Towards a Smarter, Resilient World: From Innovations to Impact

APSURS

SABARAGAMUWA UNIVERSITY OF SRI LANKA

4th Applied Sciences Undergraduate Research Symposium 2025

ABSTRACTS

"Towards a Smarter, Resilient World: From Innovations to Impact"

14th August 2025
Faculty of Applied Sciences
Sabaragamuwa University of Sri Lanka
Belihuloya

APSURS 2025

Applied Sciences Undergraduate Research Symposium

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APSURS 2025

Applied Sciences Undergraduate Research Symposium
https://www.sab.ac.lk/app/apsurs/

Organized by the Faculty of Applied Sciences of the Sabaragamuwa University of Sri Lanka
14th August, 2025

ISSN 3093-5733

APSURS 2025 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.

Editor-in-Chief : Prof. R.G.U. Jayalal

Published by : Sabaragamuwa University of Sri Lanka
Contact : info@apsurs.sab.ac.lk

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Message from the Vice Chancellor

As the Vice Chancellor of Sabaragamuwa University of Sri Lanka, I'm honored to pen this message for the fourth annual Applied Sciences Undergraduate Research Symposium (APSURS) publication. It's truly inspiring to see our Faculty of Applied Sciences organize this important event under the theme, "Towards a Smarter, Resilient World: From Innovations to Impact." This theme speaks directly to the core mission of our university: to foster innovation, drive meaningful change, and prepare our students to tackle the complex challenges facing our world.

This symposium provides an invaluable platform for our undergraduates to present their research findings to a broad scholarly and industrial community. By doing so, they are not only sharing their hard work but also demonstrating their potential as future researchers and innovators. The connections they forge with internal and external researchers, as well as with leading industries, are crucial. These interactions open doors to significant academic and career opportunities, research collaborations, and even immediate job prospects.

The APSURS encourages our students to explore both local and global trends within their fields. It serves as a forum for them to share new developments, technologies, and skills, fostering a spirit of shared knowledge and collective advancement. Such events are vital for cultivating a vibrant research culture within our university and beyond. They prepare our students not just to be participants in their respective fields, but to be leaders who can make a real and lasting impact.

I extend my heartfelt congratulations to the Faculty of Applied Sciences for their dedication and effort in organizing this symposium. I also commend all the undergraduate participants for their commitment to research and for contributing to this year's publication. Your work is a testament to the bright future of scientific inquiry and innovation in Sri Lanka and globally. I wish all the participants a successful and enriching experience.

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

Message from the Dean

The Faculty of Applied Sciences is dedicated to cultivating resourceful, lifelong learners who possess the essential knowledge and skills in their respective disciplines. With a strong emphasis on fostering a growth mindset, the Faculty empowers students to make meaningful contributions to academia, industry, and society.

The Applied Sciences Undergraduate Research Symposium (APSURS) 2025, held under the theme "Towards a Smarter, Resilient World: From Innovations to Impact," represents a significant milestone in the undergraduate journey to showcase their independent research, inventions, and innovations. The symposium also showcases the Faculty's rich academic diversity by featuring a broad spectrum of disciplines, including Natural Sciences, Computer Science, and Sport Science & Physical Education. It is designed to provide an enriching experience for our young scientists by incorporating all the key elements of a distinguished scientific conference.

As the Dean of the Faculty, it is a great pleasure to witness the enthusiasm and dedication of both our undergraduates and academic staff in striving for the success of this inaugural symposium. I extend my heartfelt gratitude to the students who submitted their research work, their supervisors for their invaluable guidance, and the remarkable members of the APSURS 2025 Organizing Committee, led by the Symposium Chair, for their exceptional efforts. Beyond serving as a forum for academic exchange, I envision APSURS evolving into a flagship event that fosters innovation, nurtures a culture of inquiry, and inspires a new generation of researchers. As the symposium continues to grow in scope and impact in the years ahead, I am confident it will gain well-deserved international recognition and establish itself as a prestigious forum for undergraduate research excellence.

Professor R.M.K.T. Rathnayaka
Dean - Faculty of Applied Sciences
Sabaragamuwa University of Sri Lanka

Message from the Symposium Chair

It is with great pleasure that I extend this message on behalf of the Organizing Committee of the 4th Applied Sciences Undergraduate Research Symposium (APSURS 2025), organized by the Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka.

Guided by this year's theme, "Towards a Smarter, Resilient World: From Innovations to Impact," APSURS 2025 stands as a platform for undergraduate researchers to share their discoveries and ideas that address real-world challenges. The symposium features contributions across four disciplines under the themes of Food Science & Chemical Technology, Natural Sciences & Technology, Physical Sciences & Computing, and Sports Science & Physical Education, reflecting the richness and relevance of student-led research.

This year's symposium was further enhanced with two of pre-conference workshops designed to build essential academic and entrepreneurial skills, including abstract writing and a pannel discussion 'From Concept to Product;Building Entreprenurial Skills'. We are especially proud to present the "Idea Ignition" Pitching Competition, a unique opportunity for students to transform ideas into real-world solutions, with the support of mentors from both academia and industry.

We are honored to welcome Senior Professor Buddhi Marambe as our keynote speaker and deeply value the support of our plenary speakers, panelists, academic reviewers, and judges. I extend my sincere appreciation to the Vice Chancellor, Dean of the Faculty, and all department heads for their continued encouragement, as well as to Avon Pharma for the Gold Sponsorship and FADNA Group of Companies and the Alumni of the faculty of Applied Sciences for their generous contributions.

APSURS 2025 is a result of the collective effort of academic staff, non-academic staff, students who joined with enthusiasm, and external collaborators. I warmly congratulate all authors and presenters for their dedication and enthusiasm. May this experience inspire our young researchers to continue striving for innovation with purpose, resilience, and impact.

Dr. Choshani Dalukdeniya
Symposium Chair - APSURS 2025
Sabaragamuwa University of Sri Lanka

Keynote Address by Professor Buddhi Marambe

The breakthroughs in science and technology pose a wide range of opportunities, as well as unforeseen challenges for the future. The scientific fictions we heard about a decade ago are quickly becoming a reality. In this context, young scientists have significant roles to play not only in the scientific sphere, but also in engaging with other stakeholders for a better and sustainable future of human beings and the planet.

