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Undergraduate Research Symposium of Technology & 3rd Applied Sciences Undergraduate Research Symposium

URSTech & APSURS 2024

ABSTRACTS

"Empowering Innovation: Bridging Theory and Practice in Applied Sciences and Technology"

11th July 2024
Faculty of Technology & Faculty of Applied Sciences
Sabaragamuwa University of Sri Lanka
Belihuloya

URSTech 2024

UNDERGRADUATE RESEARCH SYMPOSIUM OF TECHNOLOGY

&

APSURS 2024

APPLIED SCIENCES UNDERGRADUATE RESEARCH SYMPOSIUM

11TH JULY 2024
FACULTY OF APPLIED SCIENCES
SABARAGAMUWA UNIVERSITY OF SRI LANKA

URSTech & APSURS 2024

Undergraduate Research Symposium of Technology
Applied Sciences Undergraduate Research Symposium
https://www.sab.ac.lk/app/urstech_apsurs/

Organized by the Faculty of Applied Sciences of the Sabaragamuwa University of Sri Lanka
11th July, 2024

URSTech & APSURS 2024 provides a platform for undergraduates to share findings of their research, and potential as researchers with an extensive research, and scholarly community thereby exposing them to broad academic, and industrial opportunities, and research collaborations with the leading industries. It encourages undergraduates to examine local, and global trends in their fields of research, and to share the developments, technology, skills, knowledge, and investments.

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Message from the Vice Chancellor

I extend my warmest welcome to URSTech & APSURS 2024, a collaborative symposium organized by the Faculty of Applied Sciences and the Faculty of Technology at Sabaragamuwa University of Sri Lanka. This year marks a significant milestone as APSURS joins hands with the Faculty of Technology, uniting under the theme *"Empowering Innovation: Bridging Theory and Practice in Applied Science and Technology."*

This annual gathering not only showcases our commitment to advancing knowledge in applied sciences and technology but also reinforces our university's role in fostering interdisciplinary collaboration. It serves as a vital platform for researchers, scholars, and industry experts to exchange ideas, explore new frontiers, and address global challenges through innovative solutions.

The symposium offers invaluable opportunities for our students to engage with renowned researchers and industry leaders, gaining insights that will shape their academic and professional trajectories. Such interactions are instrumental in preparing them to tackle real-world problems and emerge as future leaders in their respective fields.

I extend my sincere appreciation to the diligent organizing committee whose dedication and meticulous planning have ensured the seamless execution of this event. Your efforts have been pivotal in creating an enriching and impactful experience for all participants. With enthusiasm and optimism, I look forward to the insightful discussions and fruitful collaborations that URSTech & APSURS 2024 will undoubtedly foster.

Professor M. Sunil Shantha
Vice Chancellor
Sabaragamuwa University of Sri Lanka

Message from the Dean - Faculty of Technology

As the Dean of the Faculty of Technology at Sabaragamuwa University of Sri Lanka, it is my honour to welcome you to URSTech & APSURS 2024. This year marks a momentous occasion for our faculty as we host our very first conference, in collaboration with the Faculty of Applied Sciences.

The theme *"Empowering Innovation: Bridging Theory and Practice in Applied Science and Technology"* reflects our core mission to integrate theoretical knowledge with practical application. This symposium is a landmark event, bringing together our first batch of students, esteemed researchers, and industry experts to share insights and foster innovation. This gathering is more than just an academic event; it is a celebration of interdisciplinary cooperation and a testament to our commitment to pioneering advancements in science and technology. We aim to create an environment where ideas can be exchanged freely, new research can be showcased, and meaningful collaborations can be formed.

For our students, URSTech & APSURS 2024 is a unique opportunity to engage with leading minds in their fields, gaining invaluable insights that will influence their future careers. It is through these interactions that they will learn to tackle real-world challenges and develop into the next generation of innovators and leaders.

I would like to extend my deepest gratitude to the organizing committee for their dedication and hard work in making this event possible. Their efforts have ensured that this conference will be a memorable and impactful experience for all involved. I look forward to the engaging discussions, ground-breaking presentations, and collaborative spirit that will define URSTech & APSURS 2024. Let us take this opportunity to inspire and be inspired, as we work together to advance the frontiers of applied science and technology.

Professor K.R. Koswattage
Dean - Faculty of Technology
Sabaragamuwa University of Sri Lanka

Message from the Dean - Faculty of Applied Sciences

I am delighted to write this message about the Undergraduate Research Symposium of Technology, and 3rd Applied Sciences Undergraduate Research Symposium (URSTech & APSURS-2024), organized by the Faculty of Technology (FOT) and the Faculty of Applied Sciences (FAPS) at Sabaragamuwa University of Sri Lanka.

This year, the symposium is a collaborative endeavour between FAPS and FOT, offering a valuable opportunity for undergraduates from both faculties to present the knowledge and competencies acquired through their final year independent research projects. The overarching theme of the symposium is *"Empowering Innovation: Bridging Theory and Practice in Applied Science and Technology"*.

The symposium will serve as a platform for undergraduates to share and publish their latest research findings across five domains: Food Science and Chemical Technology, Natural Sciences and Technology, Sport Science and Physical Education, Engineering Technology, and Biosystems Technology. Consequently, URSTech & APSURS-2024 is expected to foster a high-quality research culture and nurture the intellectual curiosity of young researchers.

In spite of ongoing trade union actions, organizing this research symposium signifies a significant responsibility, and we are appreciative of the tremendous support from all academic members of both faculties and the University. As the Dean of the Faculty of Applied Sciences at Sabaragamuwa University of Sri Lanka, I wish to extend my sincere gratitude to the Vice-Chancellor, Sabaragamuwa University of Sri Lanka; Dean of the Faculty of Technology and his staffers; Keynote Speaker, Prof. Yutaka Noguchi; Plenary Session Speakers; Heads of the Departments of the FAPS and their academic staff; and the Organizing Committee of the URSTech & APSURS for their unwavering dedication in ensuring the success of this event. Special acknowledgement is also due to all the research supervisors of the final year undergraduates, the other academic, administrative, and non-academic staff members, and sponsors for their unwavering support and commitment in making this event a triumph.

It is my hope that this undergraduate research symposium will serve as a platform for students to display their work, gain valuable experience, and take a significant step toward achieving their academic and career objectives. Lastly, I extend my best wishes to all the presenters.

Professor E.P.N. Udayakumara
Dean - Faculty of Applied Sciences
Sabaragamuwa University of Sri Lanka

Message from the Symposium Chair

It is a great pleasure to express this message on behalf of the organizing committee of the URSTech & APSURS 2024. URSTech & APSURS 2024 is a joint symposium organized by the Faculty of Applied Sciences and the Faculty of Technology at Sabaragamuwa University of Sri Lanka. This is APSURS' third consecutive year, and at this time, the conference is being held in collaboration with the Faculty of Technology.

This event represents a significant milestone in the academic calendar, bringing together bright minds from diverse fields within our faculties. Our symposium aims to foster interdisciplinary collaboration, innovation, and the sharing of knowledge among undergraduate students, providing a platform to showcase their research and creative projects. URSTech & APSURS 2024 has brought together experts from both faculties under the theme "Empowering Innovation: Bridging Theory and Practice in Applied Science and Technology" to provide an opportunity for undergraduate students from a wide range of five disciplines to disseminate their research findings.

The abstracts contained within this book are a testament to the dedication, hard work, and intellectual curiosity of students of both faculties. They highlight a wide range of topics and cutting-edge research that address some of the most pressing challenges and exciting opportunities in science and technology today.

We are incredibly grateful to Professor Yutaka Noguchi from the Department of Electronics and Bioinformatics at Meiji University for being our motivational keynote speaker and joining with us to share his thoughts with our young scientists. I extend my heartfelt gratitude to the Vice-Chancellor of Sabaragamuwa University of Sri Lanka, Dean, Faculty of Applied Sciences and Dean, Faculty of Technology, for their excellent guidance in making URSTech & APSURS 2024 a success. I extend my deepest gratitude to faculty advisors, staff members and students who have contributed to the success of this symposium. Your commitment to academic excellence and research is truly commendable. Special thanks also go to our organizing committee, whose tireless efforts have made this event possible.

Thank you for your participation and support. We look forward to an engaging and enriching experience for all.

Dr. H. N. M. Sarangika
Symposium Chair - URSTech & APSURS 2024
Sabaragamuwa University of Sri Lanka

Keynote Address by Prof. Yutaka Noguchi

I am honored to extend my warmest greetings and best wishes for the success of URSTech & APSURS 2024, a collaborative symposium organized by the Faculty of Applied Sciences and the Faculty of Technology at Sabaragamuwa University of Sri Lanka. This year's theme, "Empowering Innovation: Bridging Theory and Practice in Applied Science and Technology," underscores the vital importance of integrating academic knowledge with practical applications to address global challenges.

This symposium is a proof to the university's dedication to fostering interdisciplinary collaboration and advancing the frontiers of applied science and technology. It provides an exceptional platform for researchers, scholars, and industry experts to share ideas, explore new horizons, and develop innovative solutions.

I am particularly pleased to see the involvement of fresh graduates from the Faculty of Technology and the Faculty of Applied Sciences. To these bright young minds, I extend my heartfelt congratulations and best wishes for a successful future. May your participation in this conference inspire you to tackle real-world problems with creativity and determination, and may you emerge as future leaders in your respective fields.

I would also like to express my sincere appreciation to the organizing committee for their hard work and meticulous planning, which have ensured the seamless execution of this event. Your dedication has created an enriching and impactful experience for all participants.

I look forward to the insightful discussions and fruitful collaborations that URSTech & APSURS 2024 will undoubtedly foster. May this conference be a resounding success and a beacon of innovation for years to come..

Professor Yutaka Noguchi
Meiji University
Japan

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Biosystems Technology

Biodiesel and Bioethanol Production Capacity Analysis from Salvinia in Sri Lanka

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This research study focused on providing a sustainable energy solution for future energy crises in the world. Today the world has turned to 3rd generation biofuels from algae, aquatic ferns/weeds and microbes. This study presented the biodiesel and bioethanol production capacity analysis from Salvinia in Sri Lanka. Salvinia samples were collected from a paddy field, Bandaragama, Sri Lanka and soxhlet apparatus with n-hexane (250 ml), chloroform: methanol (2:1 V: V) (250 ml) solvent systems were applied to extract lipids from dried Salvinia (5.00 g). The rotary evaporator was used to separate oil from the solvent-oil mixture. The first three oil extractions were done with n-hexane followed by extraction with chloroform: methanol mixture (166.6 ml: 83.4 ml). The free fatty acid test was done for both oils taken from separate solvents. Bioethanol production was started with the use of lab scale fermenter, and the measurable parts were measured correctly by using laboratory scale. Before beginning the fermentation process, the raw materials were pretreated with acid (H_2SO_4) (5 ml) and base (NaOH) (5 ml). The mixtures were heated at 60^{circ}C for 1 hr. After 7 days, the bioethanol was separated from the fermented mixture by using the rotary evaporator. Finally, the parameters such as viscosity (1.00 mm^{2}s^{-1}), density (0.99 gcm^{-3}), alcohol percentage (2.10%) and pH value (6.37 pH) were measured according to the ASTM standards for the quality requirements. The Anton Paar viscometer SVM 3001 was used to measure viscosity and density, the DMA 35 density meter was used to measure the alcohol percentage, and the APERA PC 9500 pH meter was used to measure pH value. In the biodiesel production, 0.35 ml, 0.32 ml, and 0.33 ml oil quantities were extracted by using n-hexane and 1 ml oil was extracted by using chloroform: methanol mixture. The oil extracted from n-hexane with a 1.12% FFA value and the oil extracted from chloroform: methanol had a 2.24% FFA value. Finally base pretreated 1hr rotary, heated ethanol sample was showed 14.27% highest ethanol yield, 6.37 pH value and 2.14% alcohol yield. The results of this study belong to Salvinia, which has a capacity to produce biodiesel (1 ml) and bioethanol (71 ml) from above mentioned quantities.

Keywords: *Aquatic Fern, Biodiesel, Bioethanol, Extraction, Free Fatty Acid*

Utilization of Diverse Sugar Industry Waste Materials for Enhanced Biogas Production

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Sugarcane is a widely used raw material for the production of sugar and ethanol. Several types of waste are generated during the sugar processing and alcohol production processes. These are bagasse, filter mud, waste water, and spent wash. Distillery spent wash is the unwanted residual liquid waste generated during alcohol production, and pollution caused by it is one of the most critical environmental issues. When this waste is discharged without treatment, they adversely affect ecosystems, by polluting the land and water cycle due to the existence of hazardous and acidic components. It contains has both organic and inorganic substances, and it has a high BOD, COD and low pH (4.2 - 4.5). Processes like composting, biogas production, etc. can be applied as a sustainable solution. Biogas production can be used as an alternative solution to the growing energy crisis. The objective of this research was to conduct a lab-scale test on sugar industry waste and test the sample with the highest gas yield from it on a pilot scale. In laboratory tests, biogas is produced from anaerobic digestion using airless syringes as 50 ml size biogas reactors. The mixture of spent wash-35 ml, bagasse-10 ml, and inoculum -5 ml (Sample-A), spent wash-35 ml, food waste-10 ml and inoculum- 5 ml (Sample-B) Spent wash-35 ml, filter mud-10 ml, and inoculum- 5 ml (Sample C) Spent wash- 45 ml and inoculum- 5 ml (sample D) with varied concentrations were used as substrates. Inoculum from cow dung was used as a source of microorganisms. According to the lab scale results, sample D generated the highest peak gas yield (207.45 cm^3) in the biogas unit, while sample B showed the lowest gas yield (138.36 cm^3). Sample D was carried out for the pilot scale test. The biogas production rate and flame quality were monitored, which showed a blue gas flame with high gas yield. Henceforth, the spent wash with cow dung mixture with 45 ml and 5 ml respectively has a very good potential to produce biogas. This approach provides a great sustainable waste recovery solution to spent wash waste by producing biogas renewable energy source.

Keywords: Bagasse, Biogas, Distillery Spent Wash, Filter Mud, Food Waste, Inoculum, Sugarcane

Phytochemical and Bioactivity Analysis of Leaf and Bark Extracts of *Salacia reticulata* (Kothala Himbutu)

Peiris B.A.A.O. , Gunasena M.D.K.M.[*], Millavithanachchi S.S. , Arunkobinath A. , and Dayasena Y.A.P.K.

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Salacia reticulata (Kothala Hibutu), an endangered medicinal plant native to Sri Lankan forests, is listed in the National Red List. Rich in bioactive compounds like Salacinol, Mangiferin, Kotanalol, Betulin-3-caffeate, and Morolic acid, it's sought after for its efficacy in managing diabetes and obesity. Sri Lanka's Salacia species market has potential for growth in pharmaceutical, and herbal medication industries. However, high demand and poor supply hinder its survival. This study was done to evaluate the bioactive compounds and their bioactivities in different parts of *S. reticulata* to find out the most suitable parts for different healthcare purposes aiming to use them effectively for medicinal practices. Two *S. reticulata* plants located at Haldummulla and Kahathuduwa areas in Sri Lanka were identified and they were authenticated by Royal Botanical Gardens, Peradeniya. Leaves and bark samples were collected from those plants and they were dried, subjected to soxhlet with ethanol as the solvent to extract phytochemicals and crude extracts were collected after rotary evaporation. Phytochemicals were screened using GC-MS and their bioactivities were determined. Total Phenolic Contents (TPC) were determined by the Folin-Ciocalteu method and antioxidant activities were determined by 2,2 Diphenyl-1-picrylhydrazyl (DPPH) assay. The antimicrobial activity of different samples was determined against *E. coli, Pseudomonas*, and *Staphylococcus*. Leaf samples collected from Kahathuduwa exhibited a higher TPC (36.5 ± 1.2 mg GAE g^{-1}) and antioxidant activity than the leaves and bark samples collected from Haldummulla. The leaf samples collected from Haldummulla exhibited stronger antimicrobial activity compared to other samples. According to GC-MS analysis, sixty-one important phytochemicals were identified with biological activities such as antidiabetics, antimicrobial, anticancer, anti-inflamatory, antioxidant and anti-obesity. Bioactivity of those phytochemicals showed the possible use of *S. reticulata* leaf and bark extracts in different pharmaceutical industries.

Keywords: *Antimicrobial, Bioactivity, GCMS, Phytochemicals, Salacia reticulata*

Bioactivity Analysis of Different Tea Grades Produced in Martin Bauer Hayleys

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Tea, a product of *Camellia sinensis* plant, is known for its global consumption and health benefits attributed to a rich composition of phytochemicals. Tea can be categorized into three main types, depending on the level of oxidation, as green tea, oolong tea and black tea. Broken Mixed Fannings (BMF) is a low-grade tea product which is used for the production of instant tea in Martin Bauer Hayleys. This study aimed to investigate the Total Phenolic Content (TPC), antioxidant activity, and antimicrobial efficacy of tea extracts against *Escherichia coli, Pseudomonas aeruginosa, Staphylococcus aureus* focusing on BMF and instant tea grades. Phytochemicals were extracted in to distilled water and ethanol and TPCs were evaluated by Folin-Ciocalteu method, antioxidant activity by DPPH assay and antimicrobial activity by using the Kirby-Bauer method. Results indicated that both BMF and instant tea grades exhibit antimicrobial activity against *S. aureus*, while green tea extracts showed higher antimicrobial activity compared to black tea. However, there was no antimicrobial activity observed against *E. coli* and *P. aeruginosa*. Total phenolic content analysis revealed that green tea showing higher phenolic content, particularly in instant tea grades. Furthermore, antioxidant assays suggest that BMF green tea extracts possess greater antioxidant potential than black tea. Instant tea powder also demonstrated antimicrobial potential, particularly against S. aureus, correlating with its concentration process during production. Phenolic content analysis indicated variations among samples, with instant green tea exhibiting higher phenolic levels. Antioxidant activity was notably higher in green tea extracts, attributed to its rich catechin content. The research also examines the extraction process's impact on bioactivity, revealing that ethanol extraction yields higher volumes and concentrations of phenolic compounds compared to water extraction. Overall, this study revealed varying antimicrobial efficacy among both BMF green and black teas, as well as instant tea powders, particularly in green tea. These results indicate the potential health benefits of instant tea and its applications in various industries.

Keywords: *Antimicrobial Activity, Antioxidant Activity, Broken Mixed Fannings, Instant Tea, Total Phenolic Content*

Marker-Assisted Foreground Selection for Drought Tolerance in Advanced Rice Breeding Lines (Bg 300/AR 93)

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The rice (*Oryza sativa*) plant is vulnerable to many biotic and abiotic stresses that lead to a substantial impact on rice production. Among them, drought is a major abiotic stress effect on each stage of the rice plant having a significant influence on the growth and yield. The development and identification of drought-tolerant varieties/lines is a challenge in rice breeding. The main objective of the present study was to identify drought tolerance genotypes in advanced breeding lines (BC_2F_8) by using morphological and molecular methods. The phenotypic screening was done at the rain shelter of Rice Research and Development Institute at Bathalagoda as a pot trail. Three advanced breeding lines each containing 10 plants were exposed to drought stress for 14 days at the 28 days after germination. The leaf rolling and drying scale was measured to study the drought sensitivity as per the International Rice Research Institute guideline. For the molecular studies, DNA extraction was done by the CTAB method. Three SSR markers namely RM 573, RM 569, and RM 231 which are linked to qDTY 2.3 drought tolerance QTL were used for the PCR amplification to test the polymorphisms between the parents. All plants in breeding line number three showed low leaf rolling index and were selected as drought tolerant while all plants in the other two lines were drought susceptible. The microsatellite markers RM 569 and RM 231 showed clear polymorphisms between the parents (Bg 300 and AR 93) in the 2% agarose gel which were used for the screening of the selected plants from the phenotypic screening. Two plants in breeding line three were shown the unique allele of drought-tolerant parent (AR 93) for both RM231 and RM569 markers and all other plants showed different alleles for the same markers. The identified drought-tolerance plants will be used for further advancement at the Rice Research and Development Institute of Bathalagoda.

