxide anodes with the dye N719 and the Platinum counter-electrodes to assemble DSSCs. The ionic conductivities of electrolytes calculated using complex impedance analysis at 30 ℃ are 10.79, 6.44, and 5.40 mS/cm for 15, 75, and 300 nm filler sizes, respectively. The conductivity enhancement with added $Al_2O_3$ can be attributed to Lewis acid-base type interactions between the ionic species in the electrolyte and the filler. This creates free spaces in the polymer matrix that facilitate easier ion transfer. Increasing conductivity with decreasing particle size can be attributed to the increase of the effective surface area of fillers, which provides more active sites for interactions. The temperature dependence of conductivities exhibited Vogel Tamman-Fulcher behaviour. The efficiency of DSSCs containing nano-composite electrolytes increases with a decrease in the particle size of the nanofiller. Power conversion enhancement of the DSSCs could be due to the improvement of conductivity in the electrolyte. DSSC assembled with the polymer electrolyte containing $Al_2O_3$ with particle size 15 nm showed the best performance with the largest photoelectric conversion efficiency of 5.98%, resulting in 19.4% enhancement compared to the efficiency of the reference DSSC assembled with filler-free gel-polymer electrolyte (5.01%).

*Financial assistance from the PGIS, University of Peradeniya (Grant No. PGIS/2022/12, PGIS/2022/04) is acknowledged*

**Keywords:** Aluminium oxide, Dye-sensitized solar cells, Ionic conductivity, Nano-composite electrolyte, Power conversion efficiency

***Abstract No: 126*** ***Physical Sciences***

# MAGNETIC FIELD-INDUCED DEFORMATION OF CASTOR OIL-BASED FERROFLUIDS

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In the field of astronomy, optics is essential and adaptive optics is gaining prominence for its efficiency. This research includes the synthesis and characterization of a castor oil-based ferrofluid and the investigation of the magnetic field-induced deformation of ferrofluids and their potential as a base for liquid telescopes. Depending on the method of obtaining magnetic nanoparticles, the rheological behaviour of the ferrofluid changes significantly. Therefore, to obtain sufficiently small particles, pH level and temperature control were explored. This study proposes a novel surfactant coating method using castor oil as an alternative to oleic acid, given its ricinoleic acid content, which is chemically similar to oleic acid. Castor oil and kerosene are used as carrier liquids, with subsequent characterization of their magnetic and rheological properties. The ferrofluid particle size was studied with scanning electron microscopy (SEM). The rheological properties were studied using Rosensweig instability peaks under the precisely controlled magnetic field of a cavity magnetron electromagnet. The deformation was monitored using optical microscopy and analysed to understand the correlations between the magnetic field characteristics and the resulting deformation patterns. Based on the characterization, the pH control method proved better for obtaining smaller particles, as indicated by the sedimentation rate and confirmed by SEM data. This demonstrated that castor oil is a viable alternative to oleic acid, providing a stable base for ferrofluids that respond effectively to magnetic fields. Castor oil as the carrier liquid proved more stable due to longer response time and stable modelled surfaces. Kerosene, which was more volatile but was more rapid in response to the change in magnetic field, achieving faster response time. Data obtained were modelled using MATLAB, revealing the ferrofluids deformed relative to magnetic field strength. The outcomes of this study may be used as leverage for future studies on tunable liquid surfaces.

**Keywords:** Ferrofluid, pH control, Rosensweig instability peaks, Telescope mirror surface

***Abstract No: 131*** ***Physical Sciences***

# COMPARISON OF THE PHYTOCHEMICAL CONTENTS AND *IN-VITRO* ANTI-DIABETIC AND ANTI-OBESITY ACTIVITIES OF THE TWO VARIETIES OF *Piper nigrum* (BLACK PEPPER)

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*Piper nigrum,* commonly known as black pepper, is a widely used spice in Sri Lanka due to its pungency. In Sri Lanka, there are two varieties of *Piper nigrum* (local and hybrid varieties) based on the morphological variations of their leaves and seeds. However, they share the same scientific name. Hence, this study aimed to compare the total phytochemical constituents and anti-diabetic and anti-obesity activities of the two varieties of black pepper, which were collected from a local farmer. The crude extracts of hexane, ethyl acetate and methanol were obtained using sequential extraction by maceration. The total alkaloid content (TAC), total flavonoid content (TFC), and total phenolic content (TPC) of each variety were determined using bromocresol green (BCG) reagent method [piperine equivalent (PE)], aluminium chloride colorimetric method [quercetin equivalent (QE)] and Folin-Ciocalteu reagent method [gallic acid equivalent (GAE)] respectively. Anti-diabetic and anti-obesity activities were determined using α-amylase inhibition assay and pancreatic lipase inhibition assay, respectively. Highest total alkaloids, flavonoids and phenolic content were observed in the local variety. Among these, phenolic and flavonoid contents were higher for hexane extract of the local variety (TPC: 2.35 ± 0.01 mg GAE/g and TFC: 20.72 ± 7.95 mg QE/g), while higher alkaloid content was observed for methanol extract (8.35 ± 0.03 mg PE/g) of the local variety. Anti-obesity potential is higher for hexane extract of the local variety ($IC_{50}$ 17.18 ± 2.96 mg/L), however, there are no significant differences in the anti-diabetic potential of hexane extracts of both local ($IC_{50}$ 53.93 ± 5.73 mg/L) and hybrid ($IC_{50}$ 48.41 ± 3.97 mg/L) varieties. Thin-layer chromatographic studies of all extracts showed the presence of the same compounds in both varieties. Hence, it is assumed that the differences in bioactivities may be due to the differences in the amounts of compounds present in each variety. Further studies are required to identify the compounds responsible for these activities and their percentage in each variety.

*Financial assistance from the National Research Council (Grant No. NRC TO 20-19) is acknowledged*

**Keywords:** Anti-diabetic, Anti-obesity, *Piper nigrum*

***Abstract No: 137*** ***Physical Sciences***

# FABRICATION OF WATER-REPELLENT TEXTILE THROUGH STEARIC ACID-MODIFIED MAGNESIUM HYDROXIDE DERIVED FROM NATURAL DOLOMITE

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The addition of hydrophobic and superhydrophobic characteristics to textile surfaces has attracted significant attention of researchers and industry due to its excellent potential in outdoor apparel and protective fabrics. In this study, we have developed a novel, simple, and an efficient technique to convert hydrophilic polyester fabric into hydrophobic fabric using natural dolomite as the magnesium hydroxide precursor. Using a dip-coating procedure, a thin layer of stearic acid-modified, precipitated magnesium hydroxide was applied to the fabrics, transforming the wetting fabric into a hydrophobic one. Stearic acid serves both as a surface modifier to render $Mg(OH)_2$ hydrophobic and as a binder to adhere the surface-modified nanoparticles to the textile. The wetting property and surface morphology of the treated fabrics were characterized using contact angle/sliding angle measurements, field emission scanning electron microscopy, Fourier transform infrared, and thermogravimetric analysis. The findings reveal that the wettability of the fabric was greatly reduced depending on the experimental parameters, such as the concentration of stearic acid and the amount of stearic acid-modified precipitated $Mg(OH)_2$ nanoparticles. The technique successfully achieved a maximum contact angle of 150˚ and a sliding-off angle of 8.5˚ with 5% of nanoparticles. Further, the modified fabric exhibits potential flame retardancy since $Mg(OH)_2$ is an environmentally friendly inorganic flame retardant. Moreover, this can be considered as a method of value addition to a natural mineral resource.

**Keywords:** Dolomite, Magnesium hydroxide, Self-cleaning property, Water repellency

***Abstract No: 144*** ***Physical Sciences***

# FEASIBILITY OF COCONUT SHELL FLAKES DERIVED ACTIVATED CARBON ELECTRODES FOR SUPERCAPACITORS

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Apart from batteries and fuel cells, supercapacitors are gaining significant attention because of their unique features, such as excellent capacitance, fast charge-discharge rates, high power density, and long life cycle. Recent research has focused on biomass-derived carbon materials for use in electric double-layer supercapacitor (EDLC) electrodes due to their cost-effectiveness and eco-friendliness. Among these materials, coconut shell charcoal is a preferred candidate because of its abundance, microporous structure, and large surface area. This study investigated the suitability of activated coconut shell charcoal flakes as a supercapacitor electrode material. Cleaned coconut shells were burned in a low-oxygen environment for 2 hrs. The coconut shell charcoal was crumbled into flakes, washed, and dried on a hot plate at 150 ℃ for 1 hr. They were heated in a furnace to 900 ℃ in a low-oxygen environment for 20 min and immediately placed in a water bath for activation. This step was repeated five times. At each activation, a sample was taken and labelled for characterization. The activated charcoal flakes were cut into ($4 \times 4 \times 1.5$) $mm^3$ sized electrodes and sanded. A medium retention filter paper (separator) was sandwiched between two as-prepared charcoal flake electrodes, and the assembly was then placed between two titanium plates (current collectors) of ($20 \times 10 \times 0.45$) $mm^3$ size. This setup was clipped, and the filter paper was wetted with 2.5 M $H_2SO_4$ (electrolyte). The characteristics were investigated using cyclic voltammetry, galvanostatic charge-discharge analysis, and scanning electron microscopy. Results showed that the repetition of the activation process has a significant effect on the electrochemical properties of the supercapacitor. It was found that, within the range studied, the coconut shell charcoal flakes activated three times exhibited the optimal porous structure, with the highest specific capacitance value of 3.19 F/g, the highest energy density of 0.44 Wh/kg, and the lowest power density of 31.12 W/kg demonstrating their potential for use in supercapacitor electrodes.

**Keywords:** Activation, Coconut shell charcoal flakes, Specific capacitance, Supercapacitor

***Abstract No: 145*** ***Physical Sciences***

# COMPARISON OF BIOACTIVITY OF *Schumacheria castaneifolia* FROM DIFFERENT LOCATIONS

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*Schumacheria castaneifolia* ("Kekiriwara"), an endemic plant to Sri Lanka, exhibits significant lethality on brine shrimp and possesses anticancer properties. In our previous studies, it was identified that the compound 3-O-α-L-arabinosyloleanolic acid is responsible for the anti-cancer activities; however, it is worth noting that this compound was not present in all the *S. castaneifolia* plants, even though they were collected from the same geographical location. Hence, this study aimed to compare the bioactivity and chemical profiles of leaf and bark extracts of *S. castaneifolia* collected from two distinct locations within the Seethawaka wet zone botanical garden, Ilukovita, Avissawella, Sri Lanka. Plant samples were collected from two locations (A and B) and extracted sequentially into hexane, dichloromethane, and methanol by maceration method. Alpha-amylase inhibition, antioxidant, and brine shrimp lethal activities were evaluated for each extract. Thin-layer chromatography (TLC) analysis was performed to identify the presence of 3-O-α-L-arabinosyloleanolic acid. The methanol extract of the barks from location B exhibited the highest anti-diabetic activity ($IC_{50}$ = 72.80 ± 0.04 mg/L). The highest antioxidant activity was exhibited by the methanol extract of the barks from the location A ($IC_{50}$ = 6.39 ± 0.01 mg/L). The methanol extract of the leaves from location B showed the highest cytotoxic activity ($LC_{50}$ = 64.70 ± 1.47 mg/L). The TLC analysis revealed the compound 3-O-α-L-arabinosyloleanolic acid only in the dichloromethane extracts of leaves and barks from location B and barks from location A. It was absent in the leaves from location A and two other locations within the botanical garden. This suggests that the overall biological activities observed in this study may be influenced by the presence of other phytochemicals. Further, these data demonstrate significant variation in the bioactivity and chemical profile of *Schumacheria castaneifolia* extracts collected from the Seethawaka wet zone botanical garden and emphasize the need for extensive taxonomical identification for a better understanding of this variation.

**Keywords:** 3-O-α-L-arabinosyloleanolic acid, Bioactivity, *Schumacheria castaneifolia*

***Abstract No: 155*** ***Physical Sciences***

# DEVELOPMENT OF AN ELECTROCHEMICAL SENSOR WITH TITANIUM DIOXIDE INCORPORATED GRAPHENE QUANTUM DOTS TO DETECT PHENOXYACETIC ACID HERBICIDES

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Graphene quantum dots (GQDs) are well-known for enhancing electrochemical properties. Therefore, GQDs are used in electrochemical sensors for various applications. In this study, a titanium dioxide-graphene quantum dots ($TiO_2$-GQD) hybrid nanocomposite was developed to detect phenoxyacetic acid (PAA) herbicides. To enhance the electrochemical properties of GQDs, $TiO_2$ nanorods were incorporated with GQDs. Phenoxyacetic acid herbicides are used to control broadleaf weeds in agriculture. Common PAA herbicides widely used in agriculture include 2-methyl-4-chlorophenoxyacetic acid, 2,4 dichlorophenoxyacetic acid, and 2,4,5-trichlorophenoxyacetic acid. Exposure to PAA herbicides increases the risk of certain cancers, Hodkin's disease and soft-tissue sarcoma. Graphene Oxide (GO) was synthesised via the modified Hummer's method. The GO was subjected to hydrothermal treatments to obtain GQDs. The synthesis of GQD was confirmed by the emission of blue luminescence under UV light. The band gaps for GO and GQD were calculated as 3.9 eV and 4.5 eV. The reduction in particle size from GO to GQD leads to an increase in the band gap due to the quantum confinement effect. The $TiO_2$ nanorods were synthesised via solvothermal method using titanium tetraisopropoxide as a precursor. The obtained material was characterized using scanning electron microscopy. The average width and length of $TiO_2$ nanorods are 55.0 nm and 2.5 µm. The sensor was fabricated by modifying a glassy carbon electrode (GCE) using $TiO_2$-GQD hybrid nanocomposite. Cyclic voltammograms obtained from modified GCE showed sharp and distinct oxidation peaks, while the oxidation peaks in unmodified GCE were either absent or indistinct. The peak current of both modified and unmodified GCE increased with the increasing concentration of PAA. The modified GCE exhibited enhanced sensitivity, stability, and concentration-dependent behaviour for PAA compared to the unmodified GCE, with detectable sensitivity observed at a minimum concentration of 1.30 mM.