A social dialogue among all stakeholder groups is a necessity to ensure that the benefits of technological innovations, economic growth and global trade are enjoyed equitably and sustainably. The 4th Undergraduate Research Symposium (APSURS 2025) of the Faculty of Applied Sciences of the Sabaragamuwa University of Sri Lanka, with the theme "Empowering Young Scientists for a Sustainable Future through Innovation and Research", highlights this pressing need.

Professor Buddhi Marambe
Faculty of Agriculture
University of Peradeniya

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Environmental and Natural Resources

Towards a Smarter, Resilient World: From Innovations to Impact
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Evaluating the Impact of Rainwater-based Well Recharge on Groundwater Quality and Levels in Selected Areas of Anuradhapura, Sri Lanka

Prasadhi H.M.R. [1*], Jayawardana J.M.C.K. [1], Wanniarachchi D.N.S. [1], and Ariyananda T. [2]

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Groundwater plays a pivotal role in meeting the domestic and agricultural water needs of the rural communities in the Anuradhapura district, Sri Lanka. Excessive extraction of groundwater has led to a decline of the groundwater level and depletion of the water resource in the region. Artificial Recharge (AR) of groundwater by harvested rainwater is considered as an alternative to safeguard groundwater against its overexploitation and quality degradation. The objective of this study is to identify the effects of rainwater recharge on water level and water quality changes (pH, electrical conductivity (EC), and total dissolved solids (TDS)) in wells in the region. Groundwater levels were recorded and samples were collected from ten wells in the region before and after the rainwater recharge. Water samples were also collected from three control wells that were not recharged from rainwater. Water quality variations in wells before and after the recharge were compared in recharged and control wells using the t-test. The results indicated significant differences ($p<0.05$) in water quality parameters before and after the rainwater recharge. pH levels decreased from an average of 8.02 before recharge to 6.8 after recharge. Electrical Conductivity levels decreased significantly from 1007.8 µS/cm to 683.6 µS/cm, and TDS levels reduced from 502.8 ppm to 341.4 ppm. Water level in wells increased from 4.8m to 5.4m. Further, the results indicated that there were no significant differences in water quality parameters in control wells that were not artificially recharged during the period of measurements. The findings of the study suggest that the rainwater recharge of wells is an effective way of improving the well water quality. It also highlights the importance of rainwater recharge as a sustainable practice for groundwater management, particularly in other areas that face water quality challenges.

Keywords: *DS, EC, Groundwater Quality, pH, Rainwater Recharge*

ID: NR05

Extraction and Characterization of Microcrystalline Cellulose from Snake Plant (*Sansevieria trifasciata*)

Darshana R.I.B.M. [1], Banneheka D.G.B.M.G.J. [1], Sankalpani P.S.S. [1], Sashika S. [1], Sandunika D.M.M. [1], Pathirana M.P.M.S. [1], Millavithanachchi S.S. [1,2], Galpaya G.D.C.P. [2], and Gunasena M.D.K.M. [1,2*]

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Microcrystalline cellulose (MCC) has diverse uses in the pharmaceutical, food, and cosmetic sectors due to its compressibility, biocompatibility, and binding properties. These characteristics make it an excellent biopolymer for such applications. Traditional methods of MCC production rely on wood pulp, which involves high manufacturing costs and environmental concerns. Snake plant (*Sansevieria trifasciata*) is an abundant ornamental and medicinal plant that can serve as an alternative source for MCC production, due to its high cellulose content, offering a low-cost and sustainable option. Initially, snake plant leaves were subjected to washing, drying, and milling to remove impurities and enhance cellulose accessibility. The pre-treated material then underwent alkali treatment, bleaching, and acid hydrolysis, followed by purification. The MCC yield obtained was 28.68%, and it was characterized using X-ray diffraction (XRD) and Fourier-transform infrared spectroscopy (FTIR) to assess its physicochemical properties and potential industrial applications. The isolated MCC had a pH of 2.75, with 0.12% moisture content and 0.17% ash content. XRD analysis indicated that the isolated MCC exhibited high crystallinity, as evidenced by its characteristic diffraction peaks. The crystallinity suggests good structural integrity and suitability for industrial applications. The FTIR analysis confirmed the chemical structure of MCC by showing all the characteristic functional group peaks. These findings demonstrate that MCC derived from snake plant meets the essential structural and chemical criteria for industrial uses. Overall, the outcome of this study reveals that MCC produced from snake plant is an ideal substitute for commercial MCC, highlighting its potential as a significant component in the pharmaceutical, packaging, and cosmetic industries.

Keywords: *Biopolymer extraction, Industrial applications, Microcrystalline cellulose, Sansevieria trifasciata, Sustainable materials*

ID: NR16

Development of an Efficient Micropropagation Protocol for *Exacum macranthum* (Binara): A Species of Conservation Significance and Commercial Potential

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Exacum macranthum, an endemic and nearly threatened plant species of Sri Lanka, is valued for its ornamental light purple flowers with yellow anthers. However, its propagation is hindered by low seed germination rates, specific germination requirements and the time-consuming nature and limited scale of vegetative propagation via stem cuttings. To overcome these limitations and enhance conservation efforts, the establishment of an efficient micropropagation protocol is critical. Nodal segments and shoot tips were used as explants, with shoot tips proving to be the most effective. The explants were sterilized using 0.2% Carbendazim and 5% Clorox in varying time periods (5 and 10 minutes) following treatment with 70% ethanol. Each step was followed by three successive washings with sterilized distilled water. Shoot tips were surface sterilized using the optimal sterilization protocol and cultured on MS medium supplemented with varying concentrations of 6-benzylaminopurine (BAP); 0.5,1.0,1.5,2.0,2.5,3.0, and 3.5 mg/L for shoot initiation. Healthy shoots were then transferred to MS medium supplemented with different concentrations of 1-naphthaleneacaetic acid (NAA); 0.5,1.0,1.5,2.0,2.5,3.0, and 3.5 mg/L for in vitro root induction. Data were analyzed using Minitab software, employing a one-way ANOVA method. Ten replicates were used for each experiment to ensure data accuracy. Optimal sterilization of shoot tips was achieved using 0.2% Carbendazim solution for 10 minutes, followed by 5% Clorox solution for an additional 10 minutes with a 20% contamination percentage. MS medium supplemented with 2.0 mg/L BAP yielded the best results, producing the highest number of leaves (3.50±1.4), maximum shoot height (1.01±0.1 cm), and the longest leaf length (1.01±0.1 cm). The highest number of roots (9.7±1.4) and the longest root length (5.05±0.4 cm) were observed with 2.0 mg/L NAA and 2.5 mg/L NAA respectively. This optimized method supports the mass production of genetically uniform plants, contributing to both ecological conservation and the commercial potential of E. *macranthum* as an ornamental plant.