Keywords: *Drought Tolerance, Marker-Assisted Selection, Rice, qDTY 2.3 QTL, SSR Markers*

Feasibility Study on Organic Fertilizer Production from Coconut Processing Wastewater Sludge

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Coconut processing sludge is a byproduct of the coconut oil and milk extraction process. This sludge, often regarded as waste, contains significant amounts of organic matter and nutrients, making it potentially valuable for agricultural applications. This study expected to produce different organic fertilizer mixtures using the sludge to mitigate the environmental problems when it is discharged into the environment and to introduce composting as a viable income method to the processing plants. Three treatments, Treatment 01 : Glirizidia Leaf + Grass + Jack fruit leaf + sludge, Treatment 02 : Glirizidia Leaf + sludge and Treatment 03 : Jack fruit leaf + sludge mixtures were prepared with 50% sludge and rest with the plant matter addition. Commercially available compost was used as Treatment 04 and pure soil was used as Treatment 5 the control. Sludge was collected from a wastewater treatment plant of prominent coconut processing factory in Loluwagoda. Nitrogen, Phosphorus and Potassium levels was measured in the prepared fertilizer mixtures and the growth performance including shoot length was measured for a period of 28 days and the final dry matter content was measured using a field trial and the data was analysed using R software using ANOVA procedure and Duncan's multiple range test for mean separation at an α value of 0.05. According to the nutrient analysis, highest number of Nitrogen, Phosphorus, Potassium values was observed in treatment 01 with 0.8%, 1.16% and 0.67% respectively. This was better than the Treatment 4. The growth performance shows effect of fertilizer on the shoot length was non-significant while Treatment 01 showed the highest value of shoot length increment. Treatment 01 was also significant for increment of dry weight. Thus, fertilizer mixture 01 was selected as the best fertilizer mixture for the proposed fertilizer plant in Loluwagoda.

Keywords: *Wastewater, Sludge, Growth Performance, Coconut, Organic Fertilizer*

Microcrystalline Cellulose Extracted from Corn Husk as an Excipient for Solid Dosage Formulations

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Microcrystalline cellulose (MCC) is a widely utilized pharmaceutical excipient, highly valued for its excellent binding performance, compressibility, and biocompatibility. However, the conventional methods for producing MCC often involve resource intensive and high cost processes. Corn husk, an abundant agricultural waste, represents a promising source of MCC due to its high cellulose content and sustainable availability and previous studies have suggested the possibility of using corn husk to produce pharmaceutical grade cellulose economically. The current study explores the potential of utilizing MCC extracted from corn husk, as an excipient for solid dosage forms, offering an alternative to conventional MCC sources. Initially, corn husk was subjected to washing, drying and milling in order to remove impurities and enhance cellulose accessibility. Subsequently, the pretreated material underwent alkali treatment, bleaching and acid hydrolysis followed by purification. Obtained MCC yield was 30.80%. The extracted MCC was characterized by X-ray diffraction (XRD) and Fourier-transform infrared spectroscopy (FTIR). XRD analysis indicated high crystallinity with the characteristic diffraction peaks. The FTIR analysis demonstrated all characteristic peaks of MCC. The compatibility of extracted MCC as a tablet excipient was assessed by comparison to USP pharmacopeial specifications for powdered MCC. The extracted MCC met the pharmacopeial specifications including pH (6.82), moisture content (0.4%), water retention value (171.83%) and water soluble substances (0.2%). The extracted MCC compered well with USP standards in terms of bulk density (0.36 gcm^{-3}), tapped density (0.44 gcm^{-3}), angle of repose (42°), Hausner's ratio (1.2) and Carr's index (17.44%). The finding of this research indicates that MCC, extracted from corn husk is indeed a viable substitute for commercial MCC, highlighting its potential for the development of sustainable and cost-effective pharmaceutical formulations.

Keywords: *Pharmaceutical Excipients, Microcrystalline Cellulose, Corn Husk, Solid Dosage Formulations*

Microcrystalline Cellulose Derived from Banana Stem as an Excipient for Solid Dosage Formulations

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Cellulose, a naturally abundant polymer found in plants, is an excellent tablet excipient due to its biocompatibility, utility and sustainability. This study investigated the use of microcrystalline cellulose (MCC) extracted from banana stems (*Musa acuminate*) as a potential substitute for commercial MCC. Banana stems, an agricultural waste, contain high cellulose content (about 50%). Microwave heating method (Liquefaction, Delignification and Bleaching) was used to extract MCC. The microwave heating approach for MCC extraction resulted in a significant 40.7% yield, demonstrating the effectiveness of this extraction technology. Characterization by FTIR Spectroscopy demonstrated all peaks representing the characteristic groups present in commercial MCC. XRD analysis indicated high crystallinity for extracted MCC, along with the characteristic diffraction peak at $22.25°$. The suitability of the extracted MCC as a tablet diluent was assessed by comparing its physical and chemical properties to those of commercial MCC. Quality studies for rheological properties revealed promising results for banana stem-derived MCC. MCC had an average angle of repose of 46.22 degrees, demonstrating the good flow characteristics required for successful tablet manufacturing. Carr's index of 5% indicated good compressibility, ensuring consistent tablet compression, whilst Hausner's ratio of 1.05 stressed great flowability, preventing clogging during processing. Water-soluble ingredient tests were performed to determine purity, finding a minimal 7.1 mg average sample residue quantity. The reported average moisture content of 6.02% emphasizes the importance of maintaining controlled moisture levels for stability and preventing degradation. Furthermore, the average water retention value of 91.8% highlights the material's capacity to retain moisture, which ensures formulation stability overtime. The findings demonstrate that MCC extracted from banana stems is a feasible alternative to commercial MCC. The study supports the development of sustainable and cost-effective solutions for the pharmaceutical industry, highlighting the potential of banana stem-derived MCC as a tablet excipient.

Keywords: *Banana Stems, Microcrystalline Cellulose, Rheological Properties, Tablet Excipient, Tablet Diluent*

Reduce the Chemical Oxygen Demand (COD) of Palm Oil Mill Effluent by Using Biomass Fiber and Boiler Ash in the Palm Oil Industry

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The high Chemical Oxygen Demand (COD) value of the effluent water generated from the palm oil industries is a significant problem for their production processes. As a solution to this problem, many industries are using chemicals as an absorbent to reduce the COD value of their effluent water. It will increase the water treatment cost of the company and generate hazardous waste inside the company. As a solution for this issue, this study is focused on finding biodegradable absorbent materials by using waste materials generated from the palm oil production process. Palm oil fruit fiber and boiler bottom ash are used as the biodegradable absorbent for this experiment. Filter was created by using three layers of different sizes rocks, absorbent (fiber or ash), and cotton stuffing. Two experiments were conducted by using 100 g and 200 g of fiber as absorbent. Another two experiments were conducted by using 500 g and 1 kg of boiler ash. For these four experiments, 2 kg of different sizes of rocks less than 1 cm, 1 cm - 2 cm, 2 cm - 4 cm, and 500 g of cotton stuffing were used. 4 L of palm oil mill effluent was sent through this filter and the output water was collected after completing the 12 hour filtering and measure the COD value of the filtered water. When 100 g and 200 g fiber are used, the COD value of the water has reduced respectively by 64,000 ppm and 65,800 ppm. And 500 g and 1 kg boiler ash are used, the COD value of the water has reduced respectively by 16,000 ppm and 40,100 ppm. According to these results, palm oil fruit fiber has shown high COD absorbent performance than the boiler ash. Both materials can be used as biodegradable absorbents but palm oil fruit fibers are more suitable than the boiler ash.

Keywords: *Absorbent, Boiler Ash, COD, Fruit Fiber*

Identification of Submergence Tolerant Rice Lines from BC_2F_8 Population (BG360×Samba Mashuri SUB-1) Using Morphological and Molecular Screenings

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Rice (*Oryza sativa* L.) serves as a staple food for a significant portion of the world's population, particularly in Asia. However, submergence due to flash floods greatly affect rice cultivation, particularly in lowland areas of Sri Lanka. Developing submergence-tolerant rice varieties is crucial for mitigating crop losses due to flash floods. Marker assisted breeding is highly advantageous in the early generations of breeding programs, as it allows for the elimination of plants with unfavourable genes while selecting the individuals with the interested allele. The *SUB1 QTL* on chromosome 9 in the rice genome accounts for 70% of the phenotypic variation for survival under submergence in seedling stage. This study aimed to enhance submergence tolerance in the popular Sri Lankan rice variety Bg360 by identifying submergence-tolerant individuals in the BC_2F_8 population generated by Bg360/Samba Mashuri SUB1 cross through morphological and molecular screenings. Morphological screening focused on plant height and survival rate under submerged conditions, while molecular screening targeted the presence of the *SUB1* QTL using RM23869 SSR marker that showed polymorphism between parents. Twelve BC_2F_8 lines exhibiting reduced shoot elongation and high survival rates after de-submergence were selected based on morphological screening. Molecular screening confirmed the presence of resistance allele of the *SUB1* QTL in six of these lines, validating their resistance for submerge conditions. The integration of morphological and molecular screenings facilitated the identification of promising rice lines with enhanced submergence tolerance, offering prospects for developing resilient rice varieties suited for submerged conditions. This study highlights the significance of employing marker-assisted selection in rice breeding programs to advance the development of submerge tolerant rice varieties.

Keywords: *MAB, Rice, SSR Markers, SUB1 QTL, Submergence*

Evaluation of the Effect of Rubber (*Hevea brasiliensis*) Leaf Stages for the Establishment of Circular Leaf Spot Disease Pathogens

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The rubber tree (*Hevea brasiliensis*) is a crucial crop as it is the primary global source of natural rubber. Rubber tree is susceptible to various foliar diseases, which can result in a decrease in latex yield. A new leaf spot disease of rubber trees has been identified many rubber-producing countries. This disease shows characteristic circular spots on leaves and named as the circular leaf spot disease. This is a mixed fungal disease and the primary pathogen group has been identified as *Colletotrichum* spp. Pestalotioides is the most abundant pathogen group showing a comparatively low pathogenicity level. This study investigated the effect of leaf stages on the establishment of the Circular leaf spot disease pathogens. Four pathogen isolates which had been initially identified by the RRISL were used in this study: *Collototrichum siamense, Collototrichum fructicola, Neopestalotiopsis* spp. and *Pseudopestalotiopsis* spp.. The effect of leaf wounding on the lesion development is also tested. The pathogen was cultured and the pathogenicity tests were carried out on detached leaves to verify the most pathogenicity stage. Copper brown, apple green, semi matured and matured stages of two *Hevea* clones: RRIC 100 and RRIC 121 were tested. Variation in the pathogenicity was observed in different leaf stages inoculated with different *Colletotrichum spp* and Pestalotiopsis isolates. Juvenile leaves were more susceptible than the matured leaves. Results also showed that wounded leaves were significantly more susceptible to infection than non-wounded leaves. These results appear to correlate well with field observations and will be useful in the control, management and forecast strategies for rubber plantations in Sri Lanka.

Keywords: *Circular Leaf Spot Disease, Colletotrichum spp., Hevea Brasiliensis, Pathogenicity, Pestalotioides*

Development of Drinking Yoghurt Using Milk Solid Loses in the Production Process of Milco Company

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Yoghurt is a widely consumed dairy product which is produced by the fermentation of milk by specific bacteria, known as starter culture. Drinking yoghurt is a special type of yoghurt that has a thinner consistency and can be consumed as a refreshing beverage. This study aimed to develop a drinking yoghurt using milk solid losses at the production process and to minimize economic loss, and optimize the production plant in Milco. The milk solid losses were collected from different stages of the milk production process, such as yoghurt, curd, and pasteurized milk, and their qualities (fat content, keeping quality, density, pH) were evaluated. Drinking yogurts were prepared following an optimized protocol and their physiochemical properties (total solid, fat, pH, acidity, viscosity, moisture content), microbiological properties were evaluated and compared with already available drinking yoghurt produced without milk solid losses. Sensory evaluation was done considering sensory characteristics; appearance, taste, color, odor, mouth feel, aftertaste, and overall acceptability. According to the results, developed drinking yoghurt had similar microbial counts as the control drinking yoghurt without milk solid losses indicating that the milk solid losses did not affect the safety and acceptability of the products. Sensory evaluation revealed that, the strawberry flavoured drinking yoghurt is the most favoured product. According to the physicochemical and microbial properties, 15 days shelf-life period was observed for developed drinking yoghurt. The study concluded that the milk solid losses could be used as the starting ingredient for the development of drinking yoghurt, and reduce the waste of the company.

Keywords: _Drinking Yoghurt, Milco, Milk, Solid Losses, Waste Management_

Assessment of Bioethanol Production Potential from Diverse Waste Substrates with Different Pretreatment Conditions in the Context of Sri Lanka

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Rice straw is produced as a by-product in the rice world and in Asia, and it is important to find a sustainable solution for them. This research explores the challenges and opportunities of using rice straw waste for sustainable biofuel production. These sustainable solutions address environmental issues while focusing on ethanol production. The study examines various pretreatment methods, including NaOH, H_2SO_4, and NH_3, to remove lignin from rice straw for ethanol production. Design a 1 L reactor for the rice straw samples. The reactors were made by piercing the lids and inserting saline tubes, and the inside and outside of the reactor lids were well sealed. The straw samples were pretreated with NaOH, H_2SO_4, and NH_3. Here 8 g of yeast and 125 ml of water are added for hay samples. The reactors are then sealed well and kept for a week for fermentation. A rotary evaporator is used to purify the ethanol after the fermentation process. Maintain the speed of the evaporator at 800 rpm and its temperature between 74 °C - 78 °C during the time. Then, the kinematic viscosity and density meter are used to check the density and viscosity of the separated ethanol, and the percentage of ethanol present in the purified samples is obtained by the hand-held alcohol meter. Comparing the ethanol yield of the samples, the highest ethanol yield is found in the NaOH pretreated rice straw sample and its ethanol yield is 8.59% (w/w). The ethanol yield of H_2SO_4 pretreated straw and NH_3 pretreated straw was 7.28% (w/w) and 7.14% (w/w) respectively. According to these results, the highest amount of ethanol was produced in the sample pretreated with NaOH 4% (w/w). More ethanol can be obtained from the sample pretreated with 4% NaOH, thereby solving the rice straw waste and also solving the energy crisis through sustainable ethanol production.

Keywords: *Bioethanol, Glycerin, Poultry Waste, Pretreatment, Rice Straw*

In Vitro and Ex Vitro Propagation of *Microsorum* spp. (Blue Oil Fern), *Platycerium* spp. (Staghorn Fern) and *Sphaeropteris crinita* (Tree Fern) Through Spore Germination

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Microsorum spp., Platycerium spp. and *Sphaeropteris crinita* are ornamental ferns which are epiphytic in nature and reproduce through transformation of generation. From them *Sphaeropteris crinita* is considered as endangered species on the National Red List. These ferns possess unique economic value due to their distinct characteristics and diverse applications in floriculture, landscaping, and even in medicine. However, conventional propagation via spores or pups is slow and vegetative propagation is also hampered by low multiplication rate. Therefore, this research aimed to explore the possibility of in vitro regeneration of above-mentioned ferns to overcome the limitations of conventional propagation methods and compare it with ex vitro cultures. Surface sterilization protocol was optimized before initiate the in vitro cultures. Spores of three different ferns were surface sterilized using different concentrations of Clorox for 10 minutes followed by 70% ethanol with different exposure times and they were cultured on liquid MS medium. Sterilized spores were transferred to MS, half MS, Knudson C and MS medium supplemented with GA3 to find out the best culture medium for in vitro propagation. Sterilized spores were transferred into different potting mixtures to determine the best ex vitro propagation medium. According to the results, 10% Clorox with 10 minutes exposure time followed by 70% alcohol for 5 seconds was the best sterilization protocol for all three types of ferns with lower contamination and higher survival percentage. Half MS medium was found to be the best medium for in vitro propagation of spores with lower days taken to germinate (36.07±1.5). The best media for ex vitro propagation was coir dust:sand 1:1 with lower number of days taken to germinate (39.4±1.5). Results concluded that development of faster and more efficient propagation techniques will not only benefit the cultivation of these valuable ferns but also contribute to the conservation efforts for the endangered species.

Keywords: *In Vitro Culture, Microsorum spp., Platycerium spp., Sphaeropteris Crinite, Spore Germination*

Pyrolysis as a Sustainable Waste Management Method for Oil Palm Empty Fruits Bunch Fiber

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Oil palm Empty Fruit Bunch (EFB) fibre, a byproduct generated during the palm oil extraction process, consists of the residual biomass left behind. EFB fibres are known for their bulkiness, which poses challenges in storage, transportation and handling, thereby elevating logistical expenses and minimizing the utilization of valuable space. This study examines the use of oil palm EFB through pyrolysis as an eco-friendly waste management approach. The research explores into the pyrolysis of EFB using a lab-scale fixed bed batch type reactor, focusing on analysing the moisture content and calorific value of the raw material. Additionally, the characterization of bio-oil properties such as calorific value, flash point, pH, density, dynamic viscosity, and kinetic viscosity. Analysis of the syngas composition was done using a portable infrared syngas analyser. The temperature of pyrolysis reactor was varied in the range between 300-450 °C. The raw EFB calorific value was obtained as 17.74 MJkg^{-1} and bio-oil calorific value was obtained as 30.0 MJkg^{-1}. The production of biochar was 45% w/w and bio-oil were 25% w/w of total products. Flashpoint of oil was obtained as 36 °C. Produced bio-oil exhibited a density of 1. 02462 gcm^{-3} with a dynamic viscosity of 1.4628 mPas. The kinematic viscosity was 1.4277 mm^{2}s^{-1}. When syngas analysis calorific value was obtained at 11.7 MJkg^{-1}, CO and H_2 were obtained as 38.66% and 0.67%. The results show positive potential of pyrolyzing the EFB while producing higher energy products and also minimising the use of valuable space utilization.

Keywords: *Bio Oil, Pyrolysis, Oil Palm, Empty Fruit Bunches, Syn Gas, Fixed Bed*

Sustainable Biofuel Generation of Natural Rubber Sludge Waste Using Pyrolysis Process

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Sri Lankan Rubber glove manufacturing companies generate averagely 2000 kg of Natural Rubber (NR) waste sludge in daily basis. Pyrolysis technology can play an important role in energy generation as it creates valuable products while addressing the crucial issue of waste reduction. This study investigates the potential of $CaCO_3$ contaminated natural rubber sludge waste pyrolysis as a sustainable solution and explore the significance of pretreatment methods to remove $CaCO_3$ in enhancing the efficiency of the pyrolysis process. Pyrolysis experiments were carried out using a lab-scale fixed-bed batch type reactor in three distinct treatments: Treatment 01- HCl-pretreated NR sludge waste, Treatment 02-non-pretreated NR sludge waste, and Treatment 03-water-washed NR sludge waste. The resulting NR sludge from pretreatment went through pyrolysis process and underwent the examination of moisture content and calorific value. The bio-oil derived from the process was assessed for fuel properties. Moisture contents of raw NR waste in treatment 01, treatment 02 and treatment 03 was 22.26%, 22.27%, 26.51% and calorific was 27.79, 27.45, 30.25 respectively in value MJkg^{-1}. The pyrolysis rector operated in an average temperature of 350 °C. The percentage values of the produced bio-oil in sample 1,2 and 3 were 20.65%, 18.45%, 28.44% and char percentage values were 44.56%, 84.45%, 33.11% respectively. Comparative analysis revealed that water-washed natural rubber waste produces the highest bio-oil yield. Derived bio-oil shows density of 859.8, 857.30, 830.33 respectively in kg m^{-3}, kinematic viscosity 1.57 mm^2/s, 1.48 mm^2/s, 1.05 mm^2/s with pH values of 2.42, 2.33, 1.94 and heating value 44.47, 44.68, 39.47 respectively in MJkg^{-1} where the HCl treated NR waste was selected as the best treatment which achieved the highest heating value. According to the findings, the NR sludge waste pyrolysis shows satisfactory potential in energy generation while reducing the problem of waste management.