**Keywords:** Electrochemical sensor, Graphene quantum dots, Phenoxyacetic acid herbicides, Titanium dioxide

***Abstract No: 165*** ***Physical Sciences***

# SCREENING FOR PREDNISOLONE IN ANTI-ASTHMATIC HERBAL REMEDIES USING LC-MS/MS IN SRI LANKA

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Prednisolone, a corticosteroid used to treat asthma, poses significant concerns when adulterated in herbal remedies, particularly for athletes subjected to anti-doping regulations. Despite their widespread use, comprehensive studies to determine the extent of prednisolone adulteration in herbal products are lacking in Sri Lanka. This study aimed to fill this research gap by screening commonly used herbal remedies for asthma in Sri Lanka to identify the presence of Prednisolone. A tailored LC-MS/MS method was developed and validated for this purpose. An optimized ultrasound-assisted extraction procedure was established using a reference standard, achieving a recovery rate of 100.45% by adjusting the extraction solvent and sonication time. The LC-MS/MS method utilised a biphenyl column (100 mm × 2.1 mm, 2.7 μm) with a mobile phase of acetonitrile and water acidified with 0.1% formic acid. Chromatographic conditions were optimized for a column; oven temperature of 50 °C, an initial acetonitrile concentration of 5%, a dwell time of 0.200 secs, and a run time of 10 min. Validation of the method followed EuraChem guidelines and was done using a Prednisolone reference standard, demonstrating high precision, accuracy, sensitivity, and specificity. Extraction recoveries showed relative standard deviation (%RSD) ≤ 10% and calibration linearities had $R^2 \geq 0.988$. The detection limits were 0.03 μg/g for powdered and 0.003 μg/mL for liquid herbal matrices. The study screened 27 different over-the-counter brands and prescription anti-asthmatic herbal products collected randomly from suburban areas of Colombo. The validated LC-MS/MS method identified that 25 products were below the detection limit, while two prescribed products were flagged as doubtful. In conclusion, the developed LC-MS/MS method successfully detected prednisolone in complex herbal matrices with high specificity and precision, providing valuable insights into the prevalence and extent of prednisolone adulteration in herbal remedies.

**Keywords:** Adulteration, Herbal Remedies, LC-MS/MS, Prednisolone

***Abstract No: 185*** ***Physical Sciences***

# CAPACITANCE IMPROVEMENT IN THE PRESENCE OF FRACTAL GRAPHENE: ACTIVATED CARBON COMPOSITE BY IMPROVING THE ELECTROLYTE WETTABILITY

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Supercapacitors are gaining attention as energy storage devices due to their rapid charge and discharge capabilities, bridging the gap between traditional capacitors and batteries. A significant challenge in optimizing activated carbon-based supercapacitors is the limited wettability of the carbon material by electrolytes, which is crucial for efficient ion transport and charge storage. This study investigated the integration of Fractal Graphene Aggregate (FGA-1) into Activated Carbon (AC) to enhance wettability and supercapacitor performance. Experimental methods involved preparing two test tubes: one with activated carbon alone and the other with a composite of activated carbon and FGA-1. The electrolyte used was a 1M solution of tetraethylammonium tetrafluoroborate dissolved in acetonitrile. The experiment was conducted at room conditions, with the distance travelled by the electrolyte measured using a ruler (least count of 1 mm) and capacitance measured using Metrohm Autolab PGSTAT 128 N. The experiment was repeated five times, and the average distance travelled was recorded. Results indicated that the incorporation of FGA-1 improved the average distance travelled by the electrolyte, leading to a capacitance increase from 1 F for activated carbon alone to 3.96 F for the AC:FGA-1 composite. Quantitative analysis using the Washburn equation revealed that the effective diffusion constant of the electrolyte increased by a factor of four with FGA-1, confirming enhanced wettability. Scanning electron microscope images showed that AC pores and jagged edges were covered with FGA-1, indicating improved wettability due to size differences and the formation of new paths for electrolyte flow. These findings suggest that FGA-1 enhances activated carbon's wetting behaviour, offering the potential for developing more efficient supercapacitor materials and advancing energy storage technologies.

**Keywords:** Activated carbon, Energy storage devices, Fractal graphene, Supercapacitors, Wettability

***Abstract No: 195*** ***Physical Sciences***

# EVALUATION OF CRITICAL FIBRE LENGTHS FOR SURFACE-TREATED PINEAPPLE LEAF FIBRES INCORPORATED NATURAL RUBBER COMPOSITES

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The efficacy of short natural fibre-reinforced composites is critically influenced by the critical fibre length, a parameter essential for optimal load transfer and reinforcement within the polymer matrix. This study investigated the critical fibre lengths of untreated and various surface-treated pineapple leaf fibres (PALF) embedded in a natural rubber matrix. For better adhesion between natural fibres and the rubber matrix, surface treatments were employed, including NaOH treatment and NaOH pre-treatment followed by salicylic acid, silane coupling agent (Si 69), and poly(ethylene glycol) (PEG) treatments. Untreated PALF served as the control. Fourier transform infrared spectroscopy was used to characterize the chemical modifications induced by these treated PALF fibres. The critical fibre lengths were determined through the single fibre pullout test, tensile strength measurements of individual fibres, and fibre diameter assessments. The findings revealed critical fibre lengths of 5.96 mm (untreated PALF), 4.48 mm (NaOH-treated PALF), 4.76 mm (salicylic acid-treated PALF), 5.07 mm (PEG-treated PALF), and 2.44 mm (Si 69 treated PALF). These results indicate that surface treatments significantly enhance the fibre-matrix adhesion, thereby reducing the critical fibre length required for effective reinforcement of natural rubber composites. Among the treatments, Si 69 demonstrated the most pronounced improvement in fiber-matrix compatibility. This research underscores the pivotal role of fibre surface treatment in optimizing the mechanical performance of natural fibre-reinforced natural rubber composites, providing valuable insights for future material development.

**Keywords:** Critical fibre length, Natural rubber, Pineapple leaf fibre (PALF), Surface treatment

***Abstract No: 202*** ***Physical Sciences***

# ENHANCING DYE DEGRADATION WITH YAM PEEL-MEDIATED SILVER, ZINC OXIDE NANOPARTICLES AND THEIR COMPOSITE

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Using agricultural waste for synthesizing nanoparticles (NPs) is becoming increasingly crucial to support environmental sustainability. This study focused on the biogenic synthesis of silver (Ag), zinc oxide (ZnO) NPs, and silver@zinc oxide nanocomposite (Ag@ZnO NC) and evaluate their photocatalytic activity. The optimal conditions for synthesizing nanomaterials (NMs) with increased yields were identified. Many analytical techniques were used to characterize NMs. Preliminary verification was provided by surface plasmon resonance peaks, observed at 400-430 nm for Ag NPs, 350-360 nm for ZnO NPs, and 350-450 nm for Ag@ZnO NC. Bioactive chemicals serving as reducing, capping, and stabilizing agents were found in the phytoextracts by FT-IR analysis, and ZnO NP and NC synthesis were confirmed by the Zn-O bond stretching mode in 500-700 $cm^{-1}$ range. The synthesis of flake-shaped Ag NPs, spherical-shaped ZnO NPs, and nanoflower-shaped Ag@ZnO NC was confirmed by SEM analysis. Ag was found coexisting with ZnO in the NC, with an average particle size of 60.2 nm, according to TEM images. Particle sizes for ZnO NPs and Ag NPs mediated by yam peel were 82.4 nm and 92.8 nm, respectively. The XRD analysis confirmed that Ag@ZnO NC has both face-centered cubic structure and hexagonal wurtzite structure. Energy dispersive spectroscopy analysis confirmed that Ag NPs contained only Ag; ZnO NPs contained Zn and O; and the NC contained all three elements. Under optimized conditions, NMs demonstrated varying degrees of photodegradation efficiency for pigment dye. The NC exhibited the highest efficiency, achieving a maximum of 89.9%, and ZnO NPs followed closely with an efficiency of 89.05%. In contrast, Ag NPs showed a lower photodegradation efficiency of 45.4%. A control sample, exposed to sunlight under identical conditions but without NMs, showed negligible photodegradation, confirming the catalytic role of the NMs. These results indicate that while ZnO NPs are highly effective, the combination of Ag and ZnO in NC offers a slight improvement in photodegradation efficiency due to the synergistic effect.

*Financial assistance from the National Research Council Grant (Grant No. 20-055) and the Institute of Chemistry Ceylon are acknowledged*

**Keywords:** Ag NPs, Ag@ZnO NC, Pigment dye, Yam Peel, ZnO NPs

***Abstract No: 204*** ***Physical Sciences***

# ANTI-CORROSION PERFORMANCE OF ELECTROCHEMICALLY SYNTHESIZED POLYANILINE-GRAPHENE NANOCOMPOSITE

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Polyaniline (PANI) is known as one of the best candidates for corrosion protection. In its conductive emeraldine salt form, it provides anodic protection by passivating the metal surface and promoting the formation of the metal oxide layer. However, the corrosion protection performance of PANI is constrained by its limited electrical conductivity. Therefore, further enhancing the anti-corrosion performance of PANI is a challenge. Graphene is an advanced carbon material having good electrical conductivity. Therefore, to improve the electrical conductivity and thereby ensure improved electron transfer for better anti-corrosion performance, a graphene-PANI nanocomposite was synthesised. In this study, a facile electrochemical approach was proposed to synthesize the nanocomposite. This method involved electrochemical polymerization of aniline using cyclic voltammetry (CV) by applying ten cycles in 0.1 M $H_2SO_4$ in the presence of electrochemically synthesized graphene. Synthesised material was structurally characterized using UV-visible and FTIR spectroscopy. The UV-visible data showed a characteristic band at ~265 nm, confirming the presence of graphene, and FTIR analysis confirmed the presence of PANI. The electrochemical characterization was carried out in 0.1 M HCl to illustrate the anti-corrosion performance. Potentiodynamic polarization data showed that corrosion potentials significantly shifted to the anodic region by 280 mV in the presence of PANI–graphene nanocomposite compared to bare stainless steel, indicating enhanced corrosion protection. The corrosion rate decreased significantly from 0.36 mm/yr for the bare stainless steel to 0.02 mm/yr. The electrochemical measurements, therefore, indicated that the inhibition efficiency for PANI-graphene nanocomposite was 95% compared to bare stainless steel. Electrochemical impedance spectroscopy data showed improved anticorrosive performance for nanocomposite. These findings indicate that the PANI-graphene nanocomposite synthesised via a facile method demonstrates significant anticorrosion performances. Therefore, the PANI-graphene nanocomposite is an ideal candidate for anti-corrosion application having enhanced barrier protection with improved electrical conductivity.

*Financial assistance from the Asian Development Bank (Grant No. CRG-R2-SB-1) is acknowledged*

**Keywords:** Corrosion, Graphene, Nanocomposite, Polyaniline

***Abstract No: 215*** ***Physical Sciences***

# INVESTIGATION OF THE PRESENCE OF HUMIC SUBSTANCES AND THEIR METAL BINDING ABILITY IN WATER

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Recent research suggests that humic substances (HSs) in water can effectively bind with metal ions, potentially increasing the solubility of metal ions in aquatic ecosystems, hence posing health risks. They are a fraction of dissolved organic carbon that has seen notable changes in concentration across various regions in Sri Lanka. Hence, there is an urgent need to identify the presence of HSs and their metal-binding capabilities within Sri Lankan waters. Further, recent studies have highlighted the increase of Mn levels in groundwater samples, which pose health hazards upon excessive exposure. Given the challenge of Mn removal in the filtration process, understanding HSs-Mn interaction becomes imperative. Therefore, this study mainly focused on the ability of HSs to bind with Mn. Samples were taken from two distinct water sources (groundwater and lake water). The sample preparation, extraction of HSs, and fractionation into humic acid and fulvic acid were carried out using the method available in the International Humic Substances Society (IHSS). Characterization was done using FTIR and Raman spectroscopy. Batch adsorption studies at different pH values and comparisons of FTIR and Raman spectra after metal binding were performed. Furthermore, kinetic studies were conducted. Characterization revealed functional groups of –COOH (C=O stretching: 1740-1770 $cm^{-1}$, O-H stretching: 3630-3760 $cm^{-1}$), $–CONH_2$ (N-C=O stretching: 1550-1560 $cm^{-1}$, N-H stretching: 3070-3140 $cm^{-1}$), and $–NH_2$ (N-H stretching 3190-3220 $cm^{-1}$), which facilitate effective metal binding and indicate the heterogeneity of these fractions, extracted from different sources. Although effective Mn-binding was possible at neutral pH, the highest binding was observed at lower pH values (pH 2-3). Significant variations in several spectral bands were also observed, suggesting composition changes after metal binding. As this followed pseudo-second order kinetics, chemisorption is the rate determining step. However, the exact binding mechanism remains unclear, necessitating further investigations.