Keywords: *Conservation, Endemic plants, Exacum macranthum, Micropropagation, Ornamental plants*

ID: NR17

Enhancing Farmer Community Resilience and Biodiversity Conservation through Climate Change Adaptation and Awareness Programme in Belihuloya Region

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Smallholder farmers in Sri Lanka are potentially affected by climate change, facing challenges with crop yields and securing their livelihoods in biodiversity-rich landscapes. This study aimed to enhance climate resilience and environmental stewardship in the Landuyaya, Budunwela, and Samanalawatta Grama Niladhari Divisions of Belihuloya region in the Rathnapura district by assessing farmers' perceptions and implementing a targeted awareness programme. One hundred forty-two (142) farming households in the selected study areas were interviewed directly. A mixed-method approach was adopted, utilizing a well-structured questionnaire that incorporated demographic information, farming background, awareness of climate change and biodiversity, and knowledge of conservation efforts. Significant associations were found between education levels and understanding of the value of biodiversity and climate change, as determined through statistical analysis using chi-square and Fisher's exact tests. Awareness of the effects of climate change was associated with farming experience, with a statistically significant p-value of 0.031. Farming practices, such as crop rotation, were not significantly impacted by awareness of biodiversity, with a p-value of 0.551. While 64% of the respondents identified the effects of climate change, particularly the changed patterns of temperature and rainfall, the importance of biodiversity was still not well understood, and the benefits of biodiversity awareness were not satisfactorily incorporated into farming methods. The results indicated that agricultural practices were influenced by land size, with smaller landholders preferring mixed or organic systems. Challenges such as invasive species, poor waste management, limited use of smart agriculture, and frequent conflicts between people and wildlife were reported. To give back to the community, an awareness programme was conducted for the farmers to promote climate-smart techniques, agroforestry practices, water conservation, and sustainable use of resources. This study highlights the importance of education and community participation in improving farmers' adaptive capacity and emphasizes the need for community-based awareness programmes to understand their perspectives and challenges.

Keywords: *Conservation, Endemic plants, Exacum macranthum, Micropropagation, Ornamental plants*

Assessment of Hydromorphological Quality of Kelani River using Morphological Quality Index

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The Morphological Quality Index (MQI) is an effective tool for assessing the hydromorphological conditions of rivers, particularly in the context of restoration and management. It was originally developed to evaluate streams in Italy and is a widely recognized method for assessing river hydromorphology. However, no studies have been carried out to assess the hydromorphological conditions of the Kelani River in Sri Lanka. This study applies the MQI to evaluate the hydromorphological quality of the Kelani River. The river was divided into seven reaches based on physiographic units: plain and mountains. The Morphological Alteration Index (MAI) values were used to compute the MQI. The segmentation of the river reaches and the analysis of confinement parameters were conducted using satellite imagery, Remote Sensing and Geographic Information Systems (GIS). The evaluation utilized 28 indicators, which were categorized into three components. (a) Geomorphological functionality, (b) Artificiality and, (c) Channel adjustments. Scores for each indicator were assigned based on the local geomorphic contexts and modifications made to adapt the method to Sri Lankan conditions. The results indicated varying levels of morphological quality across the reaches, ranging from poor to good conditions. The first reach, between the Colombo estuary and Kaduwela highway, exhibited an MQI score of 0.45 and was classified as "Poor". This region of the river had significant morphological alterations due to anthropogenic activities. In contrast, the fourth and sixth reaches exhibited "Good" conditions, with MQI scores of 0.81 and 0.72, respectively. These findings suggest that the Kelani River contains both heavily impacted and relatively healthy reaches in the context of morphological quality. The study demonstrates the effectiveness of the MQI in identifying anthropogenic influences on river morphology and provides a framework for future river management and restoration efforts in Sri Lanka.

Keywords: *Hydromorphology, Kelani River, Morphological Alteration Index, Morphological Quality Index*

Pyrolysis-Based Fuel Oil Production from Plastic Waste Collected at Panadura Beach, Sri Lanka

Abeygunewardana R.V.L.D. [1], Jayalath J.D.T. [1], Gunathilaka J.M.U.D.[1], Meegahakumbura M.A.T.N. [1], Shashikala W.D.T.K. [1], Wijesinghe P.N.D.D.Z.[1], Gunathilake S.K. [1], Wijesekara H.[1*], and Nilmalgoda E.P.R.H.H.W. [2]

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Plastic pollution is a rising global environmental issue, particularly in coastal and marine environments, harming entire ecosystems. Thermochemical conversion of waste plastics is a viable technology that has emerged as an effective solution to reduce plastic pollution. Therefore, this study focused on the production of fuel oil using plastic waste collected at Panadura Beach, Western Province, Sri Lanka. A total of 284.35g of High-Density Polyethylene (HDPE) and Polyethylene terephthalate (PET) based plastic waste were separately subjected to pyrolysis at 300 – 400°C under atmospheric pressure. With these conditions, HDPE took 21 minutes to complete the pyrolysis process. The HDPE, sourced from PET bottle lids, produced a significant oil yield of 125g, and only 1g of powder product resulted from the remaining PET bottle parts. The generated syngas was analyzed using a LABFAC gas analyzer, and it contained 69.28% CO_2, indicating a considerable release of greenhouse gases due to the lack of controlled facilities. The Fourier Transform Infrared (FTIR) spectroscopy analysis was separately performed on HDPE, PET and produced fuel oil to identify their functional groups, ensure material type and assess pyrolysis efficiency. FTIR results indicated that pyrolyzed oils from HDPE and PET plastics revealed characteristic functional groups along with aliphatic and aromatic hydrocarbon structures. The HDPE-derived oil showed strong C-H stretching and bending vibrations characteristic of saturated hydrocarbons. The PET-derived oil revealed C=O and C=C stretching corresponding to ester and aromatic compounds. These FTIR results confirm the successful thermal degradation of plastic polymers. The results showed that the plastic waste can be effectively converted into usable fuel oil, supporting circular economy goals. The fuel oil quality can be further enhanced by optimizing reactor conditions and introducing catalysts. Moreover, the pyrolysis process can be used to turn beach plastic into a cleaner fuel, supporting a circular and sustainable economy, while reducing beach pollution.