Keywords: *Bio-oil, Pyrolysis, Pretreatment, Natural Rubber Sludge, Waste Management*

Identification of True-Hybrids of the *Saccharum officinarum* and *Erianthus arundinaceus* Progenies by Molecular Markers

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Although *Saccharum officinarum* is a high sugar accumulating variety, it is susceptible to many biotic and abiotic stresses. *Erianthus arundinaceus* is a wild relative of sugarcane with pest and disease resistance, tolerance to environmental stresses, and better ratooning than sugarcane. New variety development through hybridization between *S. officinarum* × *E. arundinaceus* has great potential in producing superior and well-adopted new sugarcane varieties. Therefore, the objective of this study was the identification of true-hybrid progenies of the cross between *S.officinarum* × *E. arundinaceus* to determine how successful the intergeneric crosses in sugarcane. In this study, twenty crosses were randomly selected from the 2022 cross-list of the sugarcane research institute which used *S. officinarum* as the female parent and *E. arundinaceus* as the male parent. Germinated seedlings at the age of two and a half months were used for the total genomic DNA extraction. Extracted DNA of respective parents and progenies were subjected to the Polymerase Chain Reaction with 5 SSR markers. Polyacrylamide gel electrophoresis was done for the amplified PCR products to observe polymorphisms. Only the P13 SSR marker shows a significant level of polymorphisms between the two parents used for the crosses. It was chosen as the best marker that can be used to identify true hybrids in these crosses. Two hybridized plants were identified in 22-407 cross and all plants in the other four progenies were not true hybrids. The present study implies that the making of the inter-generic hybrid between *S. officinarum* and *E. arundinaceus* is possible and successful despite it having less hybridization success rate. The results of the present study will be used in the varietal improvement programs to screen the true hybrids between *S. officinarum* and *E. arundinaceus* by the Sugarcane Research Institute of Sri Lanka.

Keywords: *Erianthus Arundinaceus, SSR Marker, Progenies, Saccharum Officinarum, True-hybrid*

Optimizing Standard Batch Processing Time in Tablet Manufacturing in Pharmaceutical Industry

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Efficient production processes are vital in the pharmaceutical industry to meet the increasing demand for high-quality medications. This research focused on optimizing the standard batch processing time in tablet manufacturing, centered on three different products A, B, and C, each with distinct production processes. It commenced with a thorough review of existing batch processing methods, aiming to identify potential causes and bottlenecks. Key factors such as equipment utilization, raw material handling, and process parameters were analysed to develop a comprehensive approach to streamline tablet manufacturing. A timeline was established in accordance with established standard times to analyse instances of exceeding batch durations. Subsequently, Root Cause Analysis and 5-Why Analysis were conducted for each identified cause and bottleneck. Knowledge and training, machine type, tooling capacity, machine breakdowns, and changeover time were some of the causes identified, facilitating the identification of potential solutions. These solutions were then implemented in batch operations, including the training of operators, capacity analysis, determining the maximum output capacity of the compression machine, analysing downtime history, optimizing the preventive maintenance schedule, creating a sample plan for swab samples, and establishing a machine setting checklist. The ensuing execution of batches according to these refined processes led to the identification of the most effective means to significantly reduce overall processing time. Through the implementation of targeted solutions, the processing times for Product A was reduced to 17 hours and 9 minutes, showing a 40% optimization from historical data and staying below the 5% exceeding limit. Product B was completed in 29 hours and 14 minutes, close to the 5% exceed limit, while Product C's time was reduced to 26 hours and 38 minutes, reflecting a 55% reduction from initial times. It was anticipated that by continuing to implement these solutions, the targeted line efficiency of 100% could be achieved in the future.

Keywords: Batch Processing, Optimizing, Pharmaceutical, Root Cause Analysis, Standard Time

Preparation and Evaluation of *Ocimum tenuiflorum* Leaf Emulsion for Topical Applications

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Herbal emulsions offer numerous advantages over synthetic emulsions, including enhanced safety, therapeutic benefits, environmental sustainability and greater consumer preference. *Ocimum tenuiflorum* (Tulsi), with its rich history of therapeutic benefits, is renowned for its skincare properties due to its phytochemical composition including antioxidant, anti-inflammatory and antimicrobial activities. The current study explores the potential of *Ocimum tenuiflorum* based emulsions in skincare formulations. The leaf extract of *Ocimum tenuiflorum* was obtained by soxhlet using ethanol as solvent. Three oil in water emulsions (F1, F2, F3) were formulated using the *Ocimum tenuiflorum* leaf extract at 4% (F1), 5% (F2), and 6% (F3) with pure coconut oil, lecithin, polyethylene glycol, Phenoxyethanol, micro-crystalline wax, and purified water at different proportions. Subsequently, their physical stability was assessed under 37 °C, 40 °C, and 4 °C to enable the selection of the most stable formulation. The optimal formulation, based on stability studies, was chosen for further evaluation of physical and chemical properties, including organoleptic properties, phase separation, centrifugation, pH, washability and spreadability under room temperature, accelerated conditions, and under refrigeration for three weeks. Formulation F2 was selected as the optimal formulation based on the preliminary stability study. During further evaluation, F2 exhibited superior spreadability at 40 °C (18.6 cms^{-1}) and pH of F2 was recorded at 5.36 indicating the applicability on human skin. Visual inspection of F2 revealed good physical stability with no phase separation under the tested storage conditions over three weeks. The formulation F2 also demonstrated easy washability, enhancing their suitability for practical skincare use. Further, the formulation demonstrated good organoleptic stability in terms of colour, odour and texture under various conditions. The results suggest that the F2 formulation presents potential as medium for topical applications in skincare and medicinal formulations, emphasizing the importance it of as a valuable natural resource in holistic healthcare approaches after further optimizations.

Keywords: *Ocimum Tenuiflorum, Emulsions, Oil in Water, Stability Studies*

Analysis of Ethanol Production Potential from Fruit Waste in "Helabojun Hala" at Sabaragamuwa University of Sri Lanka

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For the survival of the world needs energy. In the present world, most of the activities in every field need various kinds of energy. Among these energy sources, fossil fuels play a vital role. With time fossil fuels are depleting and they are going to end because they are non-renewable energy sources. As a result, we need to move towards a solution. As a solution, most of are pay attention to the bioenergy section. Due to they are renewable, cheap, and safe energy sources. The objective of this study is to find the ability to produce ethanol from fruit waste generated in "Helabojun Hala" at the Sabaragamuwa University of Sri Lanka. This study was done using three types of fruit waste that are mango waste, papaya waste, and watermelon waste. These fruit wastes were fermented using *Saccharomyces cerevisiae*. The mixtures of this fruit waste are fermented in four reactors with different amounts of yeast respectively 3 g, 5 g, 7.5 g, and 10 g in room temperature under the anaerobic condition. And the sample with 5 g yeast produced the highest volume of ethanol. The weight of the fruit waste mixture was 150 g and the highest ethanol production was 48 ml. Produced ethanol had 5.7% of ethanol percentage and the kinematic viscosity was $1.5147 \ \mathrm{m^2 s^{-1}}$ and the density was $0.9861 \ \mathrm{kgm^{-3}}$. Per day, the average fruit waste generation of this facility is around 1000 kg and the per day ethanol production capacity is 320 ml. When we consider one month more than 9 L of ethanol can be produced by using this fruit waste. If we can implement ethanol production using this waste material it will be a sustainable waste management solution for the fruit waste and the generated ethanol can be used for general activities of the university.

Keywords: *Bioethanol, Waste Management, Fruit Waste*

Formulation and Evaluation of Herbal Shampoo Using Natural Surfactants from *Zingiber zerumbet* Inflorescence

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Herbal shampoos incorporate natural ingredients derived from plants, herbs and botanical extracts. Shampoo products available in the market often contain synthetic surfactants that may cause skin flaking, roughness and corrosion of hair follicles. The viscous exudate present in the inflorescence of *Zingiber zerumbet* is a bio-surfactant as well as a natural conditioner that has been widely used traditionally for hair care purposes. This research focused on formulating and evaluating a herbal shampoo using Zingiber zerumbet inflorescence's exudate as a substitute for synthetic surfactants. Two different shampoo formulations (F1, F2) were prepared by mixing the components in different composition. Based on the thickness and preliminary observations, formulation F2 (Inflorescence exudate 30%, *Psidium guajava* extract 10%, *Aloe barbadensis* extract 10%, Rice bran oil 5%, 0.1 M NaCl 10%, Xanthan gum 1%, Glycerin 5%, Vitamin-E oil 2.5%, Phenoxyethanol 1%, Essential oil 1%, Pearlizer 10%, Indigofera leaves extract 10% and Distilled water) was selected for further evaluation of visual assessment, dirt dispersion, cleaning action, surface tension, foaming ability, foam stability, skin irritation and other performance tests. pH of F2 formulation was recorded as 5.43 indicating its suitability for the acidic mantle of the scalp. F2 formulation further demonstrated good cleaning action (22.3%), better foaming capacity (56 ml), better solid content (26.95%), quick wetting time (2 s), better surface tension (41.43 dynescm^{-1}) and good viscosity (52.881 mPas). Microbial growth assessed by colony counting method reported low microbial count for the formulation. Skin irritation test was performed on a sample of 20 consenting consumers and the findings indicated that the herbal shampoo was safe to be used on human skin. In conclusion, the formulated herbal shampoo proved to be safe and effective and the results further established the *Zingiber zerumbet* inflorescence's viscous exudate as a feasible and sustainable alternative to synthetic surfactants.

Keywords: *Herbal Shampoo, Natural Surfactant, Zingiber zerumbet, Bio-surfactant*

Evaluation of the Molecular Level Diversity of Pestalotioides Isolated from Circular Leaf Spot Disease of *Hevea brasiliensis*

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The rubber tree (*Hevea brasiliensis* Mull. Arg.) is the major source of natural rubber in the world. Circular Leaf Spot Disease (CLSD) has become a significant threat for rubber plantations worldwide. Its effect on rubber trees is detrimental causing almost 100% defoliation and more than 50% yield reduction. The CLSD caused by *Collectrichum spp* and Pestalotiodes genera has caused an epidemic in many Asian rubber-growing countries. The Pestalotioides have been categorized into three genera namely, *Pestalotiopsis, Neopestalotiopsis* and *Pseudopestalotiopsis*. Species of *Pestalotiopsis* occur commonly as plant pathogens, and represent a fungal group known to produce a wide range of chemically-diverse metabolites. The main objective of this study was to evaluate the variability of the Sri Lankan population of pestalotioides causing CLSD. In the present study, molecular level diversity of pestalotioides isolates from the Rubber Research Institute of Sri Lanka (RRISL) stock culture collection was evaluated by Randomly Amplified Polymorphic DNA (RAPD) technique. Therefore, the information generated by this study is expected to be important for molecular biological research on the fungus and for the formulation of more effective management strategies over the disease. DNA was extracted from each isolate using the protocol described in DNeasy Plant Mini Kit (cat. nos. 69104 and 69106) and amplified with five RAPD primers. Data were analyzed by the statistical software, Minitab. The results exhibited a vast molecular-level diversity among 18 pestalotioides isolated from CLSD in H. *brasiliensis*. According to the resulting dendrograms, there are genetic diversities and similarities among the isolates of *Pestalotiopsis* and they probably have one common origin.

Keywords: *Circular Leaf Spot Disease (CLSD), Hevea Brasiliensis, Pestalotioides, Pestalotiopsis, Randomly Amplified Polymorphic DNA (RAPD)*

Feasibility Study of Producing Biodiesel from Coconut Processing Waste Oil

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Waste coconut oil is a byproduct of coconut milk processing which can be converted into biodiesel as a sustainable substitution to petroleum diesel. Three samples were analysed: Sample 1: mix of waste red oil and coconut sludge, Sample 2: pure coconut waste sludge, and Sample 3: coconut waste sludge enriched with calcium carbonate. The process involved centrifugation to separate the coconut waste oil layers, which was then followed by transesterification to produce crude biodiesel and transformed in to purified biodiesel. Thermochemical properties such as calorific value, kinematic viscosity, density, and flash point was analysed using different scientific methods for each prepared sample. Ultimately the results were compared with commercially available biodiesel for quality. Sample analysis showed that CV ranged from 32.184 $MJkg^{-1}$ for Sample 3 to 43.8 $MJkg^{-1}$ for Sample 1, showcasing the high energy potential of the biodiesel samples. Sample 2 exhibited the highest kinematic viscosity at 34.495 mm^2s^{-1}, while density values varied from 0.8868 gcm^{-3} for Sample 2 to 0.9128 gcm^{-3} for Sample 3. Flash points ranged from 45.5 °C for Sample 1 to 75.5 °C for Sample 2, with Sample 3 measuring 58.5 °C. The daily production of 30 liters of biodiesel from 120 liters of waste showcases its potential as a sustainable alternative fuel source. Based on the calorific value, the production potential of biodiesel from coconut waste oil high and is commercially feasible.

Keywords: *Biodiesel, Calorific Value, Coconut Sludge, Flashpoint, Transesterification*

Evaluation of Survivability of the Causative Agents of the Circular Leaf Spot Disease in Leaf Litter of Rubber Plantations in the Kalutara District

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Rubber (*Hevea brasiliensis*) is a deciduous plant and one of the major industrial crops. Rubber latex is utilized to manufacture medical devices, surgical gloves, aircraft, and car tires, cloths, toys and many more. Currently rubber plantations are facing disease named circular leaf spot disease (CLSD), which reduces latex quality and causes significant losses. The disease is spreading among Sri Lankan rubber plants, causing leaf fall and affecting latex yield. The Rubber Research Institute of Sri Lanka reports that *Collectricum* spp. and Pestalotiopsis are playing a synergistic role in causing this new leaf fall disease. This research was conducted to evaluate the survivability of causative agents of CLSD in the leaf litter. As per the method, leaf litter samples were collected from the five rubber plantations in Kalutara district and dilution series were prepared for culture initiation followed by pathogen isolation. Their morphology was observed and identified according to their colony and conidial characteristics; colony morphology, colony color, spore size, and spore shape. A pathogenicity test was performed using the isolated *Collectricum* spp. with non-wound and wounded rubber leaves using distilled water as the control. Different colony morphology characteristics and colony colors were shown on the upper and lower surfaces of isolated *Collectricum* spp. from five rubber plantations. All the isolated *Collectricum* spp. caused lesions on detached rubber leaves after the pathogenicity test. Based on the results of this study, it can be concluded that *Collectricum* spp. can survive in leaf litters of rubber plantations and have been found to affect circular leaf spot disease through pathogenicity tests.

Keywords: *Circular Leaf Spot Disease, Collectricum Spp, Leaf Litter, Pestalotiopsis Spp, Rubber*

Detection of Causative Agents of the Circular Leaf Spot Disease in the Soil Collected from Infected Rubber Plantations in Kalutara District

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Rubber (*Hevea brasiliensis*) is one of the important crops as it is the main source of natural rubber (NR) worldwide. Rubber trees are prone to a wide range of foliar diseases, which leads to a declining latex yield. A new leaf fall disease was reported in 2019 in Sri Lanka and researchers claim that the causal organism of the disease is either *Colletotrichum* spp. or Pestalotioide group. The management of the disease has become challenging as the infection occurs several rounds of the year due to the presence of the inoculum in the environment. This study aimed to identify the survivability of causative pathogens in the soil. Soil samples were collected from five rubber plantations in Kalutara district, and three samples were taken from different locations within the same plantation before herbicide application. Initially serial dilutions were prepared and microscopic observations were used to identify the causative pathogens of circular leaf spot disease. *Pestalotiopsis* spp. were successfully isolated and identified from all five rubber plantations and their growth rate, morphology of colonies and conidial characteristics were studied. Detached leaf assay technique was used to confirm the pathogenicity of the isolated fungi and pH value of rubber plantations were measured. According to the observations, the pH ranges from 4.25 and 5.69 of the soils where Pestalotiopsis spores were detected. Moreover, the temperature for the growth of the isolated fungi was assessed. After five days of incubation, it was noted that the fungi reached their maximum growth of 80% to 94% at 20 °C and 25 °C respectively. Results of the present study confirmed the survivability of *Pestalotiopsis* spp. in soil and further studies are recommended to species level identification of causative pathogens and management of the circular leaf spot disease.

Keywords: *Circular Leaf Spot Disease, Hevea Brasiliensis, Pestalotiopsis spp., Rubber, Survivability*

Engineering Technology

An Experimental Study to Enhance the Efficiency of Ground Mounted Solar PV Systems Using Solar Tracking Technology

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Solar photovoltaic (PV) systems offer a sustainable solution for converting sunlight into electricity, since the fixed panel orientation in ground-mounted solar PV systems limits their ability to absorb energy from sunlight by changing the positions of the sun while moving through the sun-path. As a solution to this limitation, solar tracking systems optimize and adjust the panel orientation according to the sun's position, which increases system efficiency. This study focuses on comparing the performance of fixed and solar tracker-based PV systems in the Sri Lankan context and aims to evaluate energy output enhancement, panel efficiency enhancement, and economic feasibility. The results were obtained through an experimental setup with two identical 260 W polycrystalline solar panels, developed as a ground-mounted system and a solar tracker-based system. The solar tracking system was developed using NEMA 23 stepper motors controlled by an Arduino microcontroller. The experimental data were collected continuously in an outdoor environment from 7.00 am to 6.00 pm with 15-minute time intervals from both solar PV systems under similar environmental conditions. The experimental results show that the enhancement of average electrical power output of the tracking type solar PV system was 24.37% and the enactment of average short circuit current (I_{sc}) was 24.79%, with no considerable enhancement in open circuit voltage (V_{oc}). It was also found that the average operating temperature of the solar panel used with the solar tracker was 4.91% higher than the fixed-mounted solar panel, which is an indicator of higher energy absorption from sunlight, and at the same time, it will negatively affect the lifetime of the solar panel. In conclusion, solar tracking systems are a worthwhile investment for tropical countries like Sri Lanka, offering enhanced performance that contributes to sustainable energy utilisation.

Keywords: Solar Photovoltaic (PV) Systems, Solar Tracking, Solar PV Efficiency, Sustainable Solution

Experimental Study on Gravitational Sedimentation of Nanofluids Based on Turbidity Measurements

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Nanofluids are emerging as a promising coolant for industrial heat transfer applications due to their improved thermo-physical properties. However, the sedimentation of nanoparticles possesses a significant challenge that impacts the stability of nanofluids. In this study, an experimental setup was developed using a turbidity sensor and a data acquisition system developed using an Arduino microcontroller. The voltage output of the developed system was inversely proportional to the turbidity measurement in NTU (Nephelometric Turbidity Units). The developed experimental setup was used to study the gravitational sedimentation of 0.1 v.% TiO_2/Water (ddH$_2$O) nanofluid and 0.1 v.% TiO_2/Water (ddH$_2$O) nanofluid with CTAB (Cetrimonium Bromide) surfactant. The gravitational sedimentation rate of nanofluid samples was measured using the voltage output of the turbidity sensor which is inversely proportional to the NTU value. The nanofluids were prepared using the two-step method with 30 minutes magnetic stirring (400 rpm, 400 ^{0}C) and 1-hour ultrasonication (400 ^{0}C) to increase the stability of the nanofluids at the initial stage. Experiment was conducted for allowing gravitational sedimentation for both nanofluid samples and the turbidity measurements were taken for 18 hours continuously with 1 minute time intervals using the developed data acquisition system. It was observed that the TiO_2/Water nanofluid with added surfactant exhibited greater stability, with a lower sedimentation rate. The NTU value of the sample with the surfactant was higher during the total measurement period. According to the experimental results during the experimental period of 18 hours, the average NTU value of TiO_2/Water nanofluid with surfactant was 12.47% higher than the sample without the surfactant. This study concludes the positive influence of surfactants for the stability of nanofluids over the gravitational sedimentation.