**Keywords:** Dissolved organic carbon, Fulvic acid, Humic acid, Humic substances, Manganese

***Abstract No: 217*** ***Physical Sciences***

# DFT CALCULATIONS OF SECOND-ORDER NONLINEAR OPTICAL PROPERTIES OF DONOR-ACCEPTOR SUBSTITUTED NICKEL(II) SCHIFF BASE COMPLEXES

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There is considerable interest in new highly efficient nonlinear optical (NLO) materials due to their potential applications in optoelectronic and photonic technologies. In recent years, various donor(D)-π-acceptor(A) type organometallic and inorganic compounds have been studied extensively for their NLO activity. Amongst them, dipolar D/A substituted Schiff base complexes and metal alkynyl complexes have received special attention. Despite the strong interest in the NLO properties of these systems, there are limited studies on the NLO properties of metal alkynyl Schiff base hybrids. The effects of different donor and acceptor substituents and diamine bridges on the second order NLO properties of metal salen and salphen complexes are also less explored. The present work reports density functional theory (DFT) and time dependent (TD) DFT calculations of second order NLO properties of a series of D/A substituted Ni(II) Schiff base complexes at the B3LYP/6-31G(d)/LanL2DZ level of theory, including a novel Ru alkynyl Schiff base hybrid complex. Incorporating a strongly electron donating Ru alkynyl fragment into an unsymmetrical A-substituted Schiff base platform is anticipated to result in a significant nonlinear optical (NLO) response due to synergistic effects. Calculations showed that all the Ni(II) Schiff base complexes have a planar Ni-salen core, resulting in a significantly high total static first hyperpolarizability ($\beta_{tot}$) compared to their free Schiff bases. The presence of D- and/or A-groups on the salicylidene groups results in a reasonable increase in the $\beta_{tot}$ value. The salphen complex bearing D = $N(CH_3)_2$ donor and A = $NO_2$ showed the lowest HOMO-LUMO energy gap, and therefore it shows the highest $\beta_{tot}$ value. The diagonal $\beta_{zzz}$ component is the dominant β tensor for all the D/A complexes, with the quadratic NLO character of these systems being one-dimensional. The D-A complex based on 2,3-diaminomaleonitrile showed the highest $\beta_{tot}$ value between the complexes with different diamine bridges due to the presence of electron withdrawing CN groups, which lowers the HOMO-LUMO energy gap considerably. The introduction of the electron donating Ru alkynyl fragment into the nitro-substituted Ni(II) Schiff base unit with diaminomaleonitrile bridge resulted in a marked increase in the computed $\beta_{tot}$ value, higher than those of the complexes with organic donors. The calculations also showed that the second order NLO properties of the hybrids are sensitive to the nature of the co-ligands around Ru. Based on the TD-DFT studies, the hybrid complexes show a substantially red-shifted metal to ligand charge transfer band, which may be responsible for their large calculated NLO coefficients.

**Keywords:** DFT, First hyperpolarizability, Metal alkynyl complexes, Nonlinear optics, Schiff base complexes

***Abstract No: 220*** ***Physical Sciences***

# THERMOELECTRIC PROPERTIES OF DODECYLBENZENE SULFONIC ACID SODIUM SALT (DBSA) DOPED POLYANILINE & REDUCED GRAPHENE OXIDE(RGO)-DBSA DOPED POLYANILINE COMPOSITES

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Polyaniline (PANI) is a highly adaptable conducting polymer. An effort has been made to enhance the thermoelectric properties of PANI by doping it with dodecylbenzene sulfonic acid sodium salt (DBSA). DBSA is a protonic organic acid, and it has a sulphonic group and a long alkyl side chain which interacts with amine/imine hydrogens. It helps to enhance the electrical properties of the polymer and ionization of charges. The sheet like structure of reduced graphene oxide (rGO) supports uniform distribution of polymer matrix and it improves the interfacial interactions between the rGO and the polymer matrix. In this work, rGO incorporated DBSA-PANI was introduced and it was compared with the DBSA doped PANI. The chemical oxidative polymerization method was used to synthesise three different DBSA doped PANI (DBSA-PANI) samples (1.0, 1.5 and 2.0 g) with 2 mL of aniline. rGO was synthesised using the modified Hummer's method. rGO-DBSA-PANI composites were prepared using the chemical oxidative method. Three different weight percentages of rGO (24%, 35% and 50%) relative to aniline (2ml) were used, with a constant DBSA mass of 1.5 g in all three synthesis processes. The resulting powders were pressed into pellets, and room temperature electrical conductivity and temperature-dependent Seebeck coefficients were measured. The successful synthesis of DBSA-PANI was observed by Fourier Transform Infrared Spectroscopy (FTIR). Characteristic peaks observed at 2914, 2829, 792 and 673 $cm^{-1}$ confirmed the presence of DBSA anion. Peaks at 3441, 3201, 1553 and 1293 $cm^{-1}$ confirmed the successful synthesis of PANI. Synthesised rGO was characterized using X-ray diffraction (XRD) and Raman Spectroscopy. Characteristic XRD peak at 25° and D and G vibrational bands observed in the range of 1700 and 1353 $cm^{-1}$ confirmed the successful synthesis of rGO. Our previous study shows an electrical conductivity of 3.5 S/m for undoped PANI. The highest electrical conductivity values of 80.7 S/m and 54.4 S/m were observed for 2.0 g DBSA-PANI and 35% rGO-1.5 g DBSA-PANI at 300 K, respectively, indicating 23 times and 16 times increments compared to that of the undoped material. The highest Seebeck coefficient values of $1.40 \times 10^{-4}$ V/K and $1.85 \times 10^{-4}$ V/K were observed for 2.0 g DBSA-PANI at 300 K and 24% rGO-1.5 g DBSA-PANI at 300 K, respectively. The highest power factor values of $1.58 \times 10^{-6}$ $Wm^{-1}K^{-2}$ and $1.32 \times 10^{-6}$ $Wm^{-1}K^{-2}$ were obtained for 2.0 g DBSA-PANI and 24% rGO-1.5g DBSA-PANI at 300 K, respectively.

*Financial assistance from the University of Peradeniya Research Grant (Grant No. URG/2022/58/S) and PGIS Research Grant (Grants No. PGIS/2022/04) are acknowledged*

**Keywords:** Dodecylbenzene sulfonic acid, Electrical conductivity, Polyaniline, Reduced Graphene Oxide, Seebeck coefficient

***Abstract No: 226*** ***Physical Sciences***

# SYNTHESIS OF POROUS GRAPHENE MATERIALS FOR SUPERCAPACITORS IN THE PRESENCE OF PHOSPHORUS-BASED ADDITIVES

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The worldwide energy crisis has led to the development of green and high-performing energy storage devices. Supercapacitors' high power density and miniaturization have made them a vital device for energy storage. Graphene is a perfect electrode material for supercapacitors. However, graphene synthesised through less sophisticated approaches like electrochemical exfoliation tends to restack because of the strong van der Waals interactions between graphene layers. This results in hindrances to the intrinsic characteristics, electron mobility rate, and penetrating power of the electrolyte. The majority of high-quality graphene manufacturing techniques are complex, costly, and require hazardous oxidizing chemicals. Therefore, the main objective of this study was to produce high-quality porous graphene (PG) with reduced restacking through a sustainable, innovative electrochemical approach. Porous graphene materials (PG-PA, PG-EA) were separately synthesised via electrochemical exfoliation with phytic acid (PA) and etidronic acid monohydrate (EA), respectively, as the additives. Synthesised PGs were characterised structurally and electrochemically. The absorbance band of ~ 270 nm in UV-Vis data verified the formation of graphene. Scanning electron microscopy confirmed the formation of a porous morphology. The synthesis of porous graphene was further confirmed by Raman spectroscopic analysis, resulting in an ID/IG ratio of 0.67 for PG-PA. The FT-IR spectra verified that the phosphorus atoms are not incorporated into the PG structure. The rectangular shape with a wider range potential window exploited in the cyclic voltammetry performed over the 5-100 mV/s range, demonstrating the electric double-layer capacitive behaviour, and electrochemical impedance spectroscopy, galvanostatic charge-discharge confirmed the improved capacitive behaviour of the synthesised PG. The specific capacitances of PG-PA and PG-EA are 21.1 F/g and 19.2 F/g, respectively, at a scan rate of 5 mV/s, and this enhancement can be considered as 42.2% and 29%, respectively, compared with the graphene sample. These characterization results validate the successful synthesis of PG with enhanced electrochemical performance in a more economical and environmentally friendly approach.

*Financial assistance from the UNESCO-TWAS and the Swedish International Development and Cooperation Agency (Sida)*

**Keywords:** Electrochemical exfoliation, Graphene, Porous graphene, Restacking, Supercapacitors

***Abstract No: 232*** ***Physical Sciences***

# INVESTIGATION OF CORROSION INHIBITION OF STAINLESS-STEEL GRADE 202 IN ACIDIC CHLORIDE MEDIUM BY CaO NANOPARTICLES

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Stainless steel (SS) Grade 202 holds immense significance among metals and alloys because of its high corrosion resistance due to the chromium oxide passive film forming on the surface of the metal. Nevertheless, SS 202 is prone to corrosion under aggressive environments, such as acidic chloride solutions. Although the deposition of polymer films and exposure to environments containing compounds of heteroatoms have been able to inhibit corrosion, there are many drawbacks to such systems, including environmental non-friendliness and cost factors. A novel approach combining the value addition of clamshells, a waste material, and characteristics of nanomaterials enhancing reaction rates is employed in this study concerning the corrosion of SS 202, which has widespread use from cookery to machines in industrial and automotive applications. Mass loss measurements of rectangular SS 202 specimens recorded in HCl solutions and mixed HCl and NaCl solutions indicate the corrosion-promoting ability of acidic conditions provided by HCl, which is strengthened by chloride ions. Nanoparticles (NPs) of CaO synthesised from clamshells through calcination at 1000 °C in a muffle furnace for 1.0 hr show an average diameter of 35.4 nm according to dual scattering particle size analysis. Further, X-ray fluorescence spectrophotometry and Fourier transform infrared spectroscopy indicate the presence of the Ca-O bond. Mass loss measurements, electrochemical impedance spectroscopy (EIS), and Tafel slope analysis of SS 202 performed in HCl and mixed HCl and NaCl systems in the presence of CaO NPs conclusively demonstrate the excellent corrosion inhibitory ability of CaO NPs. Both mass loss measurements and EIS lead to a decrease in the extent of corrosion of SS 202 of over 40% in acidic medium in the presence of CaO NPs. More importantly, low concentrations of CaO, such as 0.10 M, lead to superior corrosion inhibitory action towards SS 202 in extreme and aggressive environments, such as 0.25 M HCl solution. Nevertheless, the optimum level of CaO NPs to result in zero mass loss under the experimental time frame depends on the characteristics of the solution to which the SS 202 specimen is exposed.

**Keywords:** CaO nanoparticles, Corrosion inhibition, Impedance, Stainless steel

***Abstract No: 233*** ***Physical Sciences***

# EFFECTIVE CORROSION BARRIER OF CINNAMON LEAF OIL INCORPORATED POLYPYRROLE LAYERS FOR MILD STEEL

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Mild steel, a type of steel commonly used in industry, is prone to corrosion under certain environmental conditions, which has limited its industrial applications, necessitating intensive study into corrosion prevention techniques. In recent years, conducting polymers and green corrosion inhibitors have been independently identified as corrosion inhibitors, and less consideration has been given over the past years on the combined effect of polymers and natural inhibitors. This study aimed to investigate the corrosion inhibition efficiency by cinnamon leaf oil embedded polypyrrole layers. The electrodeposition of polypyrrole on mild steel was employed using cyclic voltametric scans from -0.2 V to 1.0 V in oxalic acid medium and polymer-coated specimens were subsequently dipped in cinnamon leaf oil to incorporate into the polymer film. Under moderate acidic conditions of HCl medium, mass loss measurements of rectangular mild steel specimens embedded with cinnamon leaf oil, polypyrrole, and the combination of both over one-week period were obtained. The results revealed a superior corrosion inhibitory behaviour of the combined layer having the decreasing order of corrosion inhibition efficiency: polypyrrole and cinnamon leaf oil > polypyrrole > cinnamon leaf oil. Polarization resistance determined by electrochemical impedance spectroscopy, a more reliable method, further supports the strong corrosion inhibitory action of the combined layer on mild steel when compared to polypyrrole and cinnamon leaf oil alone. Open circuit potential measurements also indicate a lower corrosion rate when mild steel specimens are coated with the polymer and cinnamon leaf oil.

**Keywords:** Corrosion, Inhibition, Mild steel, Polarization resistance, Polypyrrole

***Abstract No: 237*** ***Physical Sciences***

# PREPARATION AND CHARACTERIZATION OF MICROBEADS FROM POST-CONSUMER POLY(ETHYLENE TEREPHTHALATE) BOTTLES

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Plastic pollution is a formidable challenge to the environment, posing threats to humankind. The demand for plastic continues to surge, with poly(ethylene terephthalate) (PET) serving as a prominent contributor to the problem. Due to its impressive durability, it has a wide range of applications in packaging, mainly as PET bottles. The objective of this study was to derive and characterize microbeads from post-consumer PET bottles. In this study, first, a solvent system was developed to dissolve PET using dichloromethane (DCM) and trifluoroacetic acid (TFA) by varying the ratio of DCM to TFA. The PET concentration optimization was carried out by varying the PET mass dissolved in the optimized solvent system. The microbead synthesis was carried out with an ionotropic gelation technique using two methods: manual process and electrospraying process using the electrospraying unit. In each process, a collector solution, which consisted of distilled water, glutaraldehyde, and sodium dodecyl sulphate (SDS), was used to collect the microbeads. The optimization of glutaraldehyde and SDS concentrations was carried out by varying the concentration of glutaraldehyde between 0% to 0.5% and SDS concentration from $1 \times 10^{-4}$ g/mL to $1 \times 10^{-1}$ g/mL. The bead size optimization was carried out by varying the distance between the needle tip and the collector solution between 5.0 cm and 30.0 cm. The beads were characterised using digital microscopic imagining, Fourier transform infrared spectroscopy and thermogravimetric analysis. According to the results, the optimized solvent system was recorded as 1:5 DCM to TFA, PET concentration was 15% (w/v), and optimized concentrations of glutaraldehyde and SDS were 0.1% (v/v) and $1 \times 10^{-4}$ g/mL, respectively. Spherical beads were formed with both methods with an average diameter of 744.9 ± 38.6 μm and a wide service temperature range of up to 450 °C, which collectively underscores the potential of repurposing PET to microbeads.