Keywords: *Circular economy, Fourier Transform Infrared Spectroscopy, High-density polyethylene, Plastic pyrolysis, Polyethylene terephthalate*

Assessing Trace Water Content in Nominally Anhydrous Minerals using FTIR Spectroscopy

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Water, even in trace amounts, plays a critical role in geological processes such as rock deformation, melting, and metamorphism. This study investigates the presence of trace water in nominally anhydrous minerals (NAMs) in the form of structurally bound hydroxyl (-OH) from the Samanala Wewa area, situated in a shear zone along the border between Sri Lanka's high-grade metamorphic terranes of the Highland and Vijayan Complexes. Field observations revealed evidence of rock partial melting, suggesting water may have played a role in lowering the melting temperatures of minerals under high-grade metamorphic conditions. Fourteen rock samples were collected near the boundary zone, and four main minerals: quartz, garnet, feldspar, and calcite were separated and analyzed using Fourier Transform Infrared Spectroscopy (FTIR). Three distinct modes: (1) Attenuated Total Reflectance (ATR), (2) Diffuse Reflectance using Collector II accessory, (3) Transmission mode using potassium bromide (KBr) pellets were used. Among these, the Diffuse Reflectance technique proved most effective for detecting structurally bound -OH in NAMs. All the quartz samples showed distinct -OH features in the 3000 cm^{-1} - 3800 cm^{-1} wave number region, and similarly, garnet samples and feldspar samples exhibited -OH bands, further supporting the presence of trace water. Although calcite is not a NAM, it was included for comparison due to its occurrence in calc-silicate rocks within the partially melted zone. The findings confirm the occurrence of structurally bound -OH in NAMs in the Samanala Wewa area, supporting the hypothesis that water facilitated partial melting along this shear zone. The results also highlight the sensitivity of FTIR, particularly the Collector II method, for detecting trace water in geological materials. Future work should focus on quantifying -OH concentrations and integrating FTIR results with complementary techniques such as Secondary Ion Mass Spectrometry (SIMS) or Nuclear Reaction Analysis (NRA) to better constrain water budgets in high-grade metamorphic terrains.

Keywords: *FTIR, Hydroxyl, Minerals, Nominally anhydrous, Shear zone*

ID: NR30

Wildlife Crime Patterns and Hotspots in Udawalawe National Park, Sri Lanka

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Biodiversity degradation, primarily driven by anthropogenic pressures, is intensified by wildlife crimes, which constitute a critical threat to ecological integrity, particularly within protected areas that are increasingly exploited for illicit purposes. This study investigates wildlife crime in Udawalawe National Park, Sri Lanka. It is a 323.15 km^2 protected area bordered by agricultural lands and rural settlements. The research examines crime types, time-based trends, and crime locations using official park records from 2014 to 2024. The spatiotemporal analysis was performed using SPSS, R Studio, and GIS platforms (QGIS and ArcGIS). A total of 1,118 wildlife crimes were reported. The peak occurred in 2020 (n=248), and the lowest was in 2021 (n=45). The mean annual incidence was approximately 102 crimes, resulting in a cumulative spatial density of 3.46 crimes/km^2. Forty-three distinct offense categories were identified, with the ten most prevalent comprising 86.49% (n=967) of cases: Illegal Entry (n=418, 37.39%), Cannabis Cultivation (n=200, 17.89%), Illegal Fishing (n=76, 6.80%), Possessing a firearm (n=69, 6.17%), Illegal Entry of Cattle (n=58, 5.19%), Possessing Explosives (n=42, 3.76%), Clearing Vegetation (n=36, 3.22%), Illegal Settlement (n=25, 2.24%), Gem Mining (n=22, 1.97%), and Sand Mining (n=21, 1.88%). During 2014–2019, 558 cases were recorded (avg. 93/year). A major increase of 167% occurred in 2020 (n=248), with 29 different offense types reported. Although cases declined after 2020, the numbers remained above pre-2020 levels and exhibited seasonal patterns. During the study period, 639 wildlife crime cases were recorded. Among these, 742 suspects were involved, averaging about 2 suspects per case. Arrests were made in 435 cases (68.08%). In 204 cases (31.92%) with no arrests, illegal items were destroyed or confiscated. Fines were imposed in all adjudicated cases. Hotspots near park boundaries indicate at-risk areas. The study recommends adding permanent offices, increasing patrols, and using new technology to prevent wildlife crimes and enhance conservation. However, the current study utilized secondary data and community perceptions were not directly assessed. Future research should examine local crime drivers, enforcement capacity, and long-term ecological impacts of repeated offenses.

Keywords: *Crime hotspots, GIS, Offense diversity, Protected Areas, Spatial crime density*

Citizen Science-based Approach for Documenting Lesser-known Edible and Medicinal Plants in Belihuloya

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Belihuloya in Sri Lanka, a rural area renowned for its rich biodiversity due to its unique climate and geography, is home to numerous lesser-known edible and medicinal plant species. Some of them are recognized island-wide, many are specific to the local area, and are known primarily by the local inhabitants. The traditional knowledge about these plants is gradually declining due to urbanization, deforestation, and socialization, leading to the loss of valuable natural resources. This study aimed to identify lesser-known edible and medicinal plant species in Belihuloya to preserve the fading knowledge and emphasize the importance of their conservation. A semi structured questionnaire survey was conducted covering 60 respondents across ten Grama Niladhari Divisions, focusing on six main dimensions: background information, edible and medicinal plants, conservation, environmental concerns, health and cultural practices, and governance. The data were analyzed using the Pearson Chi-square test to examine the null hypothesis that there is no significant relationship between respondents' knowledge of lesser known edible and medicinal plants and demographic variables such as age, gender, period of residence, and interaction with environment. The results accepted the null hypothesis, as no significant relationships were observed ($p > 0.05$). Although the region is rich in biodiversity, most people possess limited knowledge of lesser-known edible and medicinal plants. The findings highlight the importance of public education and community participation, policy support, and institutional involvement towards the conservation of edible and medicinal plants. This study contributes to improving the understanding of biodiversity conservation among local communities and explaining the importance of preserving local ecological knowledge in Sri Lanka.