Keywords: *Gravitational Sedimentation, Nanofluid Stability, Nanoparticle Sedimentation, Surfactants, Turbidity*

Comparative Study on Physical Properties of Nanoparticle-Enriched Gasoline Nanofluids to Analyze Fuel Efficiency

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Enhancing the thermal and flow characteristics of gasoline is a major concern of gasoline and critical due to increasing fuel consumption in the transportation sector. Fuel additives play an important role in enhancing the efficiency of gasoline vehicles. They provide a cost-effective and simple way to achieve maximum power and fuel economy by enhancing combustion and reducing harmful emissions while improving fuel properties. This study experimentally investigates the effects of incorporating three carbon-based structures-Carbon Nanotubes (CNT), Carbon Nanospheres (CS), and Reduced Graphene Oxide (rGO) and Titanium dioxide (TiO_2) as metal oxide nanoparticles into gasoline on its viscosity. Dispersions of these nanomaterials into gasoline were prepared in eight samples using a two-step method at weight fractions of 0.05% and 0.1%. These eight samples and the base fluid (gasoline) were measured using a viscometer (SVM 3001) to analyze the viscosity of the gasoline mixture at temperatures ranging from 20 ^{0}C to 25 ^{0}C. The results showed that the addition of CNTs, CS, rGO, and TiO_2 to gasoline leads to a notable change in viscosity compared to the base fluid. The least change of viscosity of nanofluid was obtained from CS added nanofluid at 0.05 wt.% and it was a 0.015% increment at 20 ^{0}C in contrast to other nanofluids. However, the viscosity values of nanofluids were increased with the concentration of nanoparticles while decreasing with temperature increment. Viscosity should be maintained in some particular range at specific temperature values, in the gasoline mixture to allow the fuel to flow smoothly through the fluid line, which enhances engine performance. Based on the experimental results, carbon nanospheres can be recommended for further study to improve gasoline fuel properties.

Keywords: *Gasoline, Nanofluids, Nanoparticles, Viscosity*

Prototype Development of SCARA Robot for PET Bottle Handling in a PET Bottle Recycling Plant

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SCARA (Selective Compliance Assembly Robot Arm) robots, known for their simplicity and efficiency, are becoming increasingly relevant in various fields, including 3D printing. The ability of these industrial robot arms to navigate within the X, Y, and Z coordinate systems relative to their base makes them highly versatile. SCARA is a 4-DOF robot applicable for precision tasks including pick-and-place operations, non-contact tasks, and contact tasks in industrial settings. In this research, a low-cost SCARA robot is specially designed and developed to operate in a PET bottle recycling plant. The development of a SCARA robot begins with determining the robot's workspace to design the mechanical structure. Followed by the creation of the physical robot body using CAD software techniques. This also involves a comprehensive machine design procedure, including conceptual design, parametric design, and FEA (Finite Element Analysis) analysis of the robot structure. The fabrication process is done with aluminium extrusion bars, and the structural parts are assembled as per CAD drawings by using CNC and basic machining operations. Bearings are mounted on each revolute joint of the SCARA for flexible operation. NEMA 23 stepper motors and 35 kg servo motors are used as actuators in the SCARA system after load testing. A specially designed end effector is used to perform many functions, such as picking up the bottle, temporarily sealing the bottle and opening it when necessary, releasing the internal pressure of the bottle, and opening it to atmospheric pressure when necessary. The SCARA robot is powered using a PSU (Power Supply Unit) and motor drivers. Controlled and programmed with an ATmega2560. The robot can withstand a 1.5 kg load according to FEA in SolidWorks. Repeatability tests revealed a 2.0 mm maximum deviation from the robot base. Furthermore, the robot is robust enough to perform in a PET bottle recycling plant.

Keywords: *ATmega2560, End Effector, Machine Design, PET Bottle Recycling, SCARA Robots*

Thermal Analysis of an Industrial Battery Cooling Plate Using a Computational Fluid Dynamics (CFD) Model

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The current automotive industry requires battery cooling and thermal management systems for improve the efficiency of EVs (Electric Vehicles) and other battery-based products. Therefore, designed the battery cooling plate using Solid Edge 2022 student edition and did the CFD (Computational Fluid Dynamics) analysis for this cooling plate using Ansys Workbench 2023 R2 student version under the limited testing environment. When considering about the structure of the cooling plate this contains an aluminium plate part and copper heat pipe channel. In the simulation process defined the 333.15 K fixed temperature for aluminium plate considering the maximum working temperature of Li-Ion batteries and set the inlet velocity as 0.883 ms^{-1} under the boundary conditions. Through the testing process tested the water using three positive temperatures as 288.15 K, 298.15 K, 308.15 K and under the negative temperatures tested the JET A1 Fuel in the temperatures of 273.15 K, 263.15 K, 253.15 K. Assigned above temperature values for coolants in the simulation process and during complete testing process abled to maintain the cooling plate temperature between average max temperature of 323.706 K and average minimum temperature of 276.553 K. This testing process used the iterations for calculation stage. This CFD analysis opens the wide area to testing and identify the important thermal behaviors for cool the batteries and improve the efficiency and lifetime of the batteries. These CAD models and CFD simulation methodologies helps to reduce the testing cost and improve the final outcomes of the testing process. Through this CFD analysis helped to study the flowrates, surface temperatures and important thermal characteristics and these parameters reveals cooling plate temperature mainly independent from the coolant temperature because other facts can affect to the cooling plate temperature. Finally, this analysis helps to improve the efficiency, lifespan, and safety of the batteries by controlling the temperature of the batteries.

Keywords: *Battery Cooling Systems, Battery Thermal Management, CAD, Computational Fluid Dynamic, JET A1*

Prototype Development of Overhead High-Voltage Power Transmission Line Inspection Robot

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The overhead high-voltage power line inspection robot is an automated system designed to enhance the safety and efficiency of routine inspections of power transmission lines. The robot detects temperature changes, corrosion, erosion, and altitude variations using advanced sensors and cameras. The robot, powered by lithium-iron phosphate batteries and designed to be waterproof and dust proof, transmits real-time data to relevant sectors using NRF 2+ transceiver modules with a 2 km range in open areas. The research addresses the critical need for safer, more efficient inspection methods, replacing hazardous and resource-intensive manual inspections. The robot's design includes a locomotion mechanism, obstacle avoidance systems, and a gyroscopic balancing system. The mainframe is constructed from lightweight aluminium for durability and ease of fabrication. Key components include NEMA stepper motors for movement, dual webcams (5 MP, 1080 P, HD) for detailed cable inspection, and a Raspberry Pi 4 module for data processing. The robot's electrical components are shielded from high magnetic fields using Mu-metal sheets to ensure operational integrity. The fabrication processes such as machining, forming, additive manufacturing, and semi-permanent fastening were involved. CNC milling machines, and 3D printers were employed, with most parts fabricated in-house. Python and Arduino were utilized for software development, focusing on autonomous navigation, obstacle avoidance, camera manipulation, and data communication. The inspection programs were designed for real-time data collection and defect identification. The final tests confirmed the robot's ability to identify most of faults such as corrosion and rust, and to monitor temperature and altitude accurately. The robot demonstrated superior efficiency, reducing inspection time and resources while providing reliable data for proactive maintenance.

Keywords: *CNC Milling, High-Voltage Power Line Inspection, Maintenance, Python, Raspberry Pi 4*

Design, Development, and Testing of Smart Healthcare Assistant Unit for Sri Lankan Hospitals

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Existing patient care systems and smart assistant devices often require users to invest in comprehensive packages, increasing costs and limiting customization. This study introduces an economically viable, versatile modular healthcare assistant unit. Unlike traditional systems, the developed healthcare system offers standalone subunits that users can selectively purchase and integrate, optimizing resources and enhancing affordability. Design and simulation were performed using SolidWorks designing software 2022, creating precise and functional models. Prototype testing involved Arduino programming to ensure seamless operation of various modules, including control and data processing units, display interfaces, and communication protocols. The system's modular architecture allows each component, such as the MAX30102 heart rate sensor for monitoring heart rate, AD8232 ECG sensor for cardiac monitoring, ultrasonic sensors for distance measurement, and eight IR sensors for line following, to operate independently or in an integrated manner, providing flexibility. Communication between modules is facilitated using NRF24L01 and ESP-NOW protocols. The "Welly," a smart healthcare robotic device, was developed, demonstrating significant improvements in versatility, scalability, and efficiency. Key features include a modular design for easy integration and customization, advanced sensor integration for real-time patient monitoring, and efficient power management with wireless connectivity for enhanced usability. The device, with a height of 80 cm, a surface area of 3200 cm^2, and a mass of 24 kg, is powered by a 4400 mAh Li-ion battery, with an estimated power consumption of 15 watts, calculated from the battery capacity and the continuous runtime of 40 minutes. Testing revealed effective navigation and health monitoring tasks, with future improvements identified for line-following accuracy and sensor integration. Comparative analysis indicated that "Welly" offers a more cost-effective and user-friendly solution than traditional comprehensive healthcare systems.

Keywords: Adaptable Healthcare Systems, Affordable Healthcare Technology, Modular Healthcare Assistant, Patient-Centric Robotics, Real-Time Patient Monitoring

Design Development and Testing of a Multi-Mold Compression Machine for Selected Paper Pulp Molding Products

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The rising demand for eco-friendly products over plastics has moved pulp-based molded products into the spotlight due to their low carbon footprint and versatility. However, conventional molding techniques such as transfer molding, blow molding, rotary molding, hydroforming, and thermoforming face significant challenges, including low product quality, high costs, and mold complexity. Compression molding, by contrast, offers excellent control over product density and thickness, making it suitable for producing sturdy, uniform items. It is cost-effective for medium to high production volumes, reduces waste, and enhances energy efficiency. Despite these advantages, traditional compression molding methods do not meet the unique needs of pulp-based materials. This project aimed to design and develop an advanced compression molding and handling device specifically for pulp-based molded products, addressing issues related to precision, environmental impact, and economic viability. The device features a multi-mold system to facilitate product variations, such as egg cartons and electronic packaging, and incorporates an automated arm to minimize manual labor. The system employs a compression molding system with MOSFETs and an Arduino for precise control and automation, improving efficiency and reducing manual intervention. An advanced drainage system ensures high product quality, while an adjustable compression force mechanism allows for varying product strengths. The system is capable of producing cartons with an area of 5 square inches in a single compression stroke time of 50 seconds. The system leverages readily available raw materials, such as paper, cardboard, and agricultural waste, enhancing environmental sustainability and reducing manufacturing costs. The key objectives include reducing manufacturing time per item through automation, lowering costs due to the abundance of raw materials, decreasing labor involvement with a control system, and achieving product versatility by adjusting compression forces. This innovative approach promises to overcome the limitations of traditional methods and cater to the growing demand for sustainable packaging solutions.

Keywords: *Advanced Molding System, Automated Molding, Cost-Effective, Precise, Sustainability*

Design and Development of Enhanced Wing Profile for Vertical Take-off and Landing Prototype Aircraft

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Vertical Take-Off and Landing (VTOL) aircraft represent a category of aircraft capable of taking off, hovering, and landing vertically. These capabilities enable VTOL aircraft to operate in areas without runways, rendering them versatile and valuable for various applications. VTOL aircraft offer operational flexibility, reduced infrastructure needs, enhanced accessibility, rapid response, and versatility, making them ideal for urban air mobility, emergency response, and accessing remote or congested areas. This research aimed to design an enhanced wing profile suitable for VTOL applications. Numerical simulation of the designed wing profile is essential to predict its aerodynamic performance before prototyping. The numerical analysis on the designed VTOL wing was carried out using the ANSYS 16 V fluent solver. The wing model, was designed based on the NACA series 4412 aerofoil, and was created with the Open VSP software platform, featuring a span of 2.03 m, a chord of 0.27 m, and a standard dihedral configuration. A structured mesh was generated, with simulation settings including a flight velocity of 10 ms^{-1} within a domain size of 4 m x 3 m x 1 m. The simulation assumed laminar flow conditions, and 300 nos of iterations were carried out to obtain the results as lift and drag forces acting on the wing profile. The lift force is 31 N, and the drag is 1.96 N. Additionally, the lift-to-drag ratio was obtained for further analysis. According to the obtained numerical results, the average total drag force on the wing surface is 0.718 N. These results are essential for optimizing the wing's performance in VTOL applications. Ongoing efforts will involve further development through experimental setups. Subsequent improvements may be made by others in the future.

Keywords: *Easy Handling, Higher Flying Time, Remote Control Cargo Carrier, VTOL Design*

Quality Assessment in Tea Leaves using Feature Image Processing and Machine Learning Techniques

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Tea cultivation and processing plays a significant role in the Sri Lankan economy, contributing to the livelihoods of millions of people and generating substantial export earnings. The "tea quality" is a crucial factor in determining market value and consumer satisfaction. Traditionally, in Sri Lankan tea quality assessment involves a manual process called measuring "tea leaf count", a laborious and time-consuming process that can also be subject to human errors. Leaf count is measured either by taking a 100 g sample (weight basis method) or by randomly collecting a sufficient sample (count basis method), which is then manually sorted into three quality categories: best, below-best, and poor. The percentage of each category is calculated to assess overall tea leaf quality. This paper addresses a systematic leaf count system using object detection and classification techniques. In addition, the system identifies other objects mixed with tea bulk samples, such as stones and unwanted items as other objects. Advanced machine learning models and image processing techniques were selected for the tea quality assessment process, employing three models. SSD Mobilenet Version-1 for tea leaf detection, SSD Mobilenet Version-2 for detecting other objects, and a Convolutional Neural Network (CNN) for classifying the detected leaves and other objects into four quality categories. The tea leaf detection model achieved a smoothed loss value of 0.1393 at 15,000 steps, indicating strong convergence and reliability. The other object detection model reached a smoothed loss value of 0.1715 at 10,000 steps, demonstrating effective training and robustness. The classification model attained an accuracy of 91.5%, highlighting high precision in categorizing tea leaves into quality categories. These results indicate that the system offers a reliable and efficient alternative to traditional manual tea quality assessment methods.

Keywords: *Convolutional Neural Network, Leaf Count, Object Detection, SSD Mobilenet*

An Experimental Study on Efficiency Enhancement of Floating Solar PV Systems in Sri Lanka

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Solar photovoltaics (PV) is the most rapidly growing source of renewable energy generation technology around the globe. The most popular solar photovoltaic installation method is ground-mounted solar PV systems, which have currently encountered several practical limitations with increasing installation capacity. As a possible alternative, floating solar PV systems or floatovoltaics offer a promising solution by utilising water bodies' surface space and also taking advantage of the cooling effect, reducing land occupancy, preventing biological fouling, and also reducing the evaporating effect of water bodies. This paper presents an experimental performance analysis of floating solar photovoltaic systems in tropical regions, based on the results obtained through a pilot floating solar power system in Belihuloya, Sri Lanka. The primary objective of this study is to compare the performance of floating PV systems against ground-mounted solar systems, evaluate their efficiency, and identify other influencing parameters for system performance. Two identical test setups were utilised, each using a polycrystalline panel mounted on modular rafts for the floating system and ground-mounted units. Data collected under varied conditions was used to analyse the impact of these conditions on the efficiency of solar PV systems. This research aims to contribute insights into enhancing solar power generation efficiency in tropical contexts, particularly in Sri Lanka. The results of the study show that the floating solar system was able to gain 2.06% enhanced power output over ground-mounted PV systems. The performance ratio of the floating solar PV system was higher (89.60%) compared to the ground-mounted system (87.79%). Which shows floating solar PV systems are more productive and effective in tropical countries like Sri Lanka. The results obtained in this study conclude that floating solar systems are more sustainable compared to ground-mounted solar systems in the Sri Lankan context.

Keywords: Efficiency Enhancement, Floatovoltaics, Floating Solar PV, PV Efficiency, Renewable Energies

An Experimental Study on the Relationship Between the Operating Temperature and Electrical Efficiency of Solar Photovoltaic Panels

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Solar photovoltaic (PV) systems have become the most popular source of renewable energy in Sri Lanka over the past decade. The efficiency degradation of solar PV panels with increasing operating temperature is one of the main challenges faced by photovoltaic panels globally. This scenario is comparatively more common for the solar PV systems installed in tropical countries like Sri Lanka. This study was conducted to investigate the performance of a commercial-grade polycrystalline photovoltaic panel equipped with a closed-loop heat pipe water circulating cooling system through an experimental procedure conducted at Belihuloya, Sri Lanka. The developed experimental setup included a polycrystalline PV panel, an aluminium closed-loop cooling system, a water flow rate monitoring system, and a temperature monitoring system. Overall efficiency of the PV panel was calculated by dividing power out from power input with the use of open circuit voltage, short circuit current, solar irradiance and panel's surface area. The experimental results revealed that the electrical efficiency of the polycrystalline PV panel decreases by 0.69% for every 1 ^{0}C increase in temperature, within a panel surface temperature range of 27.5 ^{0}C to 47.5 ^{0}C. This finding indicates that the operating temperature negatively impacts the electrical efficiency of polycrystalline PV panels and also highlights the significance of managing the operating temperature of PV panels to enhance their efficiency. This research also examines the potential of water-cooling systems to optimise the efficiency and energy output of photovoltaic panels, making them more viable for widespread application because the use of water-cooling systems can transfer temperature immediately and can control easily to maintain desired temperature ranges. The positive correlation between reduced temperature and increased efficiency emphasises the importance of thermal management in photovoltaic technology.

Keywords: Solar System Efficiency, Solar PV Cooling Systems, Polycrystalline Photovoltaic Cells

Simulation of a Cost-Efficient Prototype Egg Incubator with Fully Automatic Egg Turning

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An egg incubator is a machine that is used to hatch fertile eggs successfully under a controlled environmental condition by regulating the temperature and humidity of the container. However, the technologies used in current egg incubators often come with exorbitant costs and maintenance requirements. The aim of this project is to design a cost-efficient, fully automatic egg incubator for the poultry industry. In the prototype, microcontrollers were used as a cost-effective alternative to the expensive hardware components like heaters and coils. A DHT11 temperature and humidity sensor were used to monitor the temperature and the humidity inside the incubator. A 25 W filament bulb for regulated heat generation, and the SG90 servo motor powered egg turning tray to turn the eggs four times per day were used. All the components in the system are controlled by the Arduino UNO board. This cost-efficient prototype can reduce the production costs by eliminating the need for manual egg turning and contributes to the sustainability of poultry farming.

Keywords: *Cost-Efficient, Egg Incubator, Fully automatic Egg Turning, Poultry Farming, Servo Motor Powered Egg Turning Tray*

Simulation-Based Investigation of Wind-Powered Battery Charging Unit for Electric Vehicles (EVs)

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Emissions of greenhouse gases are a serious problem in different sectors, especially in transportation. The adoption of Electric Vehicles (EVs) is one of the solutions for this issue. EVs rely on batteries as a power source, which is a key and costly component determining their travel range. Solar and wind energy can be used to charge the batteries of EVs and reduce both fuel costs as well as greenhouse gas emissions. One method of using wind energy is to place a turbine at the front of EVs to generate power while the vehicle is in motion. This research study aims to simulate and calculate the wind force generated on the turbine while the car is being driven. The simulation study addresses how the turbine's parameters change in response to the vehicle's speed in the evaluation section. The simulated turbine's blade length is 600 mm and the hub diameter is 15 mm. Simulation results show that the drag force acting on the rotating turbine is approximately 71.05 N at a speed of 36 kmh^{-1}. To overcome this drag force, the vehicle battery is required to supply power of 710.5 W. But power generated by the turbine equals to 284.2 W at 36 kmh^{-1} speed. The turbine generates about one-third of the power that it consumes when moving against the wind. Due to their direct proportionality, increasing the turbine's speed and capturing area produces more energy but also increases drag force. The study reveals that the proposed method for EVs leads to energy wastage due to wind drag, making it unsuitable for vehicle implementation due to overall inefficiency. Further studies are recommended to reduce energy wastage and increase turbine energy generation for hybrid vehicles, determining the turbine-generated power's ability to extend hybrid vehicles' driving range.