**Keywords:** Ionotropic gelation, Microbeads, Plastic pollution, Poly(ethylene terephthalate)

***Abstract No: 238*** ***Physical Sciences***

# POST-CONSUMER POLY(ETHYLENE TEREPHTHALATE) BASED MEMBRANES USING ELECTROSPINNING TECHNIQUE

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Poly(ethylene terephthalate), commonly known as PET, is a thermoplastic polymer resin. Recycling efforts of PET waste are essential to minimize the environmental impact. Therefore, a type of chemical recycling of PET waste was investigated in this study. Several solvent systems in different ratios were tested to dissolve post-consumer PET water bottles. The PET-based membranes were prepared using post-consumer PET water bottles and a solvent system of trifluoroacetic acid and dichloromethane in 1:5 ratio. Electrospinning technique was used to prepare the fibrous membrane. Several instrumental parameters were optimized to obtain the best fibrous membrane, which has a minimum diameter and a lesser number of beads formed. The best selected membrane was synthesised setting the flow rate as 0.5 mL/h, distance from the needle tip to the collector drum as 10 cm, voltage as 21-22 kV and collector drum speed as 700-702 rps. Several PET solutions were also prepared based on PET concentration, and 15% (w/v) of PET solution resulted in the best membrane. The average diameter of fibres in different PET membranes was determined, and the membrane prepared from 15% PET solution recorded the smallest diameter of 752.3 ± 88.80 nm. The membrane was characterized using Fourier transform infrared spectroscopy, X-ray fluorescence analysis and thermogravimetric analysis. The Fourier transform infrared spectra of PET based membrane clearly showed C=O stretching band around 1720 $cm^{-1}$ and phenyl C-H and ethyl C-H stretching bands around 2900-3000 $cm^{-1}$. Furthermore, X-ray fluorescence analysis confirmed that this membrane does not contain any heavy metals bound to it. Thermogravimetric analysis revealed that PET membrane starts to decompose at temperatures of around 450 °C to 460 °C. This study revealed that a PET based membrane can be prepared using PET water bottle pellets.

**Keywords:** Dichloromethane, Electrospinning, PET membrane, Poly(ethylene terephthalate), Trifluoroacetic acid

***Abstract No: 244*** ***Physical Sciences***

# QUALITATIVE STUDY ON DETECTING INTERNAL CAVITIES OF TREE LOGS USING INFRARED THERMOGRAPHY

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Trees' structural stability and overall health are at risk due to internal cavities that often go unnoticed through conventional visual inspections. While effective invasive techniques are currently effective, they can cause irreversible damage to trees. The literature suggests that the temperature of a defect tends to be lower than that of the surrounding sound matter. This study addressed the challenge of early identification of internal cavities in trees using non-destructive infrared thermography, a safe, non-contact technique that provides real-time thermal imaging of the entire tree. The primary objective was to qualitatively identify hidden cavities in tree trunks by comparing the surface temperatures of healthy and unhealthy sections. Tree logs were used as models to evaluate the feasibility and the factors affecting the accuracy of using infrared thermography. Due to the differences in thermal profiles between live trees and logs, an active approach was used. Controlled cooling with water at 10-15 °C, followed by a 10-20 min. waiting phase enhanced the thermal profiles and allowed for clear thermogram capture in logs. Factors such as the size and distance from the bark were systematically considered during sampling. The results conclude that this method is effective in detecting the cavities and estimating their size and depth from the bark. Increasing the distance between the camera and the surface enhanced image contrast by capturing a wider field of view. Additionally, materials with low density produce thermographs with a broader temperature distribution in defects. Larger cavity sizes and shorter distances from the bark to the cavity were found to increase the probability of successful detection of cavities. Considering the volatility of influencing factors, the case-by-case nature of the analyses was acknowledged. Overall, this study contributes to the advancement of a non-destructive method for maintaining the long-term stability and health of tree populations, especially in regions like Sri Lanka where such investigations are limited.

**Keywords:** Infrared Thermography, Internal cavities, Thermogram, Tree logs

***Abstract No: 246*** ***Physical sciences***

# INVESTIGATION OF THE IMPACT OF CRYSTALLINITY AND SURFACE MORPHOLOGY ON THE MECHANICAL PROPERTIES OF *Artocarpus heterophyllus* LATEX AND POLY(ETHYLENE OXIDE) STRETCH FILMS

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Most researchers focus on developing new stretch films due to their advantages as packaging materials. However, the materials used to produce these films are often costly and less environmentally friendly. To address these issues, a novel material was synthesised by blending poly(ethylene oxide) (PEO) and *Artocarpus heterophyllus* latex (AHL). AHL, commonly known as jackfruit latex, is a waste material with a composition similar to natural rubber. This study aimed to investigate the impact of crystallinity and surface morphology on the mechanical properties of the novel polymer blend material. The polymer blend was prepared by mixing PEO and AHL using toluene as the solvent. The optimized sample for a stretch film was identified as a PEO:AHL ratio of 1:1, determined by comparing tensile measurements and surface photographs taken with a macro camera for different ratios. This study utilised X-ray diffraction (XRD), FEI Quanta 3D FEG dual beam scanning electron microscopy (SEM) [SEM 1], ZEISS EVO LS15 high-performance variable pressure environmental SEM [SEM 2], and polarization optical microscopy. XRD analysis revealed that both pure PEO (control) and the PEO-AHL 1:1 polymer blend exhibit semi-crystalline properties. SEM 1 and polarized optical microscopy images confirmed that incorporating AHL into the PEO matrix markedly reduces its semi-crystalline nature. This reduction was analysed by comparing the size and the distribution of spherulites, a characteristic feature of crystalline materials. SEM 2 further examined surface morphology variations due to AHL addition, revealing a ruffled surface structure in the polymer blend compared to the control sample. These findings demonstrate that adding AHL to PEO increases the material's effective surface area by changing its surface morphology from uniform to ruffled. Additionally, it significantly lowers the crystallinity of pure PEO, enhancing its stretchability and making it a viable alternative to existing stretch film materials.

**Keywords:** *Artocarpus heterophyllus* latex, Crystallinity, Poly(ethylene oxide), Polymer blend, Surface morphology

***Abstract No: 248*** ***Physical Sciences***

# CHARACTERIZATION OF rGO-INCORPORATED POLYVINYL ALCOHOL (PVA) AND POLYETHYLENE OXIDE (PEO) POLYMER COMPOSITES FOR PACKAGING APPLICATIONS

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Polyvinyl alcohol (PVA) and polyethylene oxide (PEO) are widely used in packaging applications due to their flexibility, non-toxicity and relatively low cost. These polymers can be utilised in anti-static packaging applications, given that their electrical conductivity is enhanced. The electrical conductivity of these polymers can be improved by the addition of reduced graphene oxide (rGO). rGO is a derivative of graphene oxide (GO), which exhibits higher electrical conductivity, mechanical strength and hydrophobic behaviour. This project focused on facile and low-cost synthesis of rGO/polymer composites and studying their electrical and mechanical properties. The synthesis of rGO was carried out using the modified Hummers' method, which was confirmed using Raman spectroscopy. Four different composites with different amounts of rGO (0, 0.5, 1, and 1.5 wt%), were prepared for each polymer using a solution processing method, followed by drying at 60 °C for PEO and 80 °C for PVA. According to the volume conductivity measurements obtained using the potentiostat, both PVA and PEO composites showed maximum conductivities of $1.01 \times 10^{-7}$ and $8.33 \times 10^{-8}$ S/m, respectively, at 1.5wt% of rGO. Structural studies revealed that PEO composites have higher Young's moduli compared to their PVA counterparts, while the highest Young's modulus was obtained for rGO/PEO 1.5 wt% composite. Additionally, PEO composites demonstrated higher tensile strength than PVA composites. However, both polymer composites exhibited a reduction in strength when exposed to moisture, leading to a loss of mechanical strength. The electrical conductivities and mechanical properties of both polymers were improved with the addition of rGO.

**Keywords:** Electrical conductivity, Mechanical strength, Polyethylene oxide, Polyvinyl chloride, Reduced graphene oxide

***Abstract No: 257*** ***Physical Sciences***

# COMPARISON OF ANTI-DIABETIC, ANTI-OBESITY ACTIVITIES AND TOTAL ALKALOID CONTENT OF *Murraya koenigii* LEAVES FROM THREE CLIMATIC ZONES IN SRI LANKA

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*Murraya koenigii* (curry leaves) is widely used in curry preparations and known to possess various medicinal properties. The chemical profile of a plant could be changed due to geographical variations. The phytochemical and bioactivity variations of curry leaves with respect to the geographical zone have not been studied extensively. Hence, this study aimed to compare the phytochemical and bioactivity differences of curry leaves collected from three agro-climatic zones (dry, wet, and intermediate) in Sri Lanka. Nine extracts were prepared using leaves of *M. koenigii* collected from three different zones by sequential extraction with n-hexane, ethyl acetate, and methanol. Anti-diabetic and anti-obesity activities were determined using the α-amylase inhibition assay and pancreatic lipase inhibition assay, respectively. In addition, the total alkaloid content (TAC) was determined using the bromocresol green (BCG) reagent method [piperine equivalent (PE)]. The highest pancreatic lipase inhibition activity was observed for the ethyl acetate extract of the intermediate zone sample (IC50 = 27.05 ppm), while the highest alpha-amylase inhibition activity was resulted for the hexane extract of the wet zone sample ($IC_{50}$ = 156.36 ppm). The highest alkaloid content was given by methanol extract of the wet zone (21.83 mg PE/g). There is no significant difference ($p > 0.05$) in TAC between methanol extracts of different geographical zones. However, the Pearson Correlation Coefficient data showed that there is a positive correlation between alpha-amylase inhibition activity and TAC for hexane ($r = 0.897$, $p < 0.05$) and ethyl acetate ($r = 0.884$, $p < 0.05$) extracts. These data indicate that the alkaloids may significantly affect the amylase inhibition activity. In contrast, no significant correlation was found between lipase inhibition and TAC, nor for the bioactivities of methanol extracts. It can be concluded that the TAC in curry leaf extracts varies according to the geographical zone, which may be a reason for the differences in bioactivities observed in curry leaf samples collected from different environmental regions.

*Financial assistance from the National Research Council (Grant No. NRC TO 20-19) is acknowledged*

**Keywords:** Alkaloid content, Amylase inhibition, Lipase inhibition, *Murraya koenigii*, Pearson correlation

***Abstract No: 258*** ***Physical Sciences***

# FABRICATION AND DEVELOPMENT OF A PAPER-BASED MICROFLUIDIC DEVICE FOR ELECTROCHEMICAL ANALYSIS OF COUNTERFEIT DRUGS

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Drugs of poor quality or lacking active ingredients are considered counterfeit and are a serious global health threat. This issue can be substantially minimized by frequent testing in the field of concern using an analytical device that is readily available, inexpensive, and portable. Low-cost microfluidic devices based on filter papers, where capillary action drives fluid flow, have been reported as a promising analytical tool to separate small molecules within minutes. Additionally, graphite pencils have been successfully used to fabricate low-cost electrodes to obtain electrochemical measurements. In this study, microfluidic device based on filter paper coupled with paper-based electrodes was explored for the detection of pharmaceuticals. The channel pattern on filter paper was constructed by masking it with a 1 mm wide adhesive tape and immersing it in recycled polystyrene in chloroform. The amount of hydrophobic reagent was optimized as 0.060 g/mL by measuring the contact angle. The working electrode and pseudo reference electrode were fabricated using graphite pencil lines and silver paste, respectively, using a simple plotting method. Acetaminophen and ascorbic acid were separated and detected using the developed paper-based microfluidic device with distinct amperometric peaks, showing high sensitivity. Migration times of 600 s and 350 s and peak currents of 0.35 µA and 0.56 µA for acetaminophen and ascorbic acid, respectively, were obtained for a channel distance of 1 cm. This technology enabled precise and simple control over channel formation and electrode fabrication, ensuring reliable fluid flow and sensitive electrochemical detection. Future studies will focus on constructing calibration curves for acetaminophen and ascorbic acid based on the peak areas of the amperograms.