Keywords: *Belihuloya, Edible and medicinal plants, Lesser-known plants, Pearson chi-square test, Questionnaire-based survey*

Modeling Soil Erosion and Sediment Dynamics in the Walawe River Basin, Sri Lanka

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Soil erosion is a major environmental concern in the Walawe River Basin, Sri Lanka, threatening agricultural productivity, water resources and ecosystem stability. Anthropogenic activities, such as deforestation, poor land management and intense rainfall events, have exacerbated soil erosion and sediment dynamics within the basin. This study aimed to assess soil erosion and sediment-related dynamics in the Walawe River Basin and its micro-catchments using the InVEST Sediment Delivery Ratio (SDR) model. The InVEST SDR model was employed by integrating spatial datasets, including a digital elevation model (DEM), rainfall erosivity, soil erodibility, land use land cover (LULC) and support practices. Universal Soil Loss Equation (USLE) parameters were adapted to local conditions to estimate annual soil loss, sediment export, sediment deposition and sediment retention. The main output of the study was the Total Soil Loss Map, which revealed significant spatial variation in erosion intensity, with upper catchment areas and steep slopes exhibiting the highest erosion rates. Average soil loss between 2004 and 2024 was 6.39 t ha^{-1} $year^{-1}$, with figures ranging between 6.87×10^{-7} and 1407 t ha^{-1} $year^{-1}$, indicating severe degradation hotspots, particularly in areas subjected to deforestation and intensive cultivation. The classification of soil erosion hazard levels in the Walawe River Basin showed that 77.4% of the area falls under low erosion hazard (0–5 t ha^{-1} $year^{-1}$), 7.2% under moderate (5–12 t ha^{-1} $year^{-1}$), 7.2% under high (12–25 t ha^{-1} $year^{-1}$), 7.8% under very high (25–60 t ha^{-1} $year^{-1}$) and 0.48% under extremely high hazard (¿60 t ha^{-1} $year^{-1}$). Sediment export patterns highlighted the risk of sedimentation in major reservoirs such as Samanalawewa and Udawalawe in the Walawe River Basin. To mitigate soil erosion and its cascading effects, conservation interventions in high-risk areas, including reforestation, adoption of contour farming, construction of check dams and improved land management practices, are recommended. Strengthening community-based watershed management programs is crucial for sustainable resource conservation in the basin.

Keywords: *Erosion hazard zones, GIS, InVEST SDR model, Soil erosion, Walawe basin*

Assessment of Microplastic Contamination in Coastal Sediments, Water, and Planktonic Associates in the Dondra Coastal Region, Southern Sri Lanka

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Microplastics, are plastic particles smaller than 5 mm in size, mainly originating from the breakdown of larger plastic waste and industrial sources. The small size and persistent nature of microplastics allow them to accumulate in marine organisms, move through food chains, and carry harmful chemicals. Understanding their distribution across coastal environments is essential for assessing the resulting ecological and human health impacts. In this study, microplastic contamination was investigated across four key coastal environmental components: ocean water, beach sand, submerged sediment, and in planktons at Kaissa-Wella, a site located within Dondra Beach, in the southernmost point of Sri Lanka. Samples were collected using standardized field methods and analyzed in the laboratory through vacuum filtration and stereomicroscopy. Among the four components sampled, plankton had the highest concentration of microplastics (858 $\pm$ 382 particles per gram), showing how easily these tiny plastics can attach to or be ingested by plankton. Sediment samples showed moderate levels (4.1 $\pm$ 0.94 particles per gram), likely due to settling and biofilm attachment, while beach sand had 2.1 $\pm$ 0.61 particles per gram. Ocean water showed the lowest levels (0.2 $\pm$ 0.03 particles per gram), possibly due to wave action and dilution. Most of the microplastics identified were fibers, often originating from clothing or fishing gear. Transparent particles were predominant in sand, sediment, and water, likely due to weathering and fragmentation, while black and blue particles dominated in plankton samples, possibly because of selective feeding behaviour of planktons. The majority of particles were smaller than 500 µm, suggesting increased ingestion potential and risk of chemical absorption. These findings highlight serious environmental threats and emphasize the urgent need for improved plastic waste management and coastal conservation to protect marine ecosystems.

Keywords: *Marine environment, Microplastics, Plankton, Pollution, Sediments*

ID: NR49

Evaluating Water Treatment Plant Efficiency in Microplastic Removal and Potential Improvements

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Microplastics, tiny plastic particles less than 5 mm in size, are increasingly found in freshwater sources and even treated drinking water, raising significant environmental and health concerns. This study evaluated the microplastic removal efficiency of the Katuwangoda Water Treatment Plant in Sri Lanka and proposed a cost-effective improvement using a prototype filtration column. Water samples were collected from five stages of the treatment process: raw water intake, after sedimentation, after rapid sand filtration, after chlorination, and final treated tap water. Microplastics were separated using vacuum filtration and identified under a stereomicroscope. A laboratory-scale glass filtration column, consisting of gravel, fine sand, and coconut shell activated charcoal, was developed and tested using the same raw water source. The existing water treatment plant revealed poor microplastic removal efficiency, with only 9.52% of microplastics removed across the entire treatment process. Microplastic concentration was 157 particles/L at the intake, reduced to 63 particles/L after sedimentation, but increased sharply to 274 particles/L after rapid sand filtration, likely caused by secondary contamination from aged filter media. After chlorination, the count slightly decreased to 143 particles/L. Most microplastics detected were transparent and blue filaments, sized between 101 and 500 µm. The prototype filtration column achieved a significantly higher removal efficiency of 74.5%, primarily due to the combined effects of slow sand filtration, electrostatic interactions, and surface adhesion by the activated charcoal. The ultra-slow flow rate of the column also enhanced contact time, further improving removal efficiency. A two-proportion z-test confirmed that the prototype performed significantly better than the existing treatment process ($p = 0.00015$). Although the prototype shows promise, its slow flow rate may limit scalability. This study highlights the shortcomings of conventional treatment systems and presents a sustainable, low-cost alternative for improving microplastic removal.