Keywords: *Battery Charging Unit, Drag Force, EVs, Turbine*

Design and Development of Unique Playable Farming App for Link Farmers and Dwellers

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The "Farm It" app serves as a groundbreaking platform that revolutionizes the relationship between urban residents and farmers, fostering a symbiotic relationship that benefits both parties. This innovative application provides a seamless link between individuals seeking fresh, locally sourced produce and farmers with available land for cultivation. Through subscription-based models, users can engage in farming activities without the constraints of physical proximity or time limitations. At its core, "Farm It" democratizes access to agriculture, particularly catering to urban dwellers who lack the space or time to engage in traditional farming practices. By subscribing to the app, users gain virtual access to farmland, enabling them to participate in the cultivation of crops without the need for owning land or possessing agricultural expertise. This accessibility opens doors for individuals passionate about farming or gardening, empowering them to actively contribute to the food production process. The app facilitates a fair and transparent system of compensation for farmers. Through the subscription model, users essentially lease portions of farmland, with proceeds directly benefiting the farmers based on the share of land subscribed. This not only provides farmers with a stable source of income but also incentivizes sustainable agricultural practices and fosters community engagement. "Farm It" transcends conventional boundaries, bridging the gap between urban consumers and rural producers. By harnessing the power of technology, this innovative platform catalyses a new era of collaborative farming, promoting food sustainability, community resilience, and equitable access to agricultural resources. As the app continues to evolve and expand, it holds the potential to transform the way we perceive, engage with, and benefit from agriculture in our increasingly interconnected world.

Keywords: *Community Engagement, Cultivation, Subscription-Based Models, Sustainable Practices, Virtual Access*

Examining the Efficiency of Blockchain-Based Licensing and Ownership Systems for Images: A Thorough Examination of Digital Photography Copyright Protection in the Decentralized Era

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The digital revolution has fundamentally altered the field of digital photography and created complex challenges for copyright protection. This study investigates how blockchain technology might be used to provide a safe, decentralized framework for digital image rights management in order to solve these issues. The primary objectives of this research are to build an immutable identity verification system using decentralized identities (DIDs) and technologies like Magic. Link and Self-Sovereign Identity (SSI) principles, as well as to design a user-focused online application that leverages smart contracts for automated licensing and effective privacy restrictions. The license processes are automated by smart contracts running on the Ethereum blockchain, and the research employs the InterPlanetary File System (IPFS) for off-chain data storage, reducing costs and enhancing privacy. It useuses a qualitative approach to do this. The results demonstrate how employing blockchain technology improves the efficiency and security of digital copyright management. The study concludes that integrating DIDs with blockchain and IPFS offers a sufficient remedy for the issues that digital content creators and photographers face, promoting an open and secure environment for copyright management. The research provided here increases our understanding of blockchain's potential to change copyright systems and highlights the scalability and adaptability of decentralized technology in digital rights management.

Keywords: *Blockchain, Digital Photography, Decentralized Identities, IPFS, Smart Contracts*

Food and Chemical Technology

Synergistic Effects of Herbs in Paspanguwa on Extraction of Bioactive Compounds in Aqueous Media

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Paspanguwa is a traditional herbal formulation used in Sri Lanka for treating common colds, flu, and respiratory ailments. Its five ingredients include _Coriandrum sativum, Zingiber officinale, Hedyotis corymbose, Solanum xanthocarpum,_ and _Coscinium fenestratum._ The mixed decoction of these herbal components is believed to have better therapeutic effects than the decoctions prepared by the individual herbs. This study explores the synergistic effect of each herb on extraction of bioactive compounds in aqueous media. The Total phenolic content (TPC) has been used as a measure of the extraction yield. TPC values of the aqueous decoctions prepared by powdered samples of individual herbs, as well as the mixture of all five components in equal proportions were analyzed. Further the percent decrease in the antioxidant activity of the mixed decoction, with the use of one of the herbal components in half of the proportion was measured. Finally, the antioxidant activity measurements were repeated for the same formulations prepared using whole pieces of the herbs. Phenolic contents of the decoctions were determined using Folin–Ciocâlteu method by measuring the absorbance at 765 nm which were compared to the standard curve prepared for Gallic acid. The TPC value of the mixed decoction prepared using the powdered herbs (227.8 mg GAE/g) was lower than the average of the TPC values obtained for the individual decoctions (290.8 mg GAE/g), which shows negative synergism. However, when one component is used at half the proportion, it appears to notably decrease the antioxidant activity of the combined decoction. The decrease was highest (38.4%) for low proportions of _Coscinium fenestratum._ Similar trend was observed for the decoctions prepared using whole pieces of the herbs. The TPC values were significantly low when whole pieces of _Coriandrum sativum, Zingiber officinale_ and _Solanum xanthocarpum_ were used. The results suggest possible synergism on bioactive compound extraction in the Paspanguwa aqueous extract.

Keywords: _Ayurveda, Paspanguwa, Phenolic Content, Synergistic Effects_

Development of Antioxidant-Rich Infusion Powder Mix Using Papaya Leaves, Spinach, Cinnamon, and Ginger and Analysis of Its Physicochemical Properties

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Recently, it has been realized that foods rich in antioxidants are important for improving overall health and mitigating the risk of chronic diseases. So, this study aimed to develop an anti-oxidant rich infusion powder blend, using papaya leaves, spinach leaves, cinnamon bark, and ginger rhizome. The methodology involved the preparation of raw materials, product formulation and analysis of the physicochemical properties of the infusion. Based on the analysis of total phenolic content (TPC) in immature, young mature, and old mature papaya leaves, the young mature papaya leaves exhibited the highest TPC content (4.32 mg/g) and were selected for product formulation. Papaya leaf toxicity was assessed through brine shrimp lethality bioassay, yielding an LC_{50} value of 1643.52 µg/ml, indicating non-toxicity for consumption. According to sensory analysis (5-point hedonic test: 30 un-trained panelists), sample with 40% papaya leaves, 20% spinach leaves, 20% cinnamon, and 20% ginger was selected as the best formulation achieving the highest scores for all assessed sensory attributes (taste, aroma, appearance, flavor, color, and overall acceptability). The herbal infusion exhibited high antioxidant activity of 340 ppm with the DPPH radical scavenging assay compared to standard ascorbic acid. Total phenolic content of the herbal infusion was 0.042 GAE mg/ml. The proximate composition of the herbal infusion showed, moisture (4.91±0.12%), crude fat (3.68±0.24%), crude fibre (18.76±0.07%), crude protein (22.34±0.23%), ash (8.91±0.02%) and carbohydrates (33.91±0.58%). The analysis of color values of herbal infusions from fresh and one-month-old powder mixes indicated that lightness (L*) increased over time. The study highlights the potential of developing a safe and effective antioxidant-rich herbal infusion powder blend with high sensory acceptability, making it a promising functional food product.

**Keywords:** _Antioxidants, Cinnamon, Herbal Infusion, Papaya Leaves, Spinach_

Development of Noodle Product Incorporated with Cassava Flour (*Manihot esculanta*) and Purple Yam Flour (*Dioscorea alata*)

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This research was carried out to develop a value-added noodle product by incorporating cassava and purple yam flour to enhance its nutritional profile. Properties of the flours were evaluated, including water-holding capacity, oil absorption capacity, swelling capacity, and bulk density, for cassava, purple yam, and wheat flour. Three formulations of noodles with cassava and purple yam flour were prepared. In the sensory evaluation (5-point hedonic ranking test with 30 untrained panelists) the formulation with 60% cassava flour, 30% purple yam flour, and 10% wheat flour was identified as the most preferred formulation. In the proximate composition analysis of the most preferred sample moisture content, total ash, crude fat, crude protein, carbohydrates, and fiber (15.22%) were found to be 5.85%, 2.35%, 1.00%, 1.9%, 89.71%, and 15.22% respectively. Cooking properties, including cooking loss, water absorption, and cooking time, were evaluated alongside a market sample and the three formulated samples. A higher cassava flour content increased cooking loss and water absorption while reducing cooking time due to the disruption of the wheat gluten network. Noodles with 60% cassava, 30% purple yam, and 10% wheat flour were found to be harder, stickier, less springy, gummier, and less chewy compared to the market sample, indicating a significantly different texture profile. Biological assessments showed negligible colony formation during storage, indicating microbiological safety for up to 14 days. In conclusion, incorporating 60% cassava flour and 30% purple yam flour into noodles can improve functional properties, sensory acceptability, and shelf life, making it a viable option for enhancing noodle nutritional profile.

Keywords: *Cassava, Cooking Properties, Instant Noodles, Purple Yam, Value Added Noodle*

Production of Craft Beer Using Bitter Gourd (*Momordica charantia*) as a Hops Substitute

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Hops are commonly used to add bitterness to beer, but alternative bittering agents have been explored due to availability and cost challenges. This study investigated the potential application of bitter gourd (BG) (*Momordica charantia*) powder as a substitute for hops in craft beer brewing. BG was oven-dried at $50°C$ for 24 hours to produce powder, then mixed with wort and inoculated with yeast for further fermentation. The optimal bitterness profile of ripened BG powder was identified through saponin content analysis using FTIR spectroscopy, comparing over-ripened and unripened BG. BG powder obtained from ripened fruits exhibited strong antioxidant activity ($54.83\pm0.10\%$) and a distinct color value (L^*:70.19 ± 0.54, a^*: -0.61 ± 0.09, b^*:8.14 ± 0.81), along with a phenolic content of 5.32 ± 0.48 mg GAE/g. Wort samples (T1, T2, T3, T4) were formulated with varying BG powder additions (3.0 gL^{-1}, 6.0 gL^{-1}, 12.0 gL^{-1}, 24.0 gL^{-1}) and analyzed for bitterness units (BU) to evaluate BG as a hops substitute. T4 wort displayed the most desirable BU (21.12 ± 0.93) along with original extract (OG) of 22.63 ± 1.46 and color (18.94 ± 0.34 European Brewing Convention (EBC)). Beer samples were produced using three formulations derived from fermented T4 wort: 100% BG (T1), 50% BG + 50% hops (T2), 100% hops (T3). The three beer samples showed similar alcohol content (8.7-8.98% ABV) but differed significantly ($p<0.05$) in bitterness and color. Sample T1 showed the highest bitterness (17.67 ± 0.73 BU) and darkest color (14.02 ± 0.20 EBC), consistent with the sensory evaluation results. T2 (color: 11.21 ± 0.20 EBC, bitterness: 13.65 ± 0.64 BU, alcohol: $8.87\pm0.15\%$) was the most preferred at the sensory evaluation by the trained panel. The three formulations were compared for energy (38.00-38.10 kJ/100 ml), protein (0.58-0.59 g/100 ml), and carbohydrate (1.83-1.85 g/100 ml) content. BG powder exhibited potential as a hops substitute in craft beer, offering bitterness and favourable sensory attributes.

Keywords: *Beer, Beer Quality, Bitter Gourd, Bitterness Profile, Hops Substitute*

A Study on the Thermal Properties of Palm Oil-Based Nanofluids by Incorporating Chitosan Nanoparticles Derived from Oyster Mushrooms

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This study investigates the impact of Chitosan nanoparticles (CS-NPs) on the thermal properties of nanofluids at different temperatures and weight fractions. To the best of our knowledge, these CS-NPs, synthesized from oyster mushrooms (*Pleurotus ostreatus*), are used for the first time to prepare nanofluids. These nanofluids offer high potential for industrial applications due to their biodegradability, biocompatibility, nontoxicity, vegan-friendliness, and absence of allergic compounds that are associated with marine-sourced CS-NPs. The CS-NPs were synthesized using a chemical and mechanical treatment process at three different amplitudes which were amplitude 40, 60 and 80, and CS-NPs at amplitude 80 were selected to prepare the nanofluid due to their particle size. The chitin, chitosan, and CS-NPs were characterized using the FTIR-ATR method, and the average size of the CS-NPs was measured around 70 – 100 nm range using SEM. Refined, Bleached, and Deodorized palm olein (RBD palm olein) was used to prepare the nanofluids using a two-step method. Thermal conductivity and thermal diffusivity of the nanofluids were measured according to ASTM standard methods. Thermal properties were compared for nanofluids prepared with different weight% (0.01 wt.% and 0.1 wt.%) of CS-NPs within the temperature range 40 - 160°C. The maximum enhancement for the thermal conductivity of CS-NPs incorporated nanofluid was observed at 0.01 wt.%, which is 3.7% at 100°C , and higher enhancement of smoke point was observed at 0.01 wt.% which is 1.97%. However, the thermal diffusivity of CS-NPs added nanofluids did not show significant enhancement in contrast to the base fluid within the same temperature range. These enhanced thermal properties of nanofluids facilitate more effective heat transfer, resulting in quicker and more consistent cooking of foods. They are also can be used to minimize energy usage for food processing and shorten processing time.

Keywords: *Chitosan Nanoparticles, Energy Saving, Nanofluids, Smoke Point, Thermal Conductivity*

Biodegradable Plastics from Laulu Fruit (*Pouteria campechiana*): Sustainable Production and Applications

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Laulu (*Pouteria campechiana*) fruit-based bio-plastics are novel and sustainable materials which are biodegradable, eco-friendly and low carbon footprint alternatives to traditional petroleum-based plastics. These bio-plastics help to promote global sustainability by reducing the impact on the environment. The nutrient-dense Laulu fruit, which contains carbohydrates, proteins, amino acids, lipids, fibers, vitamin C, and carotenoids, is an ideal resource for bio-plastic production. To create a thin film using Laulu pulp, the pulp and corn starch were combined in equal amounts and glycerin was subsequently incorporated into this mixture. The solution was mixed with hydrochloric acid and water, and the pH was adjusted using sodium hydroxide. The mixture was stirred and heated until gelatinized. The gelatinous mixture was then molded, dried for a short period at a moderate temperature, and subsequently dried under controlled conditions for an extended period. Then the UV-absorption measurements and the Fourier-transform infrared (FTIR) spectra of this bio-plastic material were recorded. Three bio-plastic samples were produced, differing only in glycerin content, while keeping other ingredients constant and maintaining a consistent pH. Under UV light, these bio-plastics exhibited blue fluorescence, with higher glycerin concentrations enhancing fluorescence quality due to improved molecular interactions, polymer matrix flexibility, optical clarity, and hydrophilicity. FTIR spectra showed vibrations arising from -O-H stretching, C-H stretching, aliphatic primary amides, alcohols, and inorganic phosphates. Moisture permeability studies revealed that higher glycerin levels improved permeability. The production of biodegradable plastics from Laulu fruit pulp offers a promising, long-term alternative to conventional polymers, supporting environmental sustainability through green technology. These bio-plastics demonstrated good durability for various applications, including encapsulation of organic electronic devices. Therefore it can be concluded that the Laulu-based bio-plastics have a wide range of potential uses, such as packaging, agricultural films, device fabrications, and disposable goods like flatware and plates.

Keywords: *Bio-plastics, Fluorescence, FTIR, Laulu Fruit-based Bio-plastics, Polymer Matrix Flexibility, Pouteria campechiana.*

Formulation and Development of Cheese-Spice Mixture for Instant Pasta

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The conventional recipe for cheese pasta dishes relies on expensive dairy ingredients, limiting affordability and lacking flavor adjustment for Asian consumer preferences. A cheese-spice mixture was developed for instant cheese pasta dishes through optimization of cheese quantity, choice of spices, and other non-cheese ingredients, aiming for cost-effective flavor enhancement suitable for Asian tastes. The mixture's development involved two stages. First, a trained panel sensory evaluation (n=6) of cheddar, mozzarella, and ricotta cheeses identified 40% cheddar cheese as optimal, combined with a pre-determined 60% spice mixture. Second, the mixture was refined to enhance flavor and texture, with the best formulation containing milk powder (54%), whey powder (25%), non-dairy creamer (7.5%), salt (6%), egg powder (1.8%), onion powder (1.5%), garlic powder (1.5%), pepper (0.9%), cinnamon powder (0.6%), chili powder (0.4%), turmeric powder (0.1%), corn starch (0.5%), and xanthan gum (0.2%). Cooking quality parameters were assessed, revealing a cooking time of 5.99 ± 0.99 minutes, with cooked pasta weighing 64.80 ± 5.6 g and experiencing a loss of 54.46 ± 1.90 g. The pasta exhibited improved texture with increased firmness (58.07 ± 0.46 g) and reduced adhesiveness (3.20 ± 0.09 g). The mixture demonstrated strong antioxidant activity with an IC50 value of 74.80 ppm(μgml^{-1}) and a total phenolic content of 6.317 GAE mg mL^{-1}. FTIR analysis confirmed the presence of desired chemical bonds in both the mixture and cooked pasta. Shelf life testing under refrigerated and ambient conditions using aluminum foil packaging showed stable sensory attributes, color retention, and microbial counts (total plate count and yeast and mold) over two weeks, comparable to the Kraft brand reference sample. The two-stage development identified 40% cheddar cheese and a 60% spice blend as optimal, enhancing flavor, texture, and antioxidant properties of pasta dishes while ensuring stability and safety during storage. The cheese-spice mixture offers a reliable means to enhance pasta quality while maintaining safety and stability.

Keywords: *Antioxidant Activity, Cheese-Spice Mixture, FTIR Analysis, Pasta Enhancement, Sensory Evaluation*

Impact of Pasteurization on the Quality Attributes of Fermented Coconut Sap (Toddy)

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Toddy, an alcoholic beverage, is traditionally produced by fermenting sap collected from the young or mature inflorescence of both female and male coconut palms. Due to the limited shelf life and lack of quality assessment of fermented coconut sap (Toddy), this study investigated the efficacy of pasteurization for the preservation of bottled toddy. The naturally fermented coconut sap was pasteurized at 60, 70, and 80°C for 15 and 30 minutes each, followed by refrigerated storage. The physicochemical, functional properties, and microbial profile of the toddy samples were analyzed using standard methods. Pasteurized toddy stored at refrigerated condition (4.00 ± 2°C) showed no significant changes in pH (3.45 ± 0.02), titratable acidity (0.52 ± 0.06 g/L) and alcohol level ($7.63\pm0.05\%$) over time in the sample prepared at 60°C /15 minutes. The total sugar content of the toddy sample prepared at 60°C for 30 minutes was 562.98 ± 5.30 ppm. The toddy sample pasteurized at 60°C for 15 minutes showed the highest total phenolic content (517.39 ± 6.09 mg GAE/L), and DPPH radical scavenging activity ($57.95\pm1.53\%$). The total plate count and yeast and mold count of toddy were not detected in all samples after pasteurization. The toddy samples treated at 70°C for 15 minutes received the highest sensory scores across all evaluated attributes (appearance, color, odor, taste, and overall acceptability) but significantly lower ($p<0.05$) physicochemical and functional properties than that of the sample treated at 60°C for 15 minutes. However, pasteurization at 60°C for 15 minutes was the best method to prevent further fermentation while preserving the physicochemical and functional properties, ensuring microbial stability.

Keywords: *Modified Atmosphere Packaging, Shelf-Life Extension, Wax Coating, Ziziphus mauritiana*

Formulation and Quality Evaluation of Biodegradable Packaging Material from Coffee (*Coffea arabica*) Husks

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Packaging plays a major role in the food industry. Plastics have become a dominant player in the packaging materials due to their versatility, non-toxic nature and cost effectiveness. However, the major drawback of plastics is their poor biodegradability. In this context, the present study aimed to create biodegradable packaging material using coffee (*Coffea arabica*) husks, a significant by-product of coffee dry processing. Coffee husks are rich in carbohydrates and fiber, including cellulose, hemicellulose and lignin, making them an attractive resource for eco-friendly packaging material development. Corn flour, Carboxymethyl Cellulose (CMC), glycerin and distilled water were also used as binding agents and plasticizers. The study examined the suitability of three different particle sizes (<500 µm, <1 mm, <2 mm) obtained by sieving coffee husk, to develop packaging material. The fracturability of samples made by three different particle sizes measured using texture profile analyzer, showed that the particle size <1 mm as the most suitable. The ratio of 2:1:1:0.3:3 for coffee husks, corn flour, glycerin, CMC and water were selected to develop the packaging material by analyzing the fracturability of three different formulations. Beeswax was used as a waxing agent for the selected formulation and techno- functional properties such as thickness, fracturability, water uptake ratio and water solubility were analyzed in both waxed and non-waxed samples. The average thickness of the samples was 4.00 ± 0.02 mm. The fracturability of waxed sample (1497.00 ± 7.01 g) was higher than non-waxed sample (1451.20 ± 3.67 g). The water uptake ratio and water solubility were higher in non-waxed sample. Approximately 47% of the non-waxed sample and 35% of the waxed sample were decomposed during 10 days by soil burial test. Considering the techno-functional properties, the waxed sample was found to be the most suitable for developing biodegradable packages. Thermal properties, water vapor transmission rate and oxygen and carbon dioxide transmission rate need to be evaluated to identify the potential applications. The economic feasibility should also be assessed.