**Keywords:** Acetaminophen, Ascorbic acid, Counterfeit drugs, Electrochemical, Paper-based microfluidic device

***Abstract No: 259*** ***Physical Sciences***

# APROTIC ELECTROLYTE AND REDUCED GRAPHENE OXIDE ELECTRODES-BASED SUPERCAPACITORS, PERFORMANCE DEPENDENCE ON CURRENT COLLECTORS

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Supercapacitors (SCs) offer rapid charging and discharging capabilities, making them ideal for applications requiring frequent, high-power bursts of energy. Compared to batteries, their relatively low energy density ($E_g$) limits the suitability of SCs for long-term energy storage. Reduced graphene oxide (rGO) serves as a promising electrode material for SCs due to its high surface area, excellent electrical conductivity and chemical stability. The choice of current collector material significantly influences the performance of rGO-based SCs. The present study investigated the performance of SCs with current collector materials, fluorine-doped tin oxide (FTO) and Copper (Cu). However, since Cu current collectors are difficult to use along with protic solvent electrolytes due to their high reactivity, aprotic solvent electrolytes were used. The synthesis of rGO from natural graphite was achieved through the modified Hummers method, starting with the oxidation of graphite powder using a mixture of 98% concentrated sulfuric acid, potassium permanganate and sodium nitrate. The subsequent reduction of graphene oxide (GO) was obtained by adding hydrogen peroxide. To fabricate the electrodes for the SC, rGO was dispersed in dimethylformamide together with titanium dioxide ($TiO_2$), which acts as the binder. The resulting rGO/$TiO_2$ suspension was coated onto conductive substrates, FTO and Cu, followed by solvent evaporation to obtain an rGO layer on each substrate and compare the electrode performance. Synthesised Graphite Powder, GO, rGo and rGO/$TiO_2$ electrodes were analysed using XRD spectra. The SCs were prepared using the electrolyte based on the saturated solution of Lithium trifluoromethanesulfonate dissolved in an ethylene carbonate and propylene carbonate mixture at a 1:1 molar weight ratio along with the two electrodes. The specific capacitance ($C_{sp}$) of rGO-based SCs was higher with the Cu current collector compared to that of FTO at all scan rates. The highest $C_{sp}$ values were observed at a scan rate of 2 mV/s, with Cu reaching 65.70 F/g and FTO at 59.04 F/g. The $E_g$ and power density ($P_g$) of rGO-based SCs were also higher with Cu current collectors compared to FTO at all current densities. The highest $E_g$ value was 3.36 Wh/kg with Cu at 0.5 mA/cm$^2$, while the highest $P_g$ value was 20,001.79 W/kg with Cu at 5.0 mA/cm$^2$. These results demonstrated that Cu current collectors with aprotic solvent electrolytes are more suitable for SC applications compared to FTO current collectors.

**Keywords:** Current collector, Energy density, Power density, Reduced graphene oxide, Specific capacitance

***Abstract No: 267*** ***Physical Sciences***

# LARVICIDAL ACTIVITIES OF *Capsicum frutescens* ("KOCHCHI") VARIETIES AND COMBINED EFFECT WITH *Allium sativum* (GARLIC), AGAINST *Aedes* MOSQUITO LARVAE

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Dengue is spread primarily by *Aedes* mosquitoes and affects about 2.5 billion people globally. While synthetic mosquito larvicides are effective, their non-target effects and environmental concerns drive the demand for natural larvicidal agents. This study aimed to evaluate the larvicidal properties of three different widely distributed *Capsicum frutescens*, "Kochchi", varieties in Sri Lanka; white bird's eye chilli (variety 1), purple tobasco pepper (variety 2) and African bird's eye chilli/African devil (variety 3). The ground "Kochchi" was extracted into the three solvent systems; water (maceration 24 hr × 3), hot water (reflux for 3 hr) and 1:1 water-acetone mixture (maceration 24 hr × 3). The larvicidal activity of each crude extract was evaluated through larvicidal assays, exposing three replicates of 20 mosquito larvae of the third and fourth instar to varying concentrations of each extract for 24 hr. The combined larvicidal effect of the most active extract with garlic (1:1 w/w%) was also determined. The cold-water extracts exhibited the highest larvicidal activity, with mortality percentages of 90%, 75% and 30% at 2500 mg/L for varieties 1, 2, and 3, respectively. The hot water and acetone-water extracts showed relatively lower percentage mortalities at 2500 mg/L; 58%, 50% and 48% in hot water, and 30%, 21% and 14% in water-acetone for varieties 1,2 and 3, respectively. The cold-water extract of variety 1 demonstrated the highest larvicidal activity (90% at 2500 mg/L). The cold-water extracts of three varieties, when combined with garlic, showed relatively higher activity compared to the individual extracts. The percentage mortalities observed at 10,000 mg/L, and the estimated $LC_{50}$ values were 88%, 83% and 98%, and 3384 mg/L, 4940 mg/L, and 2614 mg/L for cold water extracts of variety 1, garlic, and mixture, respectively. These findings revealed that the mixture of variety 1 and garlic has a larvicidal effect against *Aedes* mosquitoes. Ongoing studies with positive controls aim to evaluate its potential as a natural larvicide for dengue control.

*Financial assistance from the Accelerating Higher Education Expansion and Development Project (Grant No. AHEAD/RA3/UBL/PDN/OVAA/19) is acknowledged*

**Keywords:** *Aedes* larvae, *Allium sativum*, *Capsicum frutescens*, Natural larvicides

***Abstract No: 272*** ***Physical Sciences***

# EXPLORING THE ANTIOXIDANT POTENTIALS AND PHYTOCHEMICALS OF THE EXTRACTS OF BABY COCONUT ("KURUMBATTI") OF *Cocos nucifera*

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Phyto-remediation for wound healing has gained interest because of its potential to aid the healing process with minimal side effects compared to synthetic drugs. Notably, most of these remedies are rich in antioxidants, which reduce oxidative stress, enhance collagen synthesis, improve blood circulation, and help in wound healing. Paste made with the baby coconut ("kurumbatti") is a traditionally used remedy in Sri Lanka for wound healing. However, no scientific exploration on bioactivities or the phytochemical constituents of the baby coconut has been reported. Hence, this study aimed to identify the antioxidant potential and the phytochemical constituents of crude extract of baby coconut. Baby coconuts were collected within a day after their fall and extracted into hot water by refluxing (3 hr), cold water, methanol, and water-acetone (1:1) solvents separately by maceration (24 hr x 3). The antioxidant potentials of the crude extracts were assessed using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay and the ferric ion-reducing antioxidant power (FRAP) assay. In addition, crude extracts were subjected to phytochemical screening tests to determine the presence of alkaloids, saponins, phenols, tannins, flavonoids, diterpenes, quinones, carbohydrates, proteins, and betacyanin. The highest yield was obtained with water-acetone (1:1) extract (35%), while the lowest yield was from methanol extract (12%). These results highlight the advantage of using a mixed solvent system as it extracts both polar and non-polar compounds compared to other methods. The $IC_{50}$ values resulted from the DPPH assay are: $423.87 \pm 3.16$ µg/mL (methanol), $35.71 \pm 2.85$ µg/mL (cold water), $17.64 \pm 1.09$ µg/mL (water-acetone), and $13.50 \pm 1.94$ µg/mL (hot water). The FRAP values for each extract are; $478.66 \pm 3.23$ µM $Fe^{2+}$/g (hot water), $398.76 \pm 2.46$ µM $Fe^{2+}$/g (cold water), $130.71 \pm 2.16$ µM $Fe^{2+}$/g (water-acetone), and $68.53 \pm 1.85$ µM $Fe^{2+}$/g (methanol). Findings indicated that the hot water extract exhibits the highest radical scavenging ability and the reducing ability. Hot water extract resulted in the highest amount of phytochemicals, including saponins, phenols, tannins, flavonoids, diterpenes, quinones, carbohydrates, proteins, and betacyanin. The superior phytochemical content of the hot water extract correlates with its highest free radical scavenging ability and greatest reducing power.

*Financial assistance from the Accelerating Higher Education Expansion and Development Project (Grant No. AHEAD/RA3/UBL/PDN/OVAA/19) is acknowledged*

**Keywords:** Antioxidant activity, Baby coconuts, Phytochemical screening, Wound-healing

***Abstract No: 284*** ***Physical Sciences***

# FABRICATION AND OPTIMIZATION OF NANOPOROUS MEMBRANES FOR ZINC-BROMINE FLOW BATTERY

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Zinc-bromine flow batteries are crucial for large-scale energy storage. A key challenge is to develop a membrane that selectively allows bromide ions ($Br^-$) to pass through while preventing bromine ($Br_2$) without compromising efficiency. Commercial membranes, while effective, tend to be expensive. This study focused on enhancing nanoporous membranes made from poly(methyl methacrylate) (PMMA) Perspex for application in zinc-bromine redox flow batteries. The method involved initially dissolving PMMA in dichloro methane (DCM) by varying both PMMA (from 1.000 ± 0.001 g to 3.000 ± 0.001 g) and DCM (from 20 to 35 $cm^3$). After determining the optimal formulation for PMMA, silica (particle size range of 40-120 nm confirmed by a particle size analyser, with 99% purity determined by XRF analysis) synthesised from rice husks was added (1% to 10%). The solution was cast into an iron glass mould, and the pore size was measured. The data analysis revealed that the pore size is significantly decreased when silica concentration is increased. The optimal membrane formulation, consisting of 1.000 ± 0.001 g of PMMA and 25 $cm^3$ of DCM, produced an average pore size of 30.84 µm. Upon incorporating 6% rice husk silica into this formulation, the average pore size was further reduced to 6.68 µm (confirmed by SEM), making this combination the most effective for achieving the smallest pore size. However, the commercial polyethylene membranes have pore sizes ranging from 0.17 to 0.85 µm. Further, a bromine diffusion test conducted over three hours showed that approximately 45% of the bromine diffused through the membrane, whereas the commercial polyethylene showed 5% bromine diffusion. Although the pores were in the micrometre range from SEM data, the overlapping layers of PMMA created a distinct nanostructure and would be the reason for moderate bromine diffusion. The findings of this research provide valuable insights into the factors influencing the optimization of nanoporous membranes and highlight the positive impact of incorporating silica nanoparticles on membrane performance in zinc-bromine redox flow batteries.

**Keywords:** Nanoporous membranes, Poly(methyl methacrylate) (PMMA), Silica nanoparticles, Zinc-bromine redox flow batteries

***Abstract No: 287*** ***Physical Sciences***

# PHOTOPROTECTIVE PROPERTIES OF SELECTED MEDICINAL PLANTS IN SRI LANKA, ON THEIR PHENOLIC AND FLAVONOID CONTENTS

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In Sri Lanka, a diverse range of plant species has been employed in traditional medicine to treat various health issues. In our previous studies, a positive correlation between sun protection factor (SPF) and antioxidant activity (AA) has been observed on selected traditional medicinal plants; malabar nut (*Justicia adhatoda*), coffee (*Coffea arabica*), pomegranate (*Punica granatum*), guava (*Psidium guajava*), candle bush (*Senna alata*), snap ginger (*Alpinia calcarata*), and mimosa (*Mimosa pudica*) which are used in Asian countries, including Sri Lanka, to treat skin diseases. This study aimed to determine the total phenolic content (TPC) and total flavonoid content (TFC) in the leaves of malabar nut, coffee, pomegranate, guava, and candle bush, in the ground stem of snap ginger, and in the whole plant of mimosa. Further their correlation to the reported AA and SPF was studied. The TPC and TFC were assessed using the Folin-Ciocalteu method [gallic acid equivalent (GAE)] and the aluminium chloride colorimetric method [quercetin equivalent (QE)], respectively. The correlation of TPC and TFC with both AA and SPF was examined using Pearson correlation analysis. According to the results, TPC values ranged from 33.43 to 263.9 mg GAE/g, while the highest and the lowest TPC were observed in pomegranate and coffee, respectively. The highest TFC value was found in mimosa (48.82 mg QE/g) and the lowest in malabar nut (14.20 mg QE/g). Further, a strong positive correlation ($r$ = 0.921) was shown between SPF and TPC, and only a moderate correlation ($r$ = 0.550) was shown between $IC_{50}$ of AA and TPC. However, there was no correlation found between TFC with SPF, AA, or TPC. These results conclude that the other phenolic compounds, such as phenolic acids, tannins, and lignans, rather than flavonoids present in these plants, have higher potential towards AA and SPF values. Moreover, the phenolic compounds of these plants can be considered promising natural additives for enhancing photoprotective formulations.

**Keywords:** Antioxidant activity, Sun Protection Factor, Total flavonoid content, Total phenolic content

***Abstract No: 290*** ***Physical Sciences***

# QUASI-SOLID-STATE SUPERCAPACITOR WITH COCONUT SHELL-DERIVED ACTIVATED CARBON ELECTRODES AND $H_3PO_4$/ POLYVINYL ALCOHOL GEL ELECTROLYTE

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Coconut shells are excellent sources of activated carbon because of their highly porous structure, which gives a larger surface area. However, reports on solid and quasi-solid-state supercapacitors are relatively scarce. More environmentally friendly activated carbon can be produced via the physical activation process, and the physical activation approach is frequently regarded as being better than the chemical approach for deriving carbon from coconut shells. Furthermore, compared to the chemical technique, which might introduce impurities via activating chemicals, the physical method typically yields cleaner and purer activated carbon by reducing the potential for impurities to react with the electrolyte. Here, coconut shell charcoal is carbonized and heated to a high temperature to expose it to activating gases such as steam or carbon dioxide. Supercapacitor electrodes were prepared using activated carbon ink incorporated with 5% polyvinylidene formation of electrodes. This activated carbon ink was coated on graphite sheets, which were used as capacitor current collectors via the drop-casting method. The significance of the study is the use of polyvinyl alcohol (PVA)/$H_3PO_4$ based gel polymer electrolyte prepared using the hot press method. This gel polymer electrolyte exhibited the highest ionic conductivity of 46 Ms/cm when 3.5 g of $H_3PO_4$ was used with 10 mL of PVA. The specific capacitance of the corresponding assembled quasi-solid-state supercapacitor was 2.29 F/g, which is comparatively lower than that of liquid electrolyte-based supercapacitors. However, the gel electrolyte supercapacitor offers improved stability, minimized electrolyte evaporation, and reduced leakage due to its elevated viscosity and the structural integrity of the gel matrix. Cyclic voltammetric graphs appreciably resembled the behaviour of an electrical double-layer supercapacitor. The quasi-solid-state supercapacitor exhibited power and energy densities of 263.3 W/kg and $7.31 \times 10^{-2}$ Wh/kg respectively. This preliminary study establishes a basis for further optimization of photo-supercapacitors with stable gel electrolytes.