Keywords: *Activated charcoal, Microplastics, Slow sand filtration, Water treatment plant*

ID: NR52

Assessing Public Awareness and Behaviour towards E-Waste Management and Disposal (A Case Study in Balangoda)

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Improper management of electronic waste (e-waste) poses serious environmental and health risks, especially in regions with inadequate infrastructure and limited public awareness. The present study was conducted in the Balangoda Urban Council (BUC) area of Sri Lanka to assess community awareness of e-waste, disposal behaviours, and challenges faced. A structured questionnaire survey was conducted with 264 randomly selected households from 10 Grama Niladhari divisions in the BUC area, representing diverse demographic groups. Furthermore, e-waste generation was also quantified. The data were analysed using descriptive statistics, logistic regression to examine factors influencing awareness of e-waste toxicity and knowledge of national laws and regulations related to e-waste, and Chi-square tests to assess associations with demographic variables. Logistic regression analysis revealed that awareness of e-waste toxicity was significantly associated with education level (B = 0.639, Exp(B) = 1.895, p = 0.01), while knowledge of national laws and regulations was low and influenced by education (B = -5.727, Exp(B) = 0.003, p = 0.02). Chi-square tests showed that age and education significantly affected awareness of health and environmental risks ($p < 0.05$). The most common disposal methods were recycling (36%) and donating or selling to waste collectors (31%), although open dumping (10%) and burning (8%) persist. Information technology and telecommunication equipment (59%) and large home appliances (29.7%) were mostly donated or resold. Small home appliances (47%), bulbs and lighting materials (42%), and batteries (43%) were frequently dumped, with burning rates of 21%, 32%, and 53%, respectively. The annual household e-waste generation was estimated as 115,825 kg. Mainly three (3) key barriers were identified as insufficient awareness (24.9%), lack of collection points (23.6%), and lack of waste collectors (21.4%). Only 29.5% gained financial benefits from e-waste. Enhanced public education, policy enforcement, and local collection systems are essential for sustainable e-waste management in semi-urban areas.

Keywords: *Balangoda, Disposing behaviours, E-Waste, Public awareness, Recycling*

ID: NR62

Waste Segregation and Recycling Initiative in the Faculty of Applied Sciences - A Case Study from Sabaragamuwa University of Sri Lanka

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Rapid increases in solid waste generation within academic institutions, especially in faculties with large populations, cause considerable environmental and operational challenges. This study aimed to develop and implement an effective waste segregation and recycling initiative at the Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka. A comprehensive methodology included a four-week waste audit covering both academic and examination periods with a questionnaire survey using random sampling. Data was gathered from 121 respondents. The survey results indicated that 87.6% of students were aware of the waste segregation concept, but only 39.7% actively practiced waste reduction or recycling, representing a gap between awareness and action. Generated recyclable waste is E-waste, glass, paper, metal, some plastics and polythene, while hazardous waste such as chemicals and organic wastes are generated as non-recyclable waste. Key barriers identified included inconvenient bin locations (41.8%), unclear labelling (28.2%), and limited knowledge about recyclable materials (21.8%). In the examination period 1411g of paper and 806g of polythene were collected per day. 2056 g of paper and 564g of polythene were collected per day in the academic period. Statistical analysis showed no significant difference in paper ($p = 0.91$) and polythene ($p = 0.17$) generation between these two periods. Specific actions have been implemented in response to these findings such as social media outreach, attractive bin stickers, awareness programs, videos of instruction, upgrading of the recycling shed at the faculty and, a student-led monitoring team. In addition to increasing waste segregation rates, this project provided faculty members with a better understanding of their responsibilities to the environment and obtaining economic benefits from selling recyclables. The monitoring process identified that especially the external personnel did not dispose of their waste properly. Awareness is identified as a key point for avoiding those disposal habits.

Keywords: *Recycling, Solid waste management, Waste audit, Waste segregation*

ID: NR75

Quantification of Carbon Footprint of a National School: A case Study at K/Nugawela Central College

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Greenhouse gas (GHG) emissions cause climate change, which poses substantial global challenges. Educational institutions have a critical role not just in raising environmental awareness but also in demonstrating sustainable actions. This study measured the Carbon Footprint of K/Nugawela Central College for the year 2023 to identify emission sources and recommend reduction solutions. The methodology followed the GHG protocol, categorizing emissions into three categories: direct (category 1), indirect energy (category 2), and other indirect emissions (category 3). Activity data were collected from electricity bills, fuel records, and a questionnaire survey of 381 students, selected using the stratified sampling method, and all 188 staff members. Overall, the results demonstrate an organizational carbon footprint of 44,540 tCO_2e. This equates to an average per-person carbon footprint of 11.14 kg CO_2e. Diesel and Liquid Petroleum Gas use emissions from Category 01 were 6,210 tCO_2e. Category 02 emissions from electricity were 11,770 tCO_2e. and category 03 emissions from transport accounted for 26,560 tCO_2e. This indicates that transport emissions (student commuting: 16.92 tCO_2e; staff commuting: 9.82 tCO_2e) and electricity usage within key facilities such as the school office (6.02 tCO_2e) and hostels (boys' hostel: 1.80 tCO_2e; girls' hostel: 1.82 tCO_2e) are the main contributors to the school's carbon footprint. As a way of reducing the school's environmental footprint, the study recommends encouraging the use of public transport, promoting environmental awareness among students, implementing renewable energy systems such as biogas units, installing solar panels, and promoting energy conservation among the school community.

Keywords: *Carbon footprint, Educational institutions, Emission reduction, Greenhouse gas emissions, Sustainability*

ID: NR77

Assessment of Value-based Education on Environmental Responsibility at Sabaragamuwa University, Sri Lanka

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Value-based education is a form of education that emphasises the inclusion of core values in the curriculum, such as empathy, accountability, honesty, and respect, among others. It is necessary to improve the current way of education and achieve the larger goal of sustainable development in Sri Lanka. This study focuses on identifying and affecting factors related to value-based education on cooperative environmental responsibility (CER) through green practices by involving teamwork among the students, staff, and community to protect and conserve the environment. A questionnaire survey consisting of closed and open-ended questions was conducted using a random sampling method, and primary and secondary data were used. A sample of 370 students across various faculties responded to a structured 5-point Likert scale questionnaire. The data obtained was recorded, and the results were analysed through correlation and regression testing using IBM SPSS statistical software to identify the extent of value-based education. Results showed that green practices and awareness of CER have a strong positive correlation with value-based education, and the presence of value-based education in Sabaragamuwa University is relatively high. The awareness of CER and green usage behaviour showed a strong positive correlation ($r = 0.655$, $p < 0.01$), indicating that higher awareness of CER corresponds to green usage behaviour. In addition, CER awareness was positively correlated with value-based education ($r = 0.420$, $p < 0.01$), supporting the role of CER in fostering environmental responsibility. The regression model showed that CER awareness and green practice behaviour accounted for approximately 19.5% of the variance in value-based education ($R^2 = 0.195$, F 29.619, $p < 0.001$), underscoring their predictive power. Therefore, it is essential to include curriculum contents that incorporate ethical and environmental values, to promote moral responsibility and achieve sustainable development goals, producing environmentally sensitive graduates.