Keywords: *Biodegradable Packaging, Coffee Husks, Fracturability, Soil Burial Test, Techno-Functional Properties*

Development and Evaluation of Quality Characteristics of Biodegradable Packaging Material from Pineapple (*Ananas comosus*) Leaves and Corn (*Zea mays*) Husk

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With the global population constantly increasing, the demand for food has surged, making food production and safety more critical than ever. Packaging, produced from various materials is a common solution to prevent food contamination and ensure safety. Making biodegradable packaging from bio-based industrial residues offers a sustainable solution to environmental pollution. Pineapple (*Ananas comosus*) leaves and corn (*Zea mays*) husks are common bio-based industrial leftovers that contain a high amount of fiber. The purpose of this study was to formulate biodegradable packaging using fibers extracted from corn husks and pineapple leaves and evaluate the quality characteristics of the packaging. Four materials were developed by altering the ratios of fibers, which were extracted through an alkali (NaOH) treatment. The formulations included ratios of corn husk fiber to pineapple leaf fiber at 1:1(T1), 2:1(T2), 3:1(T3), and 4:1(T4). Then the physical, mechanical, and biodegradable properties of each formulation were evaluated. Water activity values varied between 0.66 ± 0.01 to 0.60 ± 0.01, while water solubility ranged from $0.48\pm0.23\%$ to $1.64 \pm 0.24\%$. The water vapor transmission rate exhibited a progressive increase from T1 to T4. The fracturability values ranged between 805.00 ± 21.00 g and 1490.00 ± 11.02 g. Tensile strength test results indicated varying force at break values, ranging from 16.73 ± 0.94 N to 26.6 ± 1.40 N. The elongation at break values ranged from 8.83 ± 0.52 mm to 4.21 ± 0.14 mm. There was a positive correlation between the corn husk ratio and both the thickness and biodegradability (20 days soil burial degradation test). Scanning electron microscope observations indicated that the sample with highest biodegradability (T4) exhibited a more porous structure. Thermogravimetric analysis test results revealed that T2, T3, and T4 samples have higher thermal stability than the T1 sample. Due to their superior physical and mechanical properties, T1, T2, and T3 samples were recommended for use as packaging materials.

Keywords: *Biodegradable Packaging, Corn Husk Fiber, Pineapple Leaves Fiber, Tensile Strength, Thermogravimetric Analysis (TGA)*

Minimizing Enzymatic Browning and Optimizing the Ripening Process of Rathambala Banana

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Enzymatic browning was a major issue in Rathambala banana (*Musa acuminata AAA*) while irregularities in ripening have been observed with current ripening recommendations. Therefore, this study aimed to determine the optimal treatment to inhibit enzymatic browning and optimize the ripening of Rathambala banana using different ethylene concentrations and exposure times. Banana slices were treated with ascorbic acid, citric acid, NaCl, and sodium metabisulphite (SMS) at 0.5%, 1.0%, and 3.0% concentrations as anti-browning agents. Ethylene concentrations in 250 ppm, 500 ppm, and 1000 ppm with exposure times of 6, 12, and 24 hours were used to optimize ripening. Standard methods were used to evaluate the quality parameters of banana after ripening. Sensory evaluation was done using a five-point hedonic scale. Banana slices treated with 3% SMS showed minimum L*, a*, and b* values change from 80.44 ± 1.57 to 70.49 ± 0.78, -3.12 ± 0.25 to -0.06 ± 0.18 and 24.67 ± 1.13 to 21.43 ± 0.40, respectively for 15 days at 4°C storage. The total soluble solid content of ripened banana ranged from 16.93 ± 0.15 to 23.40 ± 0.10, pH from 7.51 ± 0.08 to 5.57 ± 0.20, and pulp-to-peel ratio from 2.79 ± 0.04 to 3.41 ± 0.03 among different treatments. Bananas treated with 500 ppm ethylene for 12 hours showed no significant difference compared to natural ripening ($P>0.05$) in titratable acidity ($0.16\pm0.002\%$), peel firmness (710.27 ± 1.41 g), weight loss ($6.46\pm0.091\%$), moisture content ($74.64\pm0.035\%$), and color characters (L* 41.17 ± 0.97, a* 35.01 ± 1.64, and b* 34.42 ± 0.47). There was no significant difference ($P>0.05$) in mouthfeel (3.93 ± 0.82), aroma (3.86 ± 0.62), or overall acceptability (3.90 ± 0.607) as well as in crude protein ($1.30\pm0.02\%$), crude fat ($0.12\pm0.03\%$), total ash ($1.34\pm0.03\%$), and moisture contents ($74.64\pm0.03\%$) between naturally ripened banana and 500 ppm ethylene for 12 hours treated banana. Therefore, 3% SMS treatment was the most effective treatment for enzymatic browning and banana treated with 500 ppm ethylene for 12 hours showed the optimum ripening with desirable quality and sensory properties.

Keywords: *Enzymatic Browning, Ethylene, Natural Ripening, Rathambala Banana*

Development of King Coconut (*Cocos nucifera aurantiaca*) Water - Gotukola(*Centella asiatica*) Combined Refreshing Beverage and Analysis of Sensory, Physicochemical, Antioxidant and Microbiological Properties

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Herbal refreshing beverages are specialized drinks that combine herbal ingredients with electrolytes and other essential nutrients to help replenish and hydrate the body. This study aimed to develop a king coconut (*Cocos nucifera aurantiaca*) water and Gotukola (*Centella asiatica*) combined refreshing herbal beverage. The tender king coconut water (7-8 month matured) and Gotukola (matured) varieties were used for beverage preparation. King coconut water was mixed with Gotukola pulp in 98:2, 97:3, 95:5 ratios and filtered with 4-layer muslin cloth. Beverage was filled in sterilized glass bottles and pasteurized at 80°C for 1 minute. 97:3 of king coconut water: Gotukola was selected as the most consumer preferred sample with a mean overall acceptability of 4.48±0.50 for the 5-point hedonic test. The antioxidant properties, total phenolic content, titratable acidity, color, microbial properties and antibacterial properties were analyzed for the consumer preferred sample selected from sensory evaluation. The brix value of the beverage was reduced slightly during one month of storage time and there was no significant pH increment during the storage period (p>0.05). The beverage showed a titratable acidity of 0.30±0.00 (citric acid basis) and the viscosity of 1.10±0.01 mPas. The color values were L⋆ 26.66±0.64, a⋆ -1.70±0.00 and b⋆ 1.31±0.03 for the sample 867 which was not significantly changed over one month of storage (p>0.05). Furthermore, the IC_{50} value for the beverage was 220 ppm through DPPH radical scavenging assay and the total phenolic content was 364.92 GAE mg/L. Moreover, there was no yeast and mold development in the beverage during the first month of storage in the 4°C storage and showed a 1.65±0.15 cm inhibition zone against *E. coli* culture. As per the cost analysis, total cost per one-serving (200 ml) was around 130.00 LKR. Hence, the developed beverage could be recommended as natural beverage with potential health benefits.

Keywords: *Gotukola, Herbal Beverages, Inhibition Zone, Sensory Analysis, Titratable Acidity*

Development of a Plant-Based Spread Using Pumpkin Seeds, Sesame Seeds and Horse Gram

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Plant-based spreads are important as they offer a healthier, sustainable alternative to traditional butter, reducing saturated fat intake. In this study, a plant-based spread was developed using a combination of pumpkin seeds, sesame seeds and horse gram powder. The study examined different ratios of these ingredients to create the spread, focusing particularly on mitigating the grainy flavour of horse gram powder through four distinct methods: soaking and steaming horse gram seeds; soaking, steaming and oven drying at 80°C for 30 minutes; soaking in water with baking soda followed by steaming; and repeating the third method with an additional oven drying step at 80°C for 30 minutes. Consumer preferences regarding the use of pumpkin seeds with or without their seed coat were also assessed through paired comparison preference tests. Key indicators of rancidity, specifically the peroxide values for sesame and pumpkin seeds were found to be well below the acceptable threshold of 10 meq. 30 untrained panelists involved to evaluate the acceptability of the spread samples. The ratio of 5:3:1 for pumpkin seed powder, sesame seed powder and horse gram powder emerged as the most preferred. The proximate composition of selected sample has revealed total ash (2.01%), crude fat (36.11%), crude fiber (9.80%) and moisture content (1.91%). Its physicochemical properties, including pH (5.32) and water activity (0.24) provided insights into its stability and quality. Texture profile analysis, performed with a Brookfield texture analyzer, indicated hardness as 6.96 mJ and adhesiveness as 5.56 mJ. Spreadability measured using parallel plate method was noted as 5 cm^2g^{-1}. The shelf life of the product with no added preservatives was examined through peroxide value, total plate count and yeast and mold count for one month period, indicated that the product remained non-rancid and within acceptable microbial levels. The study revealed that there was a potential of developing a plant-based spread for health-conscious consumers, which needs further studies on composition of fat and product's shelf life.

Keywords: *Grainy Flavor, Horse Gram, Plant-Based Spread, Pumpkin Seeds, Sesame Seeds*

Detection of Pesticide Residue on Selected Leafy Vegetables (*Centella asiatica* and *Alternanthera sessilis*) from Organic Cultivations in Kalutara District, Sri Lanka

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Food contamination reduces food quality and poses health risks. Pesticide residues which are chemical contaminants, represent one of the greatest hazards to food safety. The present study aimed to evaluate pesticide residues in two commonly grown green leafy vegetables, *Centella asiatica* (Gotukola) and *Alternanthera sessilis* (Mukunuwenna) collected from organic farmers' fields randomly in the Kalutara district. Based on a preliminary survey, the study identified farmers' pesticide usage. Residue contents were assessed against five commonly used pesticides in Sri Lanka: Pymetrozine, Thiamethoxam, Novaluron, Profenofos, and Azoxystrobin. Samples were prepared using the quick, easy, cheap, effective, rugged, safe (QuEChERS) approach, following the official AOAC protocol. Retention Time and Mass Spectrum were used to confirm the presence of pesticides in concentrated samples after they were evaluated by LC-MS using a validated method. The limit of Detection (LoD) was 40 ppb for pesticide residue analysis. In the study area, 73.3% of *C. asiatica* and *A. sessilis* farmers used only biopesticides instead of synthetic pesticides. Among the organic farmers, *C. asiatica* was shown to be exposed to all five chosen pesticides. Profenofos, Novaluron, Thiamethoxam, and Pymetrozine were detected in *A. sessilis*. The Profenofos in *C. asiatica* was detected with the highest overall detection (14.0%). The Pymetrozine in *A. sessilis* was found to have the highest pesticide residue level (2.64 ± 0.00 µg kg^{-1}). Novaluron was detected in the highest amount (1.22 ± 0.45 µg kg^{-1}) in *C. asiatica* . Even though pesticide residues were found mainly due to the contamination, the content of pesticides detected in each sample did not exceed the maximum residual level (MRL). This study reveals that the leafy vegetables grown by organic farmers' fields are well controlled, and none of the pesticide residues exceed their MRLs and are safe for consumption. Furthermore, those MRLs are compatible with EU regulations and can be recommended for exportation.

Keywords: *A. sessilis, C. asiatica, Maximum Residue Level, Pesticide Residues, QuEChERS*

Development of Gluten Free Cookie by Using Composite Flours of Finger Millet (*Eleusine coracana*) and Oyster Mushroom (*Pleurotus ostreatus*)

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Finger millet (FM) (*Eleusine coracana*) is the third most vital cereal crop in Sri Lanka. The limited consumption of FM is attributed to the absence of ready-to-eat products at present. Oyster mushroom (OM) (*Pleurotus ostreatus*) recognized for its medicinal properties plays a critical role in meeting global demand for protein-rich foods. Incorporating OM augments the physicochemical attributes of carbohydrate-based products making OM infused cookies an attractive, nutritious alternative. The study aimed to develop a gluten-free nutritive cookie using composite flours of FM and OM without the addition of wheat flour. The raw and pre-gelatinized forms of FM flour were assessed for their water-oil absorption capacity, swelling power, bulk density, and water activity. Based on these properties, the raw FM flour was selected as the most suitable flour type for cookie preparation. The OM flour to FM flour were maintained at the ratios of 100:0 (C1), 10:90 (A), 15:85 (B), 20:80 (C), 40:60 (D), 0:100 (C2) to make the cookie formulations. The cookie with 20% OM flour (C) received the highest sensory acceptability from 30 untrained panelists. The proximate composition of treatment (C) was $2.49\pm0.593\%$, $44.01\pm0.15\%$, $16.25\pm0.12\%$, $23.29\pm0.00\%$, $12.24\pm0.00\%$, and $1.72\pm0.89\%$ of moisture, crude protein, crude fat, crude fiber, ash and carbohydrates respectively. The results showed no significant difference compared to control and market cookies ($P>0.05$) with along to treatment (C) in terms of textural properties. The shelf-life evaluation conducted over two weeks found that the total plate count, yeast and mold count, and peroxide value all complied with acceptable limits. However, the functional and biological properties need to be improved with a minimum shelf life of six months, compatible with market cookies. This research study explores developing gluten-free cookies using FM and OM for broader appeal.

Keywords: *Composite Flours, Finger Millet, Gluten-Free Cookies, Oyster Mushroom, Ready-To-Eat Products*

Assessment of Food Consumption Behaviour of Generation Z Compared to Generations X and Y; Rathnapura District in Sri Lanka

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Generation Z is a significant age group born between the mid-1990s and early 2010s and is conscious of health and sustainable food consumption. Rapid technological advancements, socio-political changes, and cultural shifts, unique environments have significantly influenced their attitudes, behaviours, and expectations toward food choices. This study identifies the food consumption behaviours of Generation Z, compared to Generations X and Y in the Ratnapura district, to address the nutritional issues in Sri Lanka. A pretested online and onsite structured questionnaire collected 1094 responses from 17 secretariat divisions with 392 Generation X, 313 Generation Y, and 301 for Generation Z. In this study, individuals' food consumption patterns deviate with age, income, education, geographical location, disease conditions, and social awareness. Generation Z was more health conscious and highly concerned about food quality, availability, and convenience. They demonstrate higher awareness of sustainable food choices at ($P < 0.05$) 61.50%, compared to 11.50% and 11.90% for Generation X and Y, respectively. Undergraduates have shown higher correlation 0.09 ($P < 0.05$) on food choices with education. In Generation X, Y, and Z, awareness of healthy food choices is 59.20%, 61.00%, and 71.80% respectively. Particularly, 30.90% of Generation Z reported that their busy lifestyle led them to skip considerations for food choices. Over 50.00% of respondents reported reading food labels before purchase, as per 52.00%, 59.70%, and 66.4% of Generation X, Y, and Z respectively. Generation Z in Rathnapura district has shown higher awareness and involvement in sustainable and healthy food choices. Despite barriers like awareness level, price, and economic status, this positive perspective of Generation Z can be harnessed to address challenges like non-communicable diseases, food insecurity, and malnutrition in Sri Lanka.

Keywords: *Food Consumption Behaviour, Generation X, Generation Y, Generation Z, Rathnapura District*

Natural Sciences and Technology

Removal of Profenofos Using *Madhuca longifolia* Plant Seeds and Coconut Shell Biochar in Aqueous Medium

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Extensive usage of pesticides is a global problem due to intensive agricultural practices. Phytoremediation like environmentally friendly green technologies is needed for the treatment of polluted natural water sources from pesticides for the well-being of the natural ecosystems. The objective of this study was to evaluate and compare the pesticide phytoremediation ability of *Madhuca longifolia* (Mee) plant seeds (MPS) with the adsorption ability of coconut shell biochar (CSBC). Profenofos was used as the model pesticide. The MPS was collected from the wet zone of Sri Lanka and CSBC was pyrolyzed at 350°C for two hours. Profenofos removal was analyzed for 7 days at different time intervals by MPS and CSBC. All the experiments were conducted at pH 7.0 and profenofos concentrations were analyzed using gas chromatography-mass spectrometry (GC-MS). A characteristic peak for profenofos was observed under optimized GC-MS conditions and hexane is used as the solvent. Both kinetic experimental results of MPS and CSBC samples were well fitted to the Fractional power model indicating a complex reaction mechanism was involved in the profenofos removal. Kinetic experiment data showed 77.98% of profenofos removal by MPS with a maximum adsorption capacity of 20.63 mg g^{-1} while 58.05% of profenofos removal by CSBC with a maximum adsorption capacity of 15.36 mg g^{-1} within 4 hours. After the third day, natural degradation of profenofos in control samples was observed. Desorption of adsorbed profenofos by MPS and CSBC was not observed until the seventh day. MPS showed a higher efficiency of profenofos removal than CSBC that indicating phytoremediation by MPS is a more successful method for organic contaminant removal than biochar at pH-neutral conditions. The findings of this study suggested that both MPS and CSBC can be used for profenofos removal from contaminated water in natural systems.

Keywords: Adsorption, Contaminant, Pesticides, Phytoremediation, Wastewater

Preparation of WO_3/$CaWO_4$ Composite Film and Its Application in Direct Water Splitting Under Solar Radiation

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This study explores the synthesis and application of WO_4/$CaWO_3$ composite films for direct water splitting under solar radiation to produce environmentally friendly hydrogen fuel. WO_3 and $CaWO_4$ were selected for their superior photocatalytic properties, stability, and ease of fabrication. WO_3, with a band gap of approximately 2.8 eV ensures strong light absorption and stability, while $CaWO_4$, possessing a wider band gap (4.0-4.5 eV) enhances charge separation efficiency when combined with WO_3, thereby improving overall photocatalytic performance. The synthesis process involves depositing a WO_3 layer onto fluorine-doped tin oxide (FTO) glass substrates. Initially, FTO glass is dipped into a solution containing $Na_2WO_4 \cdot 2H_2O$ and $NaNO_3$, followed by hydrothermal treatment to create the WO_3 layer. Subsequently, a $CaWO_4$ layer is deposited on the WO_3-coated FTO substrate by immersion in a solution prepared from $Na_2WO_4 \cdot 2H_2O$ and $CaCl_2$, followed by heating for proper coating. Characterization using X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), and UV-visible spectroscopy confirmed the films' desired structural and optical properties. Photocurrent measurements demonstrated significant enhancement in photocatalytic activity with the WO_3/$CaWO_4$ composite film compared to WO_3 alone. The WO_3 film exhibited a current density of 1.11×10^{-5} A cm^{-2} under solar radiation and 6.16×10^{-7} A cm^{-2} without solar radiation, while the WO_3/$CaWO_4$ composite film achieved 1.55×10^{-5} A cm^{-2}, a 36% enhancement under solar radiation. These experiments were conducted at 27°C and 1.01×10^5 Pa, with the electrolyte pH maintained at 7. Band gap measurements revealed 2.8 eV for WO_3 and 2.86 eV for the WO_3/$CaWO_4$ composite. Improved light absorption and efficient charge separation in the composite film contribute to the enhanced solar energy utilization. This research underscores the potential of WO_3/$CaWO_4$ composite films as effective photo catalysts for solar-driven water splitting, offering a promising avenue for sustainable hydrogen production and advancing renewable energy technologies.