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**Keywords:** Activated carbon, Coconut charcoal, Graphite, Physical activation, Supercapacitors

***Abstract No: 295*** ***Physical Sciences***

# α-TITANIUM PHOSPHATE DERIVED FROM ILMENITE BEACH SAND AS A NOVEL SENSING MATERIAL TO DETECT CHLORINE GAS AT ROOM TEMPERATURE

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Ilmenite ($FeTiO_3$) is the major constituent of Pulmoddai beach sand in Sri Lanka and is considered one of the significant ore deposits, which is widely used in synthesizing titanium compounds. The present study focused on the α-titanium phosphate (α-TiP) synthesised through KOH roasting and $H_3PO_4$ leaching processes as a chlorine gas sensing material. As a gas sensing material, α-TiP is important because of the unique crystal structure with interlayer spaces and high adsorption capacity. Moreover, as minor components of the sensing material, natural graphite was used to obtain electrical conductivity, and carboxy methyl cellulose (CMC) was used as a film-forming material. The sensor electrode was fabricated using the doctor blade method. The extremely toxic nature of chlorine gas to human health is increasing the demand for the development of chlorine gas sensors at room temperature. A custom-made gas sensing chamber was used to investigate the sensing characteristics of chlorine gas, and a voltage divider circuit and LabJack apparatus were used to take voltage response measurements. The synthesised α-TiP and the sensing material were characterized using XRD, FTIR, and Raman spectroscopy. The electrical properties of the sensing material were analysed using the four-probe conductivity meter, resulting in the ohmic behaviour with a good conductivity of 0.31 S/m. From (20 – 1000) ppm, chlorine gas concentrations were checked using the fabricated sensor. It shows a good sensitivity of 0.185 mV/ppm. The average response time is 2 to 3 min, and the recovery time is 1 to 3 min. The sensor has good selectivity towards the chlorine gas and stability for ageing. The experiments are in progress to reduce the response time and recovery time by modifying the sensor.

**Keywords:** α-titanium phosphate, Chlorine gas, Gas sensor, Ilmenite, Room temperature

***Abstract No: 31*** ***Science Education***

# IMPACT OF DIFFERENT TEACHING METHODS ON INTRINSIC MOTIVATION, SELF-CONCEPT AND ACHIEVEMENT IN SCIENCE: A CASE STUDY OF GRADE SIX STUDENTS AT A 1AB SCHOOL IN THE DEHIOWITA EDUCATION ZONE, SRI LANKA

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Science teaching needs to inspire children's curiosity by shifting the emphasis from knowing facts to focusing on innovation and creativity in applying ideas. If students have intrinsic motivation, they are active, curious, interested, and ready to engage in the learning process. Teaching methods are one of the best ways to inspire intrinsic motivation, self-concept and achievement. This research was conducted to investigate the effect of teaching methods on Grade 6 students' intrinsic motivation, self-concept and achievement in science in a 1AB school in Dehiowita Education Zone. A quantitative approach was applied, and the convenience sampling technique was used. Thirty-nine students from Grade 6-A and 40 students from Grade 6-B were selected. The 6-A class was used as the control group, while the 6-B class was used as the experimental group. The intervention process was implemented with conventional teaching methods for the control group and activity-based learning for 6-B. A Likert-type multidimensional questionnaire was administered before and after the intervention for both groups to measure their intrinsic motivation and self-concept. There were significant differences in intrinsic motivation and self-concept in the experimental group before and after the intervention (intrinsic motivation: $t = 7.493$, $p = 0.001$; self-concept: $t = 7.584$, $p = 0.001$). There was a significant difference between the control and experimental groups after the intervention (intrinsic motivation: $t = 7.743$, $p = 0.001$; self-concept: $t = 7.534$, $p = 0.001$). The results conclude that activity-based learning supports the improvement of students' intrinsic motivation and self-concept, thereby enhancing science education in Sri Lanka.

**Keywords:** Achievement, Intrinsic motivation, Science education, Self-concept

***Abstract No: 33*** ***Science Education***

# ENHANCING ACHIEVEMENT IN SCIENCE THROUGH INTRINSIC MOTIVATION AND CONCEPT MAPPING: AN ACTION RESEARCH STUDY FOR GRADE SIX STUDENTS

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Over the last few decades, researchers of different disciplines have been trying to identify the potential factors that contribute to students' reluctance to enter the field of science. It is known that intrinsic motivation is a crucial psychological factor to enhance students' achievements. This action research aimed to use intrinsic motivation and concept mapping to enhance students' achievement in science. Twelve Grade 6 students from a 1AB school in the Dehiowita Education Zone were selected. The student group was selected based on the term test marks of the science subject (marks obtained were below 30 for both 1st and 2nd term tests). Concept mapping was used as the main strategy of the intervention, and intrinsic motivation was used as the key psychological factor. As homework assignments, 30 concept maps were developed by each student in the study group, and revisions were made at the school. During the intervention, positive reinforcements and constructive feedback were given while evaluating the students. A good rapport was built with students through effective communication. The question-and-answer strategy was applied to enhance intrinsic motivation. After the intervention, it was observed that students improved their achievement and obtained above 30 marks for the third term test. This study showed the effectiveness of concept- maps in boosting student achievements. A significant difference ($t$ = 7.546, $p$ = 0.001) between pre and post-interventions in their intrinsic motivation was observed. The findings confirmed that intrinsic motivation and concept mapping are powerful factors to enhance students' achievement in science.

**Keywords:** Concept mapping, Intrinsic motivation, Science performance

***Abstract No: 47*** ***Science Education***

# IMPROVING CLASSROOM BEHAVIOURS THROUGH INTRINSIC MOTIVATION: AN ACTION RESEARCH ON MOTIVATING GRADE EIGHT SCIENCE STUDENTS

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Interpersonal relationships and students' perceptions of teachers' behaviour in the classroom are important determinants of students' intrinsic motivation. Students need an autonomy-supportive environment in the teaching-learning process. This study was carried out to improve the classroom behaviour of selected students from the Grade 8 class of a 1AB School in the Dehiowita Education Zone. Five misbehaving Grade 8 students were identified based on the information given by the class teacher and subject teachers. Constant talking with peers, verbal hostility, damaging school property, not completing homework, and not paying attention during lessons were the main misbehaviours observed in these students. The specific aim of this research was to improve the behaviour of these students through intrinsic motivational strategies. Positive reinforcement, verbal rewards, good rapport, and constructive feedback were the targeted interventions. Two intervention cycles were implemented, and during the first intervention, five well-behaved students were selected to mentor the misbehaving students. These mentors were responsible for monitoring their peers and marking a checklist over a given time period. After the first intervention, improvements were observed in the misbehaving students. Due to the positive impact of the initial intervention, a second intervention cycle was introduced. In the second intervention, student-centred teaching methods, such as debates, presentations, collaborative learning, and project-based learning, were employed. Intrinsic motivational strategies, including positive reinforcement, verbal rewards, constructive feedback, and collaborative evaluation strategies, were also applied. The misbehaving students were assigned specific duties and responsibilities within the teaching-learning process. By the end of both intervention cycles, the students' behaviour improved drastically, and instances of misbehaviour were no longer observed. As a result, the teaching-learning process became significantly smoother due to the positive changes in these students' behaviour. These interventions focused on the science subject, and it was noted that the students began cooperating more with their classmates.

**Keywords:** Intrinsic motivation, Misbehaviours, Reinforcements, Targeted interventions

***Abstract No: 67*** ***Science Education***

# IMPACT OF AI-DRIVEN TOOLS AND PERSONALIZED LEARNING PLATFORMS ON SCIENCE EDUCATION IN HIGHER EDUCATION INSTITUTIONS

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This study investigated the impact of AI-driven tools and personalized learning platforms on science education within higher education institutions. The study was conducted at the Faculties of Science in two state universities. The sample included 98 students and 11 lecturers. A mixed-methods approach and a longitudinal design were employed to capture changes and trends over an academic year. The sample was selected through a stratified random sampling method. Data collection methods included surveys, standardized test scores, classroom observations, and interviews. Quantitative data were analysed using SPSS and Excel, while qualitative data were examined through thematic analysis. The preliminary findings of the study showed that academic performance was significantly enhanced by AI-driven tools, with 74 out of 98 students (75.5%) benefiting from personalized and adaptive learning experiences and 8 out of 11 lecturers (72.7%) reporting improvements in administrative efficiency and instructional support due to AI integration. Performance was reported to improve through personalized and adaptive learning experiences, which addressed individual student needs and fostered critical thinking and problem-solving skills. Students demonstrated increased engagement and motivation, which were attributed to interactive and autonomous learning environments. Enhanced digital literacy was another notable outcome. For lecturers, administrative tasks were streamlined by AI tools, particularly through automated grading and data management, allowing them to focus more on instructional activities. Personalized instructional support based on data-driven insights helped resources be allocated effectively, and teaching strategies be tailored. The continuous learning opportunities and feedback available through AI-driven professional development tools enhanced teaching methodologies and classroom effectiveness. The challenges identified during the study included technical implementation hurdles, the need for adequate lecturer training, and potential equity concerns due to access disparities. Data privacy and algorithmic biases were also critical issues that needed to be addressed to ensure the fair and secure use of AI in education. The outcomes concluded that the integration of AI-driven tools and personalized learning platforms is promising in improving educational outcomes and lecturer efficiency at higher education institutions.

**Keywords:** AI-driven tools, Digital literacy, Lecturer efficiency, Personalized learning platforms, Science education

***Abstract No: 88*** ***Science Education***

# AWARENESS AND PERCEPTIONS OF ARTIFICIAL INTELLIGENCE (AI) TOOLS: A CASE STUDY OF UNDERGRADUATES IN THE FACULTY OF ARTS, UNIVERSITY OF PERADENIYA, SRI LANKA

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As Artificial Intelligence (AI) continues to expand across various sectors, it is essential to understand how students in non-STEM (Science, Technology, Engineering, and Mathematics) fields perceive and engage with this technology. This study explored the awareness and perceptions of AI tools among undergraduates in the Faculty of Arts at the University of Peradeniya. Structured surveys and semi-structured interviews were conducted with a sample of 248 first-year students to explore their initial perceptions and early experiences with AI, providing insights into their foundational awareness and attitudes. The survey, administered online via Google Forms, included questions on demographic information, familiarity with AI concepts, frequency and purpose of AI tool usage, and perceptions of AI's role in academia and future employment. Data was analysed using R software. The majority of respondents were female (92.3%), with significant representation from Geography (14.2%), Sociology (13.7%), and Information Technology (11.0%) departments. The knowledge and awareness of AI were high, with 90.3% having heard of AI and 53.2% possessing some understanding of it. Usage of AI tools was prevalent, particularly for ChatGPT (39.5%) and for tasks such as grammar checking, assignment completion, and note-making. Privacy and data security emerged as the primary concerns (36.3%). Statistical analysis revealed significant associations between the province of the student belongs to and the knowledge of AI ($p$ = 0.006). Significant associations were reported between the department, which the students represent and the knowledge and understanding of AI ($p$ = 0.008). While the majority of students (82.0%) agreed that AI tools are becoming a new norm, less % of students (16.3%) believe that AI could completely replace human teachers. Thematic analysis of interview transcripts revealed a positive outlook on AI's potential benefits in education and job prospects, though ethical implications and job displacement were notable concerns. Future research should examine the long-term effects of AI literacy programs across different non-STEM faculties.

**Keywords:** Artificial intelligence, AI tools, Awareness, ChatGPT, Non-STEM students

***Abstract No: 106*** ***Science Education***

# TEACHERS' PERCEPTIONS ON UTILIZING SMALL-SCALE CHEMISTRY ACTIVITIES TO TEACH SECONDARY SCHOOL SCIENCE EDUCATION IN SRI LANKA

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The importance of a robust science education framework in Sri Lanka is widely recognized, yet several challenges hinder its effectiveness. This study explored teachers' perceptions of using small-scale chemistry (SSC) activities in science education through a mixed-method approach by training secondary school science teachers and lecturers from the National Colleges of Education (NCoE). The study aimed to foster attitudinal change toward conducting practicals using improvised laboratory equipment and minimal chemicals. A sample of 395 teachers from all nine provinces of Sri Lanka and 23 NCoE lecturers participated in the training, which introduced five SSC activities through a specially designed educational toolkit. The properties of oxygen gas, acid-base indicators, gas diffusion, electrolysis, and carbonate-acid reactions were conducted using the educational toolkit. Data were collected through questionnaires, focus group discussions, and semi-structured interviews. Quantitative data were analysed using SPSS version 26.0, while qualitative data were thematically analysed to provide insights into the challenges and opportunities associated with SSC. The findings indicate that most participants were unaware of SSC before attending the training. However, they viewed it positively after the training. While recognizing the importance of SSC as a remedial measure for the shortage of resources and laboratory facilities, the participants expressed a keen interest in incorporating the SSC approach into their current teaching and learning activities. However, the study highlights significant challenges to SSC adoption, including insufficient training, lack of professional development, and limited access to materials. The study recommends implementing professional development programs to equip teachers with SSC skills, integrating SSC activities into the science curriculum, and ensuring adequate resources. Further research would focus on evaluating the long-term impact of SSC on students' performance and its applicability in various educational contexts across Sri Lanka.