Keywords: *Corporate environmental responsibility, Ethical, Green practices, Sustainable, Value-based education*

ID: NR110

Assessment of Soil pH Management and Sustainable Fertiliser-use Practices for Enhancing Tea Yield among Smallholders in Belihuloya Region, Sri Lanka

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Tea cultivation is a vital component of Sri Lanka's economy, requiring sustainable practices to ensure environmental and agricultural viability. This study assessed soil pH management (e.g. application of lime, dolomite) and sustainable tea farming practices (e.g. compost use, chemical fertilizers) and government support as perceived by the smallholders, in Landuyaya and Ihalagalagama Grama Niladhari Divisions of Belihuloya region through a questionnaire survey of 58 randomly selected tea smallholders. The study incorporated closed and open-ended questions, with data analysis using descriptive statistics in IBM SPSS. Key findings revealed that tea estates typically maintain 10,000–12,500 plants per hectare, with 53% of smallholders using dolomite to balance the soil pH. Tested samples had pH values from 4.46 to 6.22, averaging 5.11 within the optimal range of tea cultivation (4.5-5.5). Fertilizer application ranged from 250–500 kg/ha/year, primarily comprising calcium carbonate and calcium oxide. Seasonal variations significantly impacted tea yield, with peak production of 1250 kg/ha during regular rainy seasons and declines during periods of heavy rainfall or drought. The Smallholders expected further government support in improving their crop cultivations. Statistical analysis using Pearson correlation and regression models highlighted the significant relationship between the amount of fertilizer and tea yield per hectare in

ID: NR115

the heavy rain season. A strong positive correlation was observed between the amount of fertilizer and tea yield in heavy rain ($r = 0.377$, $p < 0.01$), indicating that farming practices significantly influence productivity. Regression analysis further confirmed that the amount of fertilizer is a key predictor of yield ($\beta = 0.356$, $p = 0.002$), explaining 21.93% of variability ($R^2 = 0.219$). The study underscores the need for community engagement and localized soil management to enhance sustainability. By integrating scientific insights with traditional knowledge, smallholders can optimize soil pH and improve tea yield, fostering long-term resilience in Landuyaya and Ihalagalagama.

Keywords: *Chemical fertilisers, Dolomite, Soil pH management, Sustainability practices, Tea plantations, Wet season*

Food Science and Technology

Regional Color Variations in Ceylon Black Tea and Green Tea

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Color is a crucial sensory characteristic of Ceylon black tea (BT) and green tea (GT). Measurement of regional color variations is important to assess quality and authenticity, develop color grading systems, influence consumer preferences, and reflect chemical variations. Hence, this research was conducted to measure regional color variations of Ceylon BT and GT powder and infusions. Freshly prepared similar grade Ceylon BT and GT samples were collected from tea manufacturers in 3 main tea growing regions of Sri Lanka with five black tea and five green tea samples collected from each region. Color of tea powder and infusion were measured (using Hunter Lab and CIE L*a*b* colour spaces). Results were provided with SE values. In GT powder, Mid Country (MC) and Up Country (UC) had significantly higher CIE L* values (31.63±2.02, 32.29±1.55) compared to the Low country (LC) region ($P<0.05$). Moreover, Low Country (LC) had significantly less CIE a* (-1.18±0.52) and Hunter a (-0.76±0.33) values than MC and UC regions ($P<0.05$). However, both UC and MC had significantly higher Hunter b values (4.70±1.96, 4.66±1.46) compared to the LC region ($P<0.05$). However, there was no significant regional color difference in GT infusion. In BT powder, there was no significant regional difference in CIE L* and a* value. However, UC and LC regions had significantly higher b* values compared MC region ($P<0.05$). In BT infusion, MC had significantly higher Hunter L value compared to UC and LC regions ($P<0.05$). In conclusion, MC and UC green tea powder were lighter in color than LC, but MC and UC green tea powder contained higher greenness (-a*, -2.02±0.61, -1.86±0.31) and yellowness (+b*,7.50±2.17, 7.71±3.61) than LC. Moreover, there was more yellow color black tea powder in the UC and LC regions, but MC produced more lighter black tea infusion than the other two regions.

Keywords: *black tea, color, green tea, regionalize, sensory property*

ID: FST07

Valorisation of Cheese Whey by the Production of a Novel Functional Beverage Through the Fermentation with SCOBY

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Whey, a major by-product of cheese manufacturing, is often discarded despite its high nutritional value and the significant environmental impact it poses. This study aimed to valorise cheese whey by developing a functional beverage using symbiotic culture of bacteria and yeast (SCOBY) and evaluating the influence of three sugar substrates (glucose, white sugar, brown sugar) in four (4%, 8%, 12%, 16%) on fermentation dynamics, physicochemical properties, microbial growth, and sensory acceptability. A control sample without added sugar was also included for comparison. Fermentation trials were conducted for eight days at ambient temperature using pasteurized sweet whey inoculated with 10% (v/v) SCOBY starter and 1.5% (w/v) SCOBY mat. Key parameters, including pH, titratable acidity (TA), total soluble solids (TSS), turbidity (OD at 600 nm), total plate count (TPC), viscosity, and colour were monitored. Results showed that pH and TSS declined and TA increased significantly over time ($p<0.05$), indicating active microbial metabolism. Microbial growth peaked on Day 8 in glucose 12%, showing a statistically significant increase ($p<0.05$), followed by white sugar and brown sugar. Optical density values supported these findings, with glucose 12% recording the highest OD (0.7497; $p<0.05$). Viscosity and colour parameters also showed significant variation ($p<0.05$), with brown sugar imparting the darkest hue due to molasses content. Sensory analysis using a 5-point hedonic scale identified white sugar 12% as the most acceptable formulation ($p<0.05$), balancing acidity, flavour, and appearance. Based on these results, the fermentation dynamics of sweet whey depend on the type and concentration of sugar used, both of which significantly influence its functional and microbial characteristics. While glucose supported the highest microbial activity, white sugar at 12% concentration yielded the most acceptable beverage in terms of sensory quality.