Keywords: *Hydrogen Fuel, Hydrothermal Treatment, PEC Water Splitting, WO₃/CaWO₄ Composite Film*

In Vitro Bioactive Potential of Total Phenolic Content and Antioxidant Potential Investigation of Lichen *Roccella montagnei*

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The study examines the *In Vitro* pharmacological and bioactive capabilities of *Roccella montagnei*, a fruticose lichen, collected from a coconut plantation in Chilaw, Sri Lanka, focusing on its Total Phenolic Content (TPC) and antioxidant potential. Methanol and ethyl acetate were used in turn to extract the defatted lichens. Two subfractions were obtained from the concentration of the ethyl acetate fraction (RE) the ethyl acetate soluble fraction (RE_1) and the ethyl acetate insoluble fraction (RE_2). Three subfractions were obtained by concentrating methanol extract (RM), resuspending it in aqueous methanol, and partitioning it using dichloromethane and ethyl acetate: RMD, RME, and RMW (remaining aqueous fraction). The fractions RE_2 and RMD exhibited notable TPC amounts of 0.609 ± 0.005 mg GAE/g and 0.573 ± 0.007 mg GAE/g, respectively, and the RME exhibited the lowest TPC of 0.463 ± 0.017 mg GAE/g indicating their efficiency in extracting phenolic compounds due to their polarity. Phenolic content losses might arise due to Seasonal variations in temperature, rainfall, climate, nutrient condition, UV exposure, and photoperiod of *Roccella montagnei*. The fraction RE_2 exhibited the highest antioxidant potential for DPPH, ABTS, and FRPA assays followed by RM. The reported elevated antiradical characteristics of RE_2 and RMD may be due to the contribution of phenolic compounds, like phenolic hydroxyls. The inclusion of phenolic chemicals within these fractions probably plays a substantial role in their antioxidant capacity. Statistical analysis confirmed significance ($P < 0.05$) and positive correlations among TPC, and antioxidant activities of different extracts of *R. montagnei*. The law correlation coefficients stated that although phenolic molecules do play a role in antioxidant activity, they may not be the only factors influencing it. Overall, this study underscores the therapeutic potential of *Roccella montagnei* extracts, paving the way for further exploration of novel pharmaceutical interventions.

Keywords: *Antioxidant, Concentration, Correlation, Roccella, TPC*

Cleaner Production Assessment and Greenhouse Gas Emission Quantification of the Kids' Apparel Industry in Sri Lanka

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The kids' apparel industry has a major impact on the global economy, catering to the ever-evolving needs of children's clothing. According to the apparel industry, fabric offcuts represent the primary waste stream during the cutting and sewing operations. This waste ends up in landfills, contributing to environmental pollution and resource depletion. The industry faces growing pressure to address its greenhouse gas (GHG) emissions, which contribute to climate change and its associated detrimental effects. This cleaner production assessment focused on a representative kids' apparel industry in Sri Lanka and aimed to identify the normalized fabric waste generation for selected styles according to the different geographical locations (i.e., geographical proximity) based on the manufacturing process and quantify the emission of GHG in categories 1 and 2 according to the gate-to-gate approach. Data were collected mainly using continuous walkthrough inspection and estimation-based methods. A significant waste generation was observed in the cutting section (68.4%). Therefore, minimizing fabric waste generation in the cutting process reduces the normalized fabric waste per garment. According to the Pearson correlation statistical results, with a 0.09 p-value represents that there is no relationship between normalized fabric waste per garment and geographical proximity. Thus, it represents that the normalized fabric waste per garment varies with many factors such as waste management practices, legal requirements, customer specifications, and management commitment instead of geographical proximity. According to the quantifying GHG emission, category 2 (72%) is always more significant than category 1 emission. Therefore, minimizing the consumption of category 2 emissions leads to reducing overall GHG emissions. As recommendations, reusing fabric waste as a resource for making hand-crafting items by local people instead of exporting the total amount, developing a performance-based reward system to incentivize pattern makers to create innovative and waste-reducing patterns, implementing baseline standardization for style-wise possible waste generation can be considered.

Keywords: *Apparel, Cleaner Production, Fabric Waste, GHG Emissions*

Production of Bioplastics by Utilization of Edible Ferns and Investigation of Its Physical, Chemical, and Biodegradable Properties

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The world is shifting towards biodegradable materials, with the environmental impact of petroleum-based synthetic polymers and the sharp rise in petroleum prices. Bioplastics are one of the most inventive environmentally friendly materials recently. Bioplastic substitutes emerged with the emergence of renewable resources. This study focuses on harnessing cellulose derived from edible ferns including *Diplazium esculentum* (Miyenadalu) and *Blechnum orientale* (Bara-koku) to develop bioplastics, thereby increasing the value of these ferns while examining the physicochemical and mechanical properties of the resulting cellulose-based polymer. The process of cellulose isolation was accomplished using sodium hydroxide methods, followed by an extensive bleaching procedure with sodium hypochlorite. Subsequently, the cellulose side chains were oxidized using hydrogen peroxide. In the subsequent synthesis of bioplastics, glycerol was incorporated as a plasticizer to enhance the flexibility and durability of the material, while corn starch was utilized as the matrix, providing the necessary structural framework and integrity for the bioplastic. The ideal bioplastic comprised 100% starch, 100% glycerol, and 80% cellulose which ensured structural integrity and biodegradability. Characterization of the composites involved testing of water absorption capacity, UV resistance, biodegradability, and amylase. Water absorption capacity stabilized after an hour for all the types of bioplastics from both ferns and the patterns were varied with their composition, structure, and surface characteristics. No alterations were observed under UV exposure. During 30 days, they were degraded by environmental conditions of sunlight, humidity, and temperature. They were susceptible to hydrolysis by alpha-amylase and it provided valuable insights into the enzymatic activity and its potential applications in bioplastic production. The research successfully yielded bioplastic sheets, suggesting the potential applications in plastic bags and food packaging.

***Keywords**: Biodegradable, Bioplastics, Cellulose, Ferns, Starch*

Determination of Apparent Magnitudes of the Standards of Praesepe (M44) Open Cluster using CCD Aperture Photometry

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The determination of the apparent magnitudes of bright stars in the open cluster Praesepe (M44), also known as the Beehive Cluster, is crucial for understanding stellar properties and evolutionary processes within the cluster. The aim of this study was to determine the apparent magnitude of eight bright stars in the cluster, which was undertaken through the application of CCD aperture photometry reduction techniques utilizing the Image Reduction and Analysis Facility (IRAF) software. Data collection for the study was carried out by capturing CCD images through U, B, and V filters with the 45 cm Cassegrain telescope at the Arthur C Clarke Institute. Photometric calibrations were performed utilizing the photcal tool in IRAF after carrying out initial data reduction techniques for image correction. Transformation equations were then applied to determine the apparent visual magnitudes of the bright stars. The analysis revealed standard V magnitudes for the selected M44 cluster standards: 6.196, 6.307, 6.347, 6.402, 6.506, 6.829, 6.837, and 7.115, with uncertainties ranging from 0.001 to 0.003. These values are in good agreement with those from previous studies. However, observed color indices B-V and U-B showed significant deviations from standard values. Extended observation times of over 2 hours, among other factors, may have contributed to these deviations.

Keywords: *Apparent Visual Magnitude, CCD Images, Iraf, Open Cluster Praesepe, Photometry*

Email Analyzer Copilot

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The rapidly expanding realm of Artificial Intelligence is constantly pushing boundaries. Generative AI, an advanced technique, enables machines to produce high-quality text, translations, and even creative content. This initiative leverages this capability by introducing the Email Analyzer Copilot, a chatbot designed for Microsoft Teams. Its goal is to transform the way we engage with our emails. The main objective of this endeavor is to develop an interactive chatbot for Microsoft Teams utilizing Generative AI capabilities to converse, prioritize, and summarize crucial daily important emails in the inbox, streamline the email management processes and enhance productivity and efficiency. With the overwhelming volume of emails that professionals receive daily, it is increasingly difficult to sort through the clutter and identify those requiring immediate attention. The Email Analyzer Copilot was created to address this challenge. The project incorporates various technologies such as the Microsoft Bot Framework, Azure Bot Service, Generative AI, OpenAI GPT models, $C\#$, .Net, Adaptive Cards, Proactive Messages, Microsoft Teams, Microsoft Entra ID, and Microsoft Azure Portal. The advantages of the Email Analyzer Copilot include offering an effective method for email management and saving valuable time. By summarizing important emails, it ensures that users remain informed without the need to read through every single email. This results in enhanced productivity and guarantees that no critical emails are missed. Looking forward, there are numerous exciting possibilities for future enhancements. The system could be further personalized, incorporating features like setting reminders based on email content or integrating other productivity tools. Additionally, there is potential to explore the utilization of more advanced AI models for a deeper understanding of emails and more sophisticated responses. This project is a significant step towards the overarching goal of seamless human-AI interaction in daily tasks.

Keywords: *Adaptive Cards, Email Prioritization, Generative AI, Interactive Chatbot, Microsoft Copilot*

In vitro-Antifungal Potential of, *Pityranthe verrucosa, Pterospermum suberfolium*, and *Chloroxylon swietenia* Against Human Pathogenic Fungi

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This study was carried out to investigate the in vitro antifungal potential of leaves of three dry zone tree species found in Sri Lanka, *Pityranthe verrucosa, Pterospermum suberfolium* and *Chloroxylon swietenia*. The study aimed to assess the antifungal activity and to determine the zone of inhibition of crude extracts on *Aspergillus niger* (both human and plant pathogen) and human pathogenic fungus, *Candida albicans*. Plant materials were extracted using the sequential method of extraction using increasing order of polarity with n-hexane, dichloromethane, methanol, and water. The agar well diffusion method was used to evaluate the antifungal activity. The zones of inhibition against crude extracts were measured. Standard antibiotic drugs Nystatin and Itraconazole were used as the positive controllers for *C. albicans* and *A. niger*, respectively. 2% DMSO was used as the negative controller. The hexane extractions of all three plant species were active against *Candida albicans* and *Aspergillus niger*. The dichloromethane extractions of *C. swietenia* and *P. verrucosa* were active against *C. albicans*, and all the Dichloromethane crude extracts were active against *A.niger*. The methanol extract of *P. verrucosa* was active against both *C. albicans* and *A.niger*. The methanol extraction of *C. swietenia* also active against *A niger*. According to the results obtained, *P. verrucosa* has the highest antifungal activity against both *C. albicans* (zone of inhibition, Nystatin 17.67± 2.31 mm < 25.00 ± 3.61 mm Dikwenna) and *A. niger* (zone of inhibition 21.33 ± 4.16 mm). The results obtained suggest that the bioactive compounds in the leaves of these plants possess antifungal properties and may serve as a source of antifungal ingredients for the drug production for human diseases Candida infections and aspergillosis.

Keywords: *Pityranthe Verrucosa, Pterospermum Suberfolium, Chloroxylon Swietenia, In Virto Antifungal Activity, Human Pathogens*

Removal of Total Dissolved Solids in Latex Products Manufacturing Industry Wastewater Using Rice Husk

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Water reuse is currently a major concern of many industries to save costs. Certain industrial process water is not recommended for reuse due to high concentrations of total dissolved solids (TDS). Due to the excessive cost of conventional TDS removal techniques, industries are focused on cost-effective solutions in effluent TDS reduction. This study focuses to synthesize a cost-effective biosorbent using rice husk which is an abundant agricultural waste, to remove TDS in industrial effluents from a latex products manufacturing factory complex. Rice husk ash was impregnated with a 0.2 M calcium hydroxide solution $(Ca(OH)_2)$ to prepare lime impregnated rice husk ash (LIRHA). A batch study was conducted to assess how the pH (3-10), contact time (15-120 min), biosorbent dose (0.4-1.0 g 50mL^{-1}), and temperature (293-303 K) affect the adsorption capacity of LIRHA in removing TDS from the actual industrial effluent samples. A down-flow packed-bed column study was conducted to evaluate the practical application of LIRHA in TDS removal. The maximum dissolved solids adsorption capacity of LIRHA was determined as 23.42 mg g^{-1}, at pH 10 (20°C), with a biosorbent dose of 1g 50 mL^{-1} and 120 min contact time. The pseudo-first order model was the most fitting kinetic model which indicated the inclination of the adsorption process towards physisorption. The thermodynamic study exhibited the endothermic, and spontaneous nature of the adsorption process of TDS onto LIRHA. A 42.03% removal efficiency, with an adsorption capacity of 29 mg g^{-1}, was achieved through the column study at a bed-depth of 100 cm. Regeneration capacity of the biosorbent should be assessed in future studies to ensure the scaling up of the adsorption process.

**Keywords**: Column Study, Kinetic Model, Rice Husk, Total Dissolved Solids, Water Reuse

In Living Colour; Use of Fungal Based Pigments for Textile Dyeing

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The textile industry, a cornerstone of the global economy, heavily relies on synthetic dyes. Unfortunately, these dyes harm the environment and cause serious health hazards. Natural dyes have emerged as important and sustainable alternatives to synthetic dyes due to their non-toxic and non-polluting nature. Microbial pigments are gaining significant interest as natural dyes due to their high yield, industrial process scalability, and diverse colour palette. This research explores the use of natively isolated fungi as sustainable alternatives to synthetic dyes in the textile industry. The study began with fungal isolation and the preservation of pure cultures. The selected pigment-producing fungal cultures were cultivated on agar plates to obtain biomass for pigment extraction. Red and yellow colour pigments were extracted from agar culture plates, and their dyeability and suitability as textile dyes were tested using alum on 100% cotton fabric. The antimicrobial properties of the pigments were evaluated through the agar well diffusion method. Morphological characterization of fungi was carried out using the slide culture technique. The molecular characterization of fungal species was conducted through the PCR technique. Results from this study showed that both extracted pigments are capable of dyeing cotton fabric with mordants. The yellow pigment showed antibacterial activity against _Staphylococcus aureus_ (zone of inhibition, ZOI 23 $\pm$ 1 mm, positive control ampicillin 500 ppm 60 mm) and _Escherichia coli_ (ZOI 11 $\pm$ 1 mm, ampicillin 500 ppm 26 mm). Based on the colony and morphological characteristics, these fungi were identified as _Aspergillus sp._ and _Penicillium sp._, which produce yellow and red pigments, respectively. The study concludes that these pigments show promising results in the textile industry as natural colorants. Future research will focus on scaling up pigment production for commercial use, exploring the dyeing ability of non-cotton fabrics, and collaborating with industrial partners to develop eco-friendly production practices.

**Keywords**: Antibacterial Properties, Cotton Fabric, Pigment-Producing Fungi, Textile Dye

Microplastics in Surface Water and Sediments in Upper Walawa River Basin, Sri Lanka

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This study examines the presence and characteristics of microplastics (plastic particles <5 mm in size) in surface water and sediments in the upper Walawa River basin, Sri Lanka. Surface water and sediment samples were collected from seven sites in the River basin covering the main river, tributaries and reservoirs. Density separation and wet peroxide digestion were conducted to extract microplastics from surface water and sediment samples. Extracted microplastics were characterized according to their shape, color and size classes. Chemical characterization of microplastics was performed using Fourier Transform Infra-Red (FTIR) microscopy. The results indicated microplastic concentrations ranging from 12.6 to 24.0 items L^{-1} in surface water and 16.7 to 183.3 items kg^{-1} in the sediments in sampling sites. Among the seven sampling locations, the highest microplastic concentration in surface water (24.0 ± 23.1 items L^{-1}) and sediments (183.3 ± 83.9 items kg^{-1}) were observed in sampling sites impacted by human activities. The average microplastic concentrations in surface water and sediments were 18.5 ± 10.4 items L^{-1} and 71.4 ± 69.4 items kg^{-1}, respectively. The Pearson correlation coefficient (r=0.43) revealed a notable moderate positive linear correlation between microplastic concentrations present in both surface water and sediments. The most common shape of the microplastics detected was fibres in both the surface water (56%) and sediments (43%), while the most common colours found were purple and green in surface water (33%) and sediments (47%), respectively. The most common size class of microplastics found in both the surface water (33%) and sediments (50%) was 60-1059 μm. Polyvinyl chloride, polytetrafluoroethylene and polyethylene terephthalate were the most abundant polymer types recorded within the basin. The findings of the study suggest that the Walawa River basin is contaminated with microplastics, likely from sources such as plastic waste disposal, and domestic wastewater discharge. Further investigations are required in developing pollution remediation strategies.

Keywords: *FTIR, Microplastics, Sediments, Surface Water, Upper Walawa River Basin*

Evaluate the Phytoremediation Potential of Aquatic Macrophytes for Treating Leachate Generated at Kerawalapitiya Compost Yard, Sri Lanka

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The study describes the role of aquatic macrophytes in leachate treatment. Aquatic plants can effectively remove different contaminants from wastewater and thrive even in highly polluted water. Aquatic plants *Azolla pintata* and *Pistia stratiotes* were selected for the study to improve the quality of leachate generateded from Kerawalapitiya compost plant, Sri Lanka. A laboratory-scale experiment was conducted on a hundred times diluted leachate using the both aquatic plants. Water quality parameters were tested within 4-day intervals. Reduction efficiency of pH, TDS, TSS, turbidity, salinity, electrical conductivity and concentrations of phosphate, nitrate and trace metals including Pb, Zn, Ni and Cd were evaluated. The comparisons of reduction efficiency of effluents among control and treatments were compared using One way ANOVA. The results of the experiment indicated an increase of TDS, TSS, EC and salinity values in wastewater over time with *Azolla pintata* and *Pistia stratiotes* in experimental units. The experiment indicated that there was a significant reduction efficiency ($p > 0.05$) in nitrate, phosphate, trace metal concentrations while treating with the *Azolla pintata* and *Pistia stratiotes*. The results showed removal efficiencies for phosphate, nitrate, Cd and Ni were 86.25±2.16%, 82.53±10.34%, 41.51±0.85% and 43.83±8.11%, respectively with *Pistia stratiotes*. *Azolla pintata* had Zn and Pb removal efficiencies of 78.41±2.11% and 50.90±18%, respectively that were higher than *Pistia stratiotes*. The high removal efficiencies shown by both plants could potentially be related to the pollutants being absorbed through their root systems. In comparison, the *Pistia stratiotes*-based treatment system proved to be more effective in reducing contaminants from the leachate than the *Azolla pintata* based system.

Keywords: *Azolla Pintata, Leachate, Phytoremediation, Pistia Stratiotes, Reduction Efficiency*

Assessing Public Perceptions for Solar Energy Technology Adaption and Enhancing National Grid Sustainability in Colombo District, Sri Lanka

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Solar energy, in particular, has garnered attention as a clean and abundant resource with the potential to reduce reliance on conventional energy sources and mitigate carbon emissions. This research explores the potential benefits of sustainable energy practices, the public perceptions regarding the adoption of solar energy technology, and its impact on enhancing national grid sustainability in the Colombo district, Sri Lanka. The study adopts a quantitative research design, utilizing questionnaires for 75 solar consumers and 25 prospective customers residing in the Colombo district. The surveys include questions covering current energy usage, knowledge about solar systems, solar energy awareness, impacts of solar system installation, and future considerations (i.e., sun-tracking solar panels, printable solar cells). Statistical analysis was conducted using the SPSS 26 version. Results indicated that 74.7% of solar consumers utilized net accounting, 24% used net metering, and 1.3% were on net plus systems. Notably, 98.7% of consumers eliminated their electricity bills, while 78.7% contributed to providing surplus electricity to the national grid, thereby showcasing substantial benefits to both consumers and the national grid. However, challenges persist, with 100% of solar consumers facing issues such as high initial costs and 34.7% citing lost solar production during electricity power failure. In light of these findings, recommendations were proposed to enhance solar power adoption by 100% of respondents. These included tax exemptions for solar equipment purchases, providing low-interest loans for solar installations, and implementing advanced solar energy technologies to increase solar efficiency. Recycling initiatives for solar components received approval from 100% of respondents, emphasizing the importance of sustainable practices in the renewable energy sector. In conclusion, this study sheds light on the current landscape of solar energy adoption in the Colombo district, emphasizing its benefits, challenges, and potential strategies for further growth and sustainability.