**Keywords:** Education tool kit, Secondary science education, Small-scale chemistry activities

***Abstract No: 107*** ***Science Education***

# EFFECTIVE PROFESSIONAL DEVELOPMENT STRATEGIES FOR SCIENCE TEACHERS IN SECONDARY EDUCATION IN SRI LANKA

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This study explored the effective professional development strategies for science teachers in secondary education in Sri Lanka. The study aimed at improving instructional practices and enhancing student engagement. A mixed-methods approach was adopted and investigated the effective instructional practices, and their impact on student engagement and learning outcomes. Data was collected from 27 science teachers and 58 students across 12 schools in Matale, Kandy, and Nuwara Eliya Districts. Teachers were selected by purposive sampling, and students were selected by random sampling. Surveys and questionnaires were designed to assess teachers' experiences with professional development and its impact on their teaching practices. In-depth interviews with teachers and students were facilitated using interview guides. Classroom observations were conducted employing observation protocols with rubrics or checklists. Qualitative data were analysed using thematic analysis, while quantitative data were analysed using SPSS statistical software. Ethical considerations were meticulously followed, including obtaining informed consent from participants, ensuring confidentiality and anonymity, and adhering to ethical guidelines for educational research. The findings of this study indicated that targeted professional development strategies significantly enhanced the instructional practices of science teachers in secondary education, leading to more interactive and engaging classrooms. Specifically, 81% of the teachers reported improved lesson planning and the integration of active learning techniques, such as inquiry-based learning and collaborative activities. Additionally, the incorporation of technology in teaching practices, such as digital simulations and interactive science platforms, resulted in a 15% increase in student engagement and a notable improvement in critical thinking skills. Teachers who underwent professional development centred on pedagogical innovation and technology integration demonstrated higher levels of confidence in delivering content, which in turn positively impacted student performance. These results underscore the importance of aligning professional development programs with both technological advancements and the specific pedagogical needs of science education in Sri Lanka.

**Keywords:** Instructional practices, Professional development, Science education, Student engagement

***Abstract No: 114*** ***Science Education***

# EFFECTIVENESS OF INQUIRY-BASED LEARNING STRATEGIES IN TEACHING SCIENCE CONCEPTS TO SECONDARY SCHOOL SCIENCE STUDENTS IN SRI LANKA

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This study investigated the effectiveness of inquiry-based learning (IBL) strategies in teaching science concepts to secondary school students in Sri Lanka. The outcomes were compared with the traditional lecture-based instruction method (TLBL). The mixed-method approach was used to evaluate the impact of IBL on student understanding, retention, engagement, and motivation in science classrooms. The study sample included 300 secondary school students from three different Districts in Sri Lanka (Matale, Kandy, and Nuwara-Eliya). The schools were selected through stratified random sampling to ensure representation. Pre- and post-tests were used to measure learning outcomes. Surveys and questionnaires were used to assess student engagement and attitudes. In-depth interviews with teachers and students, along with classroom observations using a standardized protocol, were also conducted. Ethical considerations, including informed consent, confidentiality, and adherence to educational research guidelines, were followed throughout the study. Quantitative data were analysed using t-tests and ANOVA, while qualitative data were subjected to thematic analysis to identify recurring themes. Students in the IBL group showed a significantly greater improvement ($t = 6.34$, $p < 0.001$) in test scores with a mean increase of $12.5 \pm 3.8$, compared to the students of the TLBL group (mean increase of $4.2 \pm 2.1$ marks). Moreover, 85% of students in the IBL group reported higher engagement compared to 60% in the TLBL group ($p = 0.002$). Inquiry-based learning showed relatively higher levels of student engagement and motivation. Preliminary findings suggest that IBL strategies significantly enhance student understanding and retention of science concepts compared to traditional lecture-based methods.

**Keywords:** Inquiry-based learning, Lecture-based teaching, Science education, Secondary students

***Abstract No: 118*** ***Science Education***

# ENHANCING STUDENTS' 21ST CENTURY SKILLS THROUGH MODULAR STEM ACTIVITIES: A NEW CURRICULUM REFORM IN SRI LANKA

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Science, Technology, Engineering, and Mathematics (STEM) education is crucial for developing 21st century skills. The present science curriculum activities in secondary schools often do not prioritize exploration, creativity, and innovation, which are central to STEM activities. The objectives of this study were to assess students' attitudes towards learning science concepts through STEM activities and to explore the challenges they faced while conducting STEM activities given in the proposed science module. It was expected to identify how proposed STEM activities enhance students' 21st century skills. A purposive sample of 121 Grade 6 students from four schools was selected, and a pilot study was carried out in the Western and Sabaragamuwa provinces of Sri Lanka. The STEM activities were selected from the module 'Things Around Us,' focusing on the theme of matter and energy. Data were gathered using a quantitative questionnaire, analysis of formative assessment marks based on rubrics, focus group discussions with students, teacher interviews, and observation schedules. The analysis of the questionnaire data and assessment marks indicated that the proposed STEM activities effectively developed 21st century skills. Teacher interviews supported these findings. Observations and student interviews revealed that students desired more activities focused on designing structures. The observations showed that students found innovative solutions to problems while engaging in STEM activities. In conclusion, the STEM approach provided a more active learning environment while enhancing students' 21st century skills.

**Keywords:** 21st century skills, Modular approach, Science Education, STEM activities

***Abstract No: 141*** ***Science Education***

# SOCIAL AND CULTURAL BARRIERS IN IMPLEMENTING 21ST CENTURY SKILLS IN EDUCATION SYSTEMS IN ASIAN COUNTRIES

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As societies undergo rapid technological transformations in the 21st century, the demand for an education system that cultivates skills necessary for the 21st century has become increasingly vital. However, the implementation of such progressive educational approaches faces complex obstacles due to the diverse socio-cultural settings in many countries. This review aimed to investigate the socio-cultural challenges in 21st century education systems in Asian countries. For that, 40 relevant review papers published after the year 2000 were selected from Google Scholar, ERIC and JSTOR. Content analysis was conducted to identify the main socio-cultural barriers and to their impact on implementing 21st century skills to Asian Education systems. According to literature, Asian countries such as Japan, Korea, China, and Singapore showed some positive impacts of socio-cultural patterns in implementing 21st century skills. Countries such as Indonesia, the Philippines, Malaysia, and Pakistan have relatively high-power distance scores (ranging from 70 to 100) according to Hofstede's cultural dimensions and comparatively low masculinity index (below 50), suggesting a more feminine cultural orientation. The low uncertainty avoidance index in Singapore, China, Vietnam, and Thailand indicates a low tolerance for uncertainty and ambiguity. High power distance, gender inequality, traditional assessment systems, low tolerance for new concepts and ideas, and poor female education were reported as the main socio-cultural barriers that affect education reforms. More than 50% of the papers highlighted the impact of these factors on students' self-expression, inquiry-based learning, creativity and critical thinking. The low tolerance for new implementations has been recognized as one of the significant factors that hinder education reforms as teachers are reluctant to deviate from the traditional classrooms. The traditional assessment methods practised in most Asian countries also negatively affect competitiveness among students. Religious and other socio-cultural aspects in Asian countries (Japan, China and Singapore) influence social norms, values, and behaviours creating barriers to implementing 21st century education systems.

**Keywords:** 21st century skills, Education systems, Social cultural barriers, Social norm

***Abstract No: 146*** ***Science Education***

# STUDENTS' COMPETENCY IN EXPLAINING SCIENTIFIC PHENOMENA AND ACADEMIC PERFORMANCE: A CASE STUDY OF ADVANCED LEVEL SCIENCE STUDENTS IN KANDY EDUCATIONAL ZONE, SRI LANKA

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Science education aims to use scientific knowledge to explain phenomena by understanding their causes, circumstances, and implications. Despite the importance of this competency in the 21st century, it is uncertain if students in Sri Lanka's G.C.E. A/L science stream possess the proficiency demanded by the global community. This study examined the relationship between competency in explaining scientific phenomena and the academic performance of students in the Advanced Level Science stream based on their gender. The study employed descriptive one-shot cross-sectional survey analysis under a quantitative research approach. The study sample consisted of 121 Grade 13 students enrolled in Advanced Level Science classes in six schools in Kandy Zone, selected by a non-randomized convenience sampling method. Data were collected using a self-constructed test of competency in explaining scientific phenomena, with a reliability coefficient of 0.584. First and second term test marks were utilised by students to assess their academic performance. Data were analysed using MS Excel and SPSS software, using descriptive and parametric statistical methods. The mean, range, and standard deviation of scores in students' competency in explaining scientific phenomena and academic performance were analysed; correlation and regression analysis were used to assess relationships between the variables. The mean scores of competencies in explaining scientific phenomena were 29.26 and 41.44, with standard deviations of 16.02 and 19.61, while mean scores of academic performance were 46.9 and 56.02, with standard deviations of 11.17 and 17.16 in male and female students, respectively. Female students demonstrated higher levels of competency than male students, with 13.6% of female and 3.2% of male students falling into the good and very good performance categories. A positive correlation between competency in explaining scientific phenomena and academic performance was observed ($r$ = 0.620, $n$ = 121, $p$ = 0.001). Furthermore, the unstandardized coefficient of the competency scores in explaining scientific phenomena indicated that for each competency score raised, male and female students' academic performance scores increased by 0.223 ($p$ = 0.011) and 0.638 ($p$ = 0.000), respectively. The findings suggest that teachers should implement instructional strategies that can improve students' competency in explaining scientific phenomena, as this affects their academic performance.

**Keywords:** Advanced level, Academic performance, Scientific phenomena, Science stream

***Abstract No: 154*** ***Science Education***

# PROBING STUDENTS' HIGHER-ORDER THINKING SKILLS IN GRADE 13 CHEMISTRY: A CASE STUDY FROM KANDY EDUCATION ZONE, SRI LANKA

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Fostering higher-order thinking skills (HOTS) in chemistry education is essential for developing students' analytical, problem-solving, and creative abilities. Recognizing this necessity, the revised chemistry syllabus implemented in 2017 by the Ministry of Education, Sri Lanka, endeavoured to integrate HOTS through various teaching-learning strategies. This research aims to assess the present status of HOTS in Grade 13 students across six public schools in the Kandy Zone of Education, Sri Lanka. A descriptive research design with a quantitative framework was employed, and a HOTS evaluation tool was developed following Anderson and Krathwohl's revised Bloom's Taxonomy, 2001. This tool consisted of 12 two-tier multiple-choice (TTMC) questions and three double-statement questions designed to evaluate students' understanding of chemical concepts with reasoning related to the three levels; Analysis, Evaluation and Creation. The validity and reliability of the instrument were established through expert judgment and Cronbach's alpha. A convenient sample of 133 (45 male and 88 female) students from the designated schools underwent the assessment. Descriptive statistics revealed that over 90% of the students answered less than 50% of the questions correctly. In terms of the three levels of HOTS, the correct responses were 26.8%, 24.4%, and 17.5% for tiers 1 and 2, and it was 44.5%, 37.3% and 36.3% for tier 1 only. The mean values for those three levels were 1.61, 1.22, and 0.70 for tiers 1 and 2 and 2.67, 1.86, and 1.45 for tier 1, respectively. The findings indicate a lack of students' skills in all three levels of HOTS. A higher percentage of correct responses for tier 1 compared to tier 2 suggests that students are relying more on rote memorization than on a deeper understanding of chemistry concepts. The study highlights the urgent need for teaching-learning interventions to enhance HOTS among students and sets the stage for further studies.

**Keywords:** Bloom's taxonomy, Higher-order thinking skills, Reliability, Two-tier multiple-choice, Validity

***Abstract No: 187*** ***Science Education***

# FOSTERING EDUCATION FOR ENVIRONMENTAL SUSTAINABILITY: LEVEL OF COMPETENCIES ON REDUCING ENVIRONMENTAL POLLUTION OF JUNIOR SECONDARY STUDENTS IN SRI LANKA

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Education for Environmental Sustainability (EES) aims to develop students' sensitivity, awareness, knowledge, attitudes, skills, and practices related to the environment and the sustainable use of its resources. It not only empowers students on environmental concerns but also connects them to more sustainable lifestyles, enabling them to become environmentally literate. This cross-sectional survey was conducted to assess the environmental literacy of junior secondary students (Grades 6 to 9) in selected Sri Lankan schools. The aim of the study was to determine students' competency levels in reducing environmental pollution. The sample included 442 students from three districts in the Western Province (Colombo, Gampaha, and Kalutara), selected using random stratified sampling techniques. A questionnaire with multiple-choice questions was used as the research instrument. Students' competency in organic farming, eco-friendly energy sources, reducing/recycling, and judgment on eco-friendly practices was assessed. Competency was measured by students' ability to identify and analyse environmental issues, ask relevant questions, evaluate and make personal judgments, and use evidence and knowledge to defend their positions. The findings revealed that students' competency levels in the focused areas improved with more effective EES implementations in school education. Students in the Colombo District recorded the highest competency level ($\mu = 0.55 \pm 0.26$), while the lowest was recorded in the Gampaha District ($\mu = 0.53 \pm 0.26$). Competency varied from 0 to 1 across all three districts. Grade 8 students showed the highest competency ($\mu = 0.55 \pm 0.22$), while Grade 6 students recorded the lowest ($\mu = 0.48 \pm 0.28$). A significant association was observed between the student category and organic farming ($p < 0.05$), as well as reducing/recycling and willingness to engage in pollution reduction activities ($p < 0.05$). There were significant variations across districts and among the three grades ($p < 0.05$). In conclusion, the findings underscore the critical role of EES in enhancing students' environmental literacy and greater awareness and promoting active participation in sustainable practices, paving the way for a more environmentally responsible generation.