Keywords: *Fermentation, Functional beverage, SCOBY, Sweet whey, Valorisation*

ID: FST08

Transforming Invasive Guinea Grass (*Megathyrsus maximus*) into Low-Cost Sustainable Food Packaging for Dry Food Application

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The global demand for sustainable packaging solutions is rising due to the environmental hazards associated with plastic waste. This study investigates the potential of transforming Guinea grass, one of the most rapidly spreading invasive grass species in Sri Lanka, into a biodegradable food packaging material. Guinea grass presents significant challenges to farmers due to its aggressive growth, rapid regeneration rate, and invasive nature on the land. Through fiber extraction, mechanical pulping, and integration with natural binders, experimental packaging films will be developed and evaluated for tensile strength, water resistance, toxicity, thermal properties, chemical resistance, biodegradability, and cost-efficiency. The Guinea grass-based material exhibits favorable mechanical properties suitable for dry food applications, while fully degrading within 45–60 days under composting conditions, providing an environmentally friendly, safe, and effective solution. The material is low-cost, non-toxic, and renewable, offering a sustainable alternative to synthetic plastics commonly used in food packaging. By transforming an agricultural problem into a value-added eco-product, this innovation will contribute to circular economy practices, environmental protection, and improved resource efficiency in the Sri Lankan food sector. The expected outcome of this project is to develop a prototype of biodegradable food packaging film made from Guinea grass suitable for selected dry food applications and to assess the feasibility of scaling up the process for industrial applications.

Keywords: *biodegradable materials, food packaging, sustainability, environmental protection, low-cost solution*

Evaluation of Antioxidant Properties And Phytochemical Constituents in Polyherbal Tea Blends

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This study aims to develop and analyze novel polyherbal tea blends formulated using ten scientifically recognized medicinal plants (*Gymnema sylvestre, Cinnamomum verum, Moringa oleifera, Trigonella foenum graecum, etc*) known for their antioxidant and anti-diabetic properties.Four blends (A,B,C and D) were prepared,each consisting of five ingredients mixed in varying ratios.The study further compares these four formulations with a commercially available antidiabetic tea to identify the most effective blend.Plant materials were dried at 45°C, ground into fine powders, and the moisture was reduced to 4–6%.Tea blends were packed into 2g tea bags and infused in 90–95°C water for 10–15 minutes for analysis.The pH of each blend was measured, and qualitative phytochemical screening was conducted to confirm the presence or absence of bioactive compounds. Total phenolic content (TPC) was determined using the Folin-Ciocalteu method,with Sample A showing the highest TPC value (10.33±0.90mg GAE g^{-1}). Total Flavonoid content (TFC) was determined using the Aluminium Nitrate ($Al(NO_3)$) method, with Sample A showing the highest TFC value (2.73±0.05 mg QE g^{-1}).Antioxidant activity was assessed using the DPPH radical scavenging assay,where Sample A showed the highest inhibition (85.51%),followed by Sample D (82.07%), Sample D (82.07%),and Sample B (78.86%), whereas the commercial antidiabetic tea showed about 79.39% inhibition. A Toxicity test was evaluated using the brine shrimp lethality assay;none of the samples exhibited 50% mortality even at the highest concentration (20,000µg mL^{-1}). The LC50 value for all the tested samples was estimated to be greater than 20,000µg mL^{-1},suggesting that all samples are non-toxic under the conditions of this assay. Sample A demonstrated the highest TPC and TFC, strong antioxidant activity,and very low toxicity,which includes plant powders from *Gymnema sylvestre, Cinnamomum verum,Trigonella foenum graecum, Psidium guajava* and *Moringa oleifera,*making it the most promising candidate for further antidiabetic testing and sensory evaluation.

Keywords: *antioxidant activity, brine shrimp lethality assay, phytochemical screening,polyherbal tea, total phenolic content*

ID: FST25

Effect of Roasting Stage and Bee Honey Concentration on Physicochemical and Sensory Properties of Peanut Spread

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The quality and the acceptability of peanut spreads are strongly influenced by the roasting stage of peanuts and the concentration of incorporated bee honey. This study examined the effect of three roasting stages (light-130°C for 20 minutes, medium-145° for 15 minutes, dark- 160°C for 10 minutes) and the three bee honey concentrations (10%, 20%, 30%) on the physicochemical and sensory properties of peanut spreads. Accordingly, eight formulations were developed and samples including the control (medium roast, 20% sugar) were tested for moisture content, pH, water activity, acid value, peroxide value, spreadability, meltability, color, and emulsion stability using standard methods. Sensory evaluation was conducted using 30 semi-trained panelists and a 5-point hedonic scale. Statistical analysis was performed using one-way ANOVA, and means were compared using Tukey's test at a significance level of 0.05. Results indicated that the dark roasted peanut spread with 20% bee honey exhibits the best overall performance, showing the highest sensory acceptability (4.70±0.53), superior spreadability (93.40±1.25 $gcm^{-1}s^{-1}$) and enhanced emulsion stability (95.03±0.28%) than those of the control (74.35±1.25$gcm^{-1}s^{-1}$ and 87.23±0.28%, respectively). This sample showed darker and more desirable color with $L^\star$, $a^\star$, and $b^\star$ values of 18.20±0.88, 1.60±0.07, and 12.93±0.21, respectively. Furthermore, when compared with the dark roasted sugar-based sample, the formulation containing 20% bee honey exhibited lower acid value (0.79±0.01 mg KOH g^{-1}fat), and peroxide value (2.74±0.09 meq $O_2.kg^{-1}$fat). Hence, the inclusion of bee honey may contribute to improved oxidative stability in peanut spreads under identical roasting conditions. The findings support the use of bee honey as a natural sweetener that improves both functionality and shelf life, especially when combined with dark roasting. This formulation presents a promising avenue for enhancing consumer-preferred peanut spreads by optimizing market-available versions with improved quality attributes.

Keywords: *acid value, bee honey, emulsion stability, peanut spread, roasting stage, spreadability.*

ID: FST26

Development and Characterization of Cationic Starch Flocculant Using Cassava (*Manihot esculenta*) Starch and Jackfruit (*Artocarpus heterophyllus*) Seed Starch

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Wastewater treatment is a significant environmental concern due to the rise of industrial