Keywords: *National Grid Sustainability, Public Perceptions, Renewable Energy, Solar Energy Adoption, Solar PV Systems*

Performance Evaluation of Kubernetes CNI Plugins for the Cluster Environment for Dynamic Data Flows

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In recent years, container-based computing has become more popular due to the rapid spread of virtualization technologies and the rise of cloud computing. Containerisation technology offers a lightweight and isolated approach to deploying applications while ensuring consistent performance across various computing environments. Multi-clustering is a key approach to success in container technology, demanding special attention to the CNI plugins used for seamless connectivity between clusters and nodes. When configuring a multi-cluster environment, choosing the best CNI plugin with optimal performance is crucial, as resources are a critical factor. Container Network Interface (CNI) plugins are the standard Kubernetes clusters used to connect container networks. This enables communication between connected pods and facilitates integration with other systems. This research explores the performance evaluation of Kubernetes CNI plugins in multi-cluster environments, specifically focusing on dynamic data flows. To examine the behavior of CNI plugins in container networking, this study evaluates their performance within multi-cluster environments experiencing dynamic data flows. This research investigates the performance of CNI plugins like Calico, Flannel, Kube-router, and Weave Net, considering parameters like bandwidth, CPU, and RAM utilisation. The evaluation process for CNI plugins was conducted in a systematic manner using k8s-bench-suite tool, ensuring individual assessment of each plugin in multi-cluster environment according to the evaluation criteria. Considering the overall results, Flannel offered solid overall performance as the CNI plugin for a multi-cluster Kubernetes environment, accommodating both dynamic and static data flows. This research lays the groundwork for further investigations into security vulnerabilities, congestion management, and jitter handling capabilities of CNI plugins to complement performance evaluation for dynamic data flows in Kubernetes clusters.

Keywords: *Cluster Computing, CNI Plugins, Dynamic Data Flows, Multi-cluster Environment, Virtualization*

Isolation of Endophytic Bacteria Antagonistic to the Pathogens Associated with the Circular Leaf Spot Disease of Rubber (*Hevea brasiliensis*) Plantations

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Biological control agents are a vital requirement regarding the integrated disease management system. Combating financial and ecological issues related to the overuse of fungicides for rubber has become essential. This study aims to isolate endophytic bacteria that are antagonistic to the Circular Leaf Spot Disease causative fungal species: *Colletotrichum siamense (C6), Colletotrichum fruticola (C8), and Pestalotioides genera (P44 and P20)*. Endophytic bacteria were cultured from the clone RRIC 100. Four bacterial isolates were obtained and purified via the streak plate method. Fungal subcultures were grown simultaneously. A dual culture test was used to identify the antagonistic bacterial isolates towards the causative fungal types. Percentage Inhibition of Radial Growth (PIRG) values were calculated for each replicate. The pathogenicity of the bacterial isolates was tested using leaf assay tests. Morphological and microscopic characteristics of pathogenic fungi were investigated. Inhibition of bacterial isolates towards fungal isolates was different (variation in PIRG values). No significant difference existed between the inhibition of fungal isolates within an isolate ($p > 0.05$). Pathogenicity tests confirmed no pathogenicity effect of bacterial isolates on rubber leaves. There was no statistically significant distinction between the average growth rates of fungal isolates in days 2 and 4 ($p > 0.05$). Results on days 6 and 8 showed a disparity in average growth rates between fungal isolates ($p < 0.05$). Results conveyed a significant difference between the means of fungal lengths and widths of the causative fungi ($p < 0.05$). The highest and lowest spore counts were reported for C6 and P44 causative fungi. This study evidenced that the isolated bacteria are antagonistic to the experimented causative fungi. Antagonistic bacteria are recommended for further testing as biological control agents under *in vitro* conditions.

Keywords: *Biological Control, Dual Culture, Endophytic, Pathogenicity, Rubber*

Socio-Economic and Environmental Impact of Solid Waste Management Center, Ratnapura, Sri Lanka

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In Rathnapura, a region renowned for its rich biodiversity and natural resources, effective waste management is essential to safeguarding environmental and human health. This study seeks to evaluate the impact of solid waste management practices at the Solid Waste Management Center (SWMC) in Kanadola, Rathnapura under three categories: impact on public health, impact on social well-being and happiness, and impact on the health of the nearby ecosystem. A questionnaire survey consisting of 79 respondents was conducted to collect data from three separate groups (i.e., households within a range of 25-500 meters from the SWMC, employees involved in operations at the SWMC and commercial residents in Rathnapura city) in January-February 2024. The data was examined using a One-Sample t-test and Chi-Square to identify any impact of SWMC operations on residents of the area and to identify any correlation between distance from the SWMC and seven variables including air, water and sound quality, mental and physical health, quality of life and test related pests, respectively. IBM SPSS ® package (version 29.0.2.0) was used to conduct the statistical analysis. The findings show that there are negative impacts of SWMC operations on residents of the area and the environment. There was no notable correlation between the distance from the SWMC and the listed factors. However, the presence of increased housefly populations in certain areas near the SWMC poses a serious health risk in the near future, thereby highlighting the need for remediation strategies. Several valuable suggestions including proposals to resolve waste sorting issues were derived from the second and third groups involved in the survey. This research offered important information on the social and economic impacts of waste management and highlighted the significance of sustainable waste management approaches. The results will guide policymakers and waste management practitioners to enhance environmental sustainability and community welfare in the studied areas.

Keywords: *Circular Economy, Environmental Sustainability, Open Dumping, Waste Management*

Sport Science and Physical Education

Moral Growth Among Sports and Non-Sports Undergraduate in Sabaragamuwa University of Sri Lanka

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Moral growth or moral development is a fundamental aspect of human maturation that encompasses the formation of an individual's ethical beliefs, values, and behaviors. This study explores the distinctions in moral growth between sports and non-sports undergraduates at Sabaragamuwa University of Sri Lanka (SUSL). This study lies in understanding how participation in sports influences the moral development of university students, which can inform educational policies, promote character development through extracurricular activities, and help design programs that foster holistic growth among undergraduates. Employing a cross-sectional design within a quantitative framework, a sample size of 375 undergraduates was selected from eight faculties using a multistage sampling technique. Among the sampled population, 169 were involved in sports, while 206 were not. Data were collected through a standardized questionnaire measuring seven dimensions of moral growth: global morality, honesty, compassion, fairness, loyalty, purity, and respect. Statistical analyses, such as general linear regression, Mann-Whitney U tests, and Kruskal-Wallis tests, were performed using R software to evaluate the differences in moral characteristics between sports and non-sports undergraduates. The results indicate significant disparities ($p<0.05$) in moral growth characteristics, including global morality, honesty, compassion, fairness, loyalty, purity, and respect, between the two groups. Furthermore, the relationship between these moral dimensions and experience also demonstrated significant differences ($p<0.05$). Interestingly, purity and respect exhibited significant discrepancies across the eight faculties, while no significant differences were observed in global morality, honesty, compassion, fairness, and loyalty among faculties. These findings underscore the importance of sports participation in fostering specific dimensions of moral growth among university undergraduates, while also highlighting variations in moral development across different academic disciplines.

Keywords: *Academic Discipline, Behaviors, Ethical Beliefs, Moral Development*

Breaking Barriers: A Comprehensive Study on Physical Activity Among Transgender Individuals in Sri Lanka

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This study aims to fill in the gaps in knowledge regarding the experiences of transgender people who engage in physical activities in Sri Lanka. Sri Lankan society is culturally strict and does not speak much about Lesbian, Gay, Bisexual, Transgender, Queer (LGBTQ+) issues. Transgenders are people who have a gender identity that does not match the sex they were normally assigned at birth or expected to be. They can change their sex into another with the help of medical treatments such as Cross-sexual Hormone Treatment (CHT) and Gender-Confirming Surgery. The prime aim of this study was to identify the challenges transgender individuals face while participating in physical activities. The study examined transgender community (n=10), aged 20-30, males and females snowball sampling, semi-structured interviews and thematic analysis were used to analyse the data. The study, which was qualitative research, identified two core themes: barriers and facilitators for young transgender adults participating in physical activities. Participants discussed internal and external barriers, such as sexual nonconformity and body dissatisfaction, and found that body satisfaction and other factors influence their participation. Study revealed that transgender males (n=7) and females (n=3) engaged in physical activities, with males (n=4) engaged in fitness training, engaged in home workouts (n=2), and females (n=2) preferring dance. Participants stated that they faced discrimination, stigmatization, harassment, and anxiety caused by other thoughts, and addressing names and that they did not have a chance to participate in competitions after the transition. The study reveals that Gender incongruence (F=6, 60%), body dissatisfaction (F=7, 70%). Externally, changing facilities in sports venues (F=10, 100%), and sport-related clothing poses challenges (F=7, 70%). Facilitators include internal motivators the accentuation of body changes as a motivator (F= 10, 100%). In conclusion, this research investigates the physical challenges faced by transgender individuals in Sri Lanka, aims to identify discrimination, and promote a safe environment for physical activities, enhancing the mental and physical well-being of the transgender community.

Keywords: *Barriers, Physical Activities, Sri Lanka, Transgenders, Transition*

Development of a Mechanical Cricket Bowling Projection Platform for Training Asian Players on SENA Pitches

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A mechanical cricket bowling projection platform (the platform) that faithfully replicates the playing conditions specific to the SENA nations—South Africa, England, New Zealand, and Australia—has been developed. The platform is designed to assist Asian cricket players in enhancing their performance at both international and national levels by replicating the lively bounce and seam typical of SENA pitches, which present challenges to Asian batsmen accustomed to slower and flatter pitches. The current training procedure includes throwing balls onto a granite surface to emulate the bounce. However, accurately replicating the seaming conditions has been found to be nearly impossible. The platform utilizes servo motors and mechanical links and joints, to recreate realistic bounce and seam conditions. We conducted a stress analysis test focusing on key criteria such as stress levels, displacement, strain, and factor of safety, with a minimum factor of safety value of 1.6 for the Computer-Aided Design (CAD) model. By providing a controlled and challenging training environment, the platform enables Asian batsmen to refine their techniques, build confidence, and develop effective strategies for international matches. To ensure accurate timing of motions, a prototype built with an Arduino Uno was also developed. A motion simulation was also carried out prior to defining configurations. Automated configurations, depending on the angles created by the actuators, were identified for predefined states. The significance of this study lies in its potential to enhance the performance of Asian cricket players in SENA countries and drive advancements in cricket training technology. We also identify areas for further improvement, including enhancing motor capacity, optimizing mechanisms for smoother operation, developing the user interface for the control system, and conducting extensive testing and validation with cricket players and coaches.

Keywords: *Cricket Training, International Cricket, Performance Enhancement, Simulation*

Design and Development of a Three-Degree-of-Freedom Cricket Bowling Machine for Enhanced Training and Performance Analysis

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Cricket is a popular game primarily involving batting, bowling, and fielding. Various practice methods have been developed to enhance cricketers' skills. This research presents the design, development, and evaluation of an advanced cricket bowling machine featuring three degrees of freedom (DOF), which is a part of an integrated cricket training system. The machine is engineered to simulate various bowling styles and conditions, providing a versatile tool for player training and performance analysis. The three DOFs allow for precise control over the ball's release point, speed, spin, and trajectory, mimicking the variations seen in real-world bowling. The machine's design and fabrication were implemented in several steps with constructive variations. All the designs were implemented using Solid-Works software. The initial design faced weight distribution, center of gravity, and stabilization issues. In the second stage, adjustable legs with screw bars were introduced for easier height adjustment, and structural enhancements such as supportive box bars and a crossbar with a worm gear system were added for better load distribution and directional control. The machine's wheels and motors were mounted on a sliding system with bushings, enhancing overall functionality and stability. The bowl projection was powered by two permanent magnetic DC motors (PMDC). After fabrication, the machine was tested for the projection distance for different projection angles from -5 to +5 degrees. The spin part is yet to be developed in the machine with the speed controlling of DC motors separately. The projection distance for the tested angles varied from 9 m to 14 m, making it a suitable machine to demonstrate real-world bowling conditions for the batting practice sessions.

Keywords: *Bowl Projection Variation, Cricket Dynamic, Mechanical Design, Sports Engineering*

Computer Application for Aptitude Test in Sport Degree Programmes

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The purpose of this study is to develop a computer application to automate the fitness test results of sports degree programs at Sabaragamuwa University. The goal is to replace manual assessment methods with automated systems, promote fairness and improve efficiency, accuracy and fairness by ensuring user-friendly interfaces and robust data security. First, the computer application was developed, which included check-in, registration, scoring, and medical clearance. The application was developed using Java and MySQL. Java programming language is used to develop the application and MySQL is used to maintain the database. Activation is through the Windows app. The accuracy of the application was tested through a model fit test that evaluated both the manual and the developed desktop application. Comparing the results obtained through the manual and the application to check the accuracy. Tested by 10 students to ensure 100% accuracy. Conduct logic test to get application accuracy. Using a random sample of 120 female students. The result is 60% correct and 40% incorrect. A study was conducted to analyse software application for examination management including password and OTP security authentication, registration and mark collection using a questionnaire by 10 Sabaragamuwa University Aptitude Test Administrators. Feedback on login, OTP secure password functionality, registration process, user-friendliness and color palette Very Easy (80%), Useful (90%), Excellent (90%), Very Efficient (70%) and Loved (40%), respectively. The majority of administrators were completely (90%) satisfied with the software. Accuracy should be further developed by incorporating permanent broad jump test standards.

Keywords: *Aptitude Test, Automated Evaluation, Data Security, Sports Degrees*

Sports Personal Knowledge on Anti-Doping and Sports Law: Reference to Balangoda Education Zone

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Sports doping is a long-standing problem with effects that go beyond the global arena and impact local sporting communities. Purpose of this study was to find out the sport personal knowledge on anti-doping and sport law in athletes, coaches, Physical Education (PE) teachers and Sports Administration Officials (SAO). A random sampling method was employed to select a sample (n=94) from the Balangoda Zone. This observational study adopts a quantitative approach. Criterion variables of this study was understanding of Anti-Doping Regulations (ADR), Anti-Doping Education (ADE), Sports Law Knowledge (SLK) and Student-Athlete Welfare (SAW), by using an extensive questionnaire. Data were analysed by using descriptive statistics. Student athletes display moderate understanding (SLK: 2.38, ADE: 2.66, ADE: 2.98), with high awareness of SAW (3.42). Coaches exhibit fair awareness (ADR: 3.00, SAW: 3.50), needing improvement in ADE (2.75) and SLK (2.40). Physical Education teachers were showed intermediate knowledge (SLK: 2.60-3.05, SAW: 3.35). SAO demonstrate variable understanding (3.00-3.50). Results of the study revealed that there were certain areas of strengths, such understanding of Anti-Doping Regulations, Anti-Doping Education and Student-Athlete Welfare and there are still significant knowledge gaps, in knowledge of coaches about Anti-Doping Regulations and Student-Athlete Welfare. This study recommends to promote the inclusion of anti-doping instruction in physical education and sports science curricula that will help to foster an ethical culture in children from a young age.

Keywords: *Anti-doping Regulations, Clean Sport, Sports Law Knowledge*

Influence of Sports Facilities and Tourist Attractions on the Economy in Sri Lanka (Down South)

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In recent years, the development of sports facilities and tourist attractions has played a pivotal role in driving economic growth and fostering sustainable tourism in the region. Sri Lanka's economy is projected to see moderate growth of 2.2% in 2024, showing signs of stabilization, following the severe economic downturn of 2022 with tourism contributing approximately 5.3% to the national economy. Sports tourism has emerged as a significant contributor to the Sri Lankan economy, attracting a growing number of international visitors each year. This study analyzes the economic implications of sports tourism based on empirical data from the past decade. Key findings reveal that the number of international tourists visiting Sri Lanka primarily for sports-related activities has steadily increased by an average of 8% annually. Financially, sports tourism generates substantial revenue, with an estimated contribution of over $150 million annually to the Sri Lankan economy. This revenue encompasses spending on accommodation, dining, transportation, and sports-related expenditures. Moreover, sports events and tournaments hosted in Sri Lanka significantly boost local businesses and employment in the tourism sector. Data were collected from 87 tourists using a random sampling technique, by a questionnaire to interpret qualitative data, identifying key trends and insights from respondents' feedback, and a Likert scale was utilized to measure visitors' satisfaction with various sports facilities and tourist attractions. Findings reveal a diverse demographic of visitors with varying preferences in activities and attractions. Popular sports facilities included surfing spots (53.8%), diving centers (40%), and yachting facilities, which received generally positive ratings on the Likert scale. The findings indicate a substantial and growing contribution from sports tourism to the Sri Lankan economy, highlighting its potential as a key driver of economic prosperity and cultural exchange on a global scale.

Keywords: *Foreign Reserves, Inflation, Investments, Political Influence*

Demographic Determinants of Olympic (Summer / Winter) Success: An Analysis of Age, Height, Weight, and Medal Achievements

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This study aims to analyze the demographic and performance characteristics of athletes in the Olympic Games to identify patterns and trends related to age, height, weight, and medal achievements, addressing a significant research gap in the comprehensive understanding of how these variables collectively influence athletic success. The dataset includes variables such as age, height, weight, team, sport, and medals won by athletes across various Olympic events, covering 66 sports including Archery, Athletics, Taekwondo, Tennis, Volleyball, Weightlifting, Wrestling, and more. The methodology included a data set of 269731 data, data cleaning, statistical analysis, and visualization, including scatter plots, bar charts, and correlation matrices, to explore the distribution of age, height, and weight groups and their relationship with winning medals. Key findings revealed that certain age groups, particularly 30 to 34 years, had a higher probability of winning medals relative to the number of participants, suggesting that peak athletic performance often occurs in this age range due to experience. The distribution of height groups showed that athletes between 171 cm and 190 cm in height tend to win more medals, but they only represented about 15% of the participants. This percentage increases to 24% in the 191 cm to 210 cm category and 33% in the taller category, indicating that specific sports may favor particular height ranges. The correlation analysis between height, weight, and age with medal wins indicated a moderate positive relationship. The heatmap showed that the values along the diagonal are all 1.00, indicating a perfect correlation with themselves. A value of 0.79 indicates a strong positive correlation between height and weight, while a value of 0.06 indicates a weak positive correlation between height and age. The number of medals awarded has been increasing over time for both males and females. The study concludes that demographic factors such as age, height, and weight significantly influence the likelihood of winning medals in the Olympics. These findings offer valuable insights for athletes, coaches, and sports organizations to optimize training and selection strategies.

Keywords: *Olympic Games, Success Trends, Weight Distribution*

Investigation of Dietary Habits in Sports Sciences Undergraduates During the Financial Crisis in Sri Lanka After 2022

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Sri Lanka's economic downturn has resulted in significant food price increases and unemployment and it was impact on life style of the Sri Lankans. This study aims to investigate the dietary habits of Sports science (SS) students enrolled in public universities in Sri Lanka during the financial crisis. All SS students who followed sports sciences degree programs were invited to the study, and a total of 520 students (males = 239, females = 281) were responded. A questionnaire was made and standardized with the advice of experts in the field of data collection. Its reliability value was (P=0.74) Descriptive statistics were applied to examine data on dietary habits, food frequencies, and demographic characteristics. The Mann-Whitney U test evaluated differences in eating habits before and after the crisis, with significance levels set at 95%. Additionally, the Kruskal-Wallis H test explored differences in habit changes across universities using SPSS version 21. Significant differences were reported in breakfast (P¡ 0.001), lunch (P = 0.008), dinner (P = 0.019), and snack consumption (P= 0.007) after the crisis. Further, significant differences were reported in the consumption of vegetables (Z = -3.31, P =0.001), fruits (Z = -3.02, P =0.002), fast food (Z =-2.65, P =0.008), nutritional supplements (Z =-0.30, P =0.766), and alcohol (Z =-0.64, p =0.525). Dietary habits remained stable across gender groups before the crisis. There was a significant reduction only in snack consumption after the crisis (z = -2.120, P =0.034). Moreover, the Kruskal-Wallis test highlighted significant differences in behavioural changes across universities in nutritional supplements (P =0.006). It could be concluded that the frequency of breakfast, lunch, dinner, and snack consumption was reduced and meal skipping was increased after the financial crisis. Further, the reduction of vegetable, and fruits consumption reflect that quality of food consumed was reduced. Therefore, a careful consideration must be performed on the dietary requirement and the quality of the diet of the students.

Keywords: *Dietary Habits, Financial Crisis, Food Frequency*

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