**Keywords:** Education for environmental sustainability (EES), Educational pedagogy, Environmental literacy, Junior secondary level students

***Abstract No: 213*** ***Science Education***

# EFFECT OF DIFFERENT TEACHING METHODS ON STUDENTS' PERFORMANCE IN THE ELECTRONIC SECTION OF G.C.E. ORDINARY LEVEL SCIENCE: CASE STUDY OF STUDENTS FROM NUWARA ELIYA DISTRICT, SRI LANKA

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The majority of science students week in the electronic section of the science curriculum prepared for the General Certificate Examination of Ordinary Level (G.C.E. O/L) in Sri Lanka. The primary objective of this study was to evaluate student performance in the electronics unit of the Grade 11 science curriculum. The four different teaching methods were comparatively evaluated for their effectiveness. The identification of suitable teaching methods, determination of subject performance, and evaluation of the relationship between teaching methods and performance were the specific objectives of this study. A quasi-experimental design with a quantitative approach was used for the study. A sample of 113 Grade 11 students from two schools in the Nuwara Eliya District was selected using non-randomized sampling. The electronic unit of the science curriculum of Grade 11 was taught to four parallel classes using four different teaching methods: guided discovery method, lecture method, teacher demonstration method and simulation method. The performance test scores obtained were analysed using SPSS software. The findings indicated a significant difference between teaching methods and student achievements ($p$ = 0.001). Among the four teaching methods, the simulation method was identified as the best method. Both male and female students showed preferences for the simulation method, suggesting its importance in teaching the electronic section in the Grade 11 science curriculum.

**Keywords:** Achievements and performance, Electronics, Guided methods, Simulation method

***Abstract No: 256*** ***Science Education***

# MENSTRUAL HYGIENE AMONG SCHOOL CHILDREN IN SOUTH ASIA: AWARENESS, PRACTICES AND CONSTRAINTS

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Menstrual hygiene practices among adolescent girls in South Asia are influenced by a complex array of factors, leading to disparities and challenges in proper menstrual management. The aim of this study was to explore the dynamics of menstrual hygiene among school children in South Asia and identify barriers affecting their menstrual health. The specific objectives included assessing the level of awareness, current practices, and constraints related to menstrual hygiene. A systematic review of 15 research articles, sourced from databases such as Google Scholar, ResearchGate, PubMed, and Web of Science, was conducted. The review specifically focused on school children in South Asia, addressing aspects of their awareness, practices and constraints on menstrual hygiene. Out of these 15 articles, 10 provided a comprehensive analysis of awareness, practices, and constraints related to menstrual hygiene. Among these, seven studies were conducted in India, one in Pakistan, and two in Nepal. Two articles solely discussed awareness, with one article each focusing exclusively on practices, awareness and constraints. The findings suggest that most South Asian school girls receive information about menstruation prior to menarche and that mothers are the main providers of this information. However, the articles consistently highlight the lack of comprehensive knowledge regarding menstrual cycles, secondary sexual characteristics, and reproductive health among them. Many girls do not adhere to the recommended frequency of changing sanitary products every 3-4 hours, which can lead to various health complications, including an increased risk of reproductive tract infections (RTIs), skin irritation, and other hygiene-related issues. Additionally, burning appears to be the most common method of disposing used products. Cultural and religious taboos impose significant restrictions on menstruating girls, compounded by inadequate hygiene facilities such as gender-segregated toilets and washing and changing amenities in schools. In conclusion, the study calls for comprehensive menstrual health education, affordable products, and cultural shifts to improve menstrual management and well-being for South Asian female students.

**Keywords:** Cultural and religious taboos, Menarche, Menstrual health, Sanitary products

***Abstract No: 260*** ***Science Education***

# TEACHERS' ROLE IN ENHANCING STUDENTS' ACADEMIC PERFORMANCE AND BEHAVIOURS

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Teaching has been considered a noble profession ever since human civilization began. Apart from imparting knowledge, teachers play multiple roles. This review investigated the role of teachers in students' academic performance, attitudes, and behaviours. The information was collected from review articles, conference papers, master's theses, and doctoral dissertations published between 2000 and 2023. Additionally, thirty research papers were selected from Google Scholar, PubMed, and ResearchGate. The literature reveals a lack of sufficient studies conducted in Sri Lanka, as the majority of these studies (90%) were carried out in other countries. Data were analysed through content analysis. According to the findings, teacher-student interactions, specific teaching practices, motivation toward learning, and teachers' organizational techniques were identified as the main factors affecting students' academic performance, attitudes, and behaviours. Teacher-student interactions were found to be the most critical factor (mentioned in 33% of the articles) that shapes student behaviour and attitudes. Nearly 23% of articles emphasized that both teaching strategies and the motivational support received from teachers are important for student performance. A few research articles (20%) highlighted the impact of teachers' organizational abilities on students' attitudes and performance. These findings provide valuable insights for enhancing teacher training programs.

**Keywords:** Academic performance, Attitudes, Behaviours, Motivation, Performance

***Abstract No: 148*** ***AI in Biomedical Sciences***

# NOVEL DRUG COMBINATIONS AGAINST METHICILLIN RESISTANT *Staphylococcus aureus*

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Methicillin-resistant *Staphylococcus aureus* (MRSA) causes a major public health issue due to its resistance to multiple antibiotics, leading to severe infections and increased healthcare costs. As traditional treatments are becoming less effective against antibiotic-resistant bacteria like MRSA, innovative therapeutic approaches are necessary. In many reported cases, synergistic drug combinations have been used to address issues related to antibiotic resistance. Therefore, this study aimed to identify novel synergistic drug combinations to combat MRSA by predicting the bioactivity of 3000 drug candidates, primarily phytochemicals. Using the KNIME Analytics Platform, an *in-silico* screening pipeline was developed to predict the activity of these phytochemicals against MRSA. The study retrieved 2D structural information of the 3000 drug candidates, 25 antibiotics, and 17 drug combinations from the ChEMBL database. The training data were selected from current treatment practices in hospitals, while test data were chosen based on literature on antimicrobial properties. Cheminformatics tools and machine learning models, including Random Forest (RF), Artificial Neural Network (ANN), and Support Vector Machine (SVM), were used to train and validate the data. Model performances were evaluated using accuracy, Root Mean Squared Error (RMSE), precision, recall, F1 score, and Cohen's kappa. Synergistic drug combinations were predicted with accuracies of 98.41% for RF, 98.01% for ANN, and 98.21% for SVM. Five compounds: Psoralen, Nintedanib, Deuxibuprofen, D-Pinitol, and Gallic acid were identified as promising candidates against MRSA after filtering through a Pan-assay. These compounds possess known antimicrobial properties but are not commonly used against MRSA. The drug combination of CHEMBL235842 and CHEMBL2152348 demonstrated the highest synergy score, suggesting that combining these compounds could target more bacterial survival pathways than single-drug therapies, reducing resistance development. This research developed a Machine learning pipeline to predict drug synergy, reducing the experimental sample size and saving resources and time for *in-vitro* experiments.

**Keywords:** Antibiotic resistance, KNIME, MRSA, Machine learning, Synergy prediction

***Abstract No: 150*** ***AI in Biomedical Sciences***

# DRUG REPURPOSING FOR STREPTOCOCCUS TOXIC SHOCK SYNDROME (STSS), THE "FLESH-EATING BACTERIA" SPREADING IN JAPAN

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Streptococcus Toxic Shock Syndrome (STSS), caused by invasive group A *Streptococcus* bacteria, presents significant health challenges in Japan due to limited treatment options and increasing antibiotic resistance. This study addressed these challenges by exploring drug repurposing through a computational screening method. Using the KNIME Analytics Platform, a Machine learning pipeline screened 3000 drug candidates (primarily phytochemicals sourced from medicinal plants) against STSS using training data from 36 antibiotics. Training data were selected from current treatment practices in hospitals, while test data were chosen based on literature on antimicrobial properties. A training-validation split of 80:20 was employed, where 80% of the data was used for model training and 20% for validation to assess model performance and generalizability. The pipeline includes Random Forest (RF), Artificial Neural Network (ANN), and Support Vector Machine (SVM) models, achieving prediction accuracies of 99.84%, 99.31%, and 98.31% respectively, with corresponding Root Mean Squared Error (RMSE) values of 0.04, 0.08 and 0.13. Model performances were evaluated using precision, recall, F1 score, and Cohen's kappa metrics. From the screening, seven compounds emerged as promising candidates after validation through Pan-assay: Fosbretabulin disodium, Amphotericin B, Cysteamine, Taxol A, Tilarginine, Ascaridole, and D-Penicillamine. Ascaridole, with its natural origin and historical medicinal use, stands out for its antimicrobial and anti-inflammatory properties as a phytochemical. While further pre-clinical and clinical studies are necessary to evaluate their efficacy and safety for STSS treatment, this research used Machine learning to identify new therapeutic options for STSS through drug repurposing.

**Keywords:** Antibiotic resistance, Drug repurposing, KNIME, Machine learning, STSS

***Abstract No: 174*** ***AI in Biomedical Sciences***

# NOVEL APPROACH TO AUTOMATED SOLAR POWERED HYBRID DNA ELECTROPHORESIS EQUIPMENT

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Due to a lack of domestic repair and manufacturing, Sri Lanka faces a shortage of several instruments important for research activities. Agarose gel electrophoresis equipment is a simple but vital tool in biomedical sciences specially in the areas of genetics and molecular biology. It is used to separate mixtures of DNA, RNA, or proteins according to their size and charge. There are various versions and agarose gel electrophoresis uses an electric field to separate a mixed population of macromolecules in an agarose matrix. Conventional gel electrophoresis setups further require additional separate devices such as power supplies and UV illuminators to visualize DNA. This increases the cost and requires manual monitoring during an analysis. This study addressed these issues by presenting a novel, low-cost gel electrophoresis machine that could test DNA samples, specifically to be used in Sri Lankan laboratories. The machine utilizes readily available materials in the country and integrates the gel running unit, power unit, and illuminator into a single system. User-friendly features include a high-end display with a graphical user interface (GUI), an in-built illuminator with image processing functionalities, cloud-based data management, and Raspberry Pi programmed with the help of AI to control for stand-alone operation. Additionally, the machine incorporates solar power as a secondary source and a battery management system for enhanced reliability. The cost of production is extremely lower than the current market price in the country. Therefore, this low-cost, locally sourced machine offers a sustainable solution for Sri Lankan laboratories, reducing reliance on imported equipment and minimizing maintenance costs.

**Keywords:** AI, Biomedical sciences, Electrophoresis, Machine learning, Renewable energy

***Abstract No: 227*** ***AI in Biomedical Sciences***

# LEVERAGING LARGE LANGUAGE MODELS FOR REGION-SPECIFIC FOCUS IN PULMONARY EMBOLISM DETECTION

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Pulmonary embolism (PE), characterized by the blockage of lung arteries due to blood clots, is a critical and potentially life-threatening condition that demands precise and timely diagnosis. Manual readings of medical images can sometimes lead to misdiagnoses, especially when the image quality is not ideal, putting patients at serious risk. Traditional PE detection models rely on image data alone, limiting their accuracy and interpretability. In the evolving field of deep learning for medical image analysis, there is significant potential to improve PE detection through advanced methodologies. The study aimed to enhance the detection of PE by integrating Large Language Models (LLMs) with Data efficient image Transformer architecture (DeiT), which addresses some of the key limitations of traditional Vision Transformers. This multimodal approach is novel and shows promising results. For this research Down sampled RSNA data set was used to represent all the available positive studies and equal number of negative studies. The traditional CNN approach achieved over 76.4% accuracy and the transformer-based approach achieved over 79.7% accuracy, however, this proposed method achieved an impressive accuracy of over 91.2%. These findings revealed that this integrated approach significantly enhances both the accuracy and interpretability of PE detection models. The use of attention mechanisms with Vision Transformers showcases superior capabilities compared to traditional CNN-based approaches, making a notable impact on medical image analysis and disease diagnosis. This advancement highlights the broader applicability of this method, enhancing detection accuracy and reducing processing time, ultimately leading to better patient outcomes.

**Keywords:** Attention map, Large language models, Pulmonary embolism, RSNA data, Vision transformer

***Abstract No: 235*** ***AI in Biomedical Sciences***

# PREDICTION OF POTENTIAL SULFONAMIDE-LIKE ANTIMICROBIAL PHYTOCHEMICALS USING KNIME AND MACHINE LEARNING-BASED APPROACH

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Sulfonamide drugs are the first synthesised, selectively toxic antibiotics. They mimic p-aminobenzoic acid (PABA) to hinder folate production, which is crucial for DNA replication and thereby inhibit bacterial growth. Sulfonamides have broad-spectrum activity and are vital in treating several bacterial infections, like urinary tract infections and respiratory infections. Though different antibiotics are currently available, sulfonamides are significant, especially for patients allergic to penicillin. This study aimed to discover novel sulfonamide-like compounds from phytochemicals using a quantitative structure-activity relationship (QSAR) approach, a productive and cost-effective technique that allows the determination of the structural and biological similarities between the chemical compounds. The QSAR approach was implemented on the KNIME platform, version 5.2.5, along with cheminformatics extensions. Structural data for 407 phytochemicals, 18 FDA-approved sulfonamide drugs, and 21 control drugs were obtained from the ChEMBL database in SMILES format. These data were processed in KNIME to generate MACCS molecular fingerprints using the RDKit nodes. Three types of Machine learning (ML) models, Random Forest (RF), Artificial Neural Network (ANN), and Support Vector Machine (SVM), were trained to detect sulfonamide-like molecules, and the models were able to achieve a high prediction accuracy of 99.30%, 99.55%, and 99.33%, respectively. Both RF and ANN predicted Kaempferol-3-O-P-D-glucoside, a phytochemical obtained from *Saraca indica*, as a potential sulfonamide drug, while the SVM model did not identify any phytochemicals. The bioavailability of the predicted compound was confirmed by a drug likeliness test using Lipinski's rule of five. In this study, Kaempferol-3-O-P-D-glucoside was identified as a promising compound for producing a novel sulfonamide antibiotic drug. However, further *in-vitro* and *in-vivo* experiments are required to confirm its potential to develop novel sulfonamides and utilise it for clinical purposes as an antibiotic. In addition, this study demonstrated the effectiveness of KNIME and ML models in computer-based drug discovery.

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**Keywords:** Antibiotic drug discovery, KNIME, Machine learning, QSAR, Sulfonamides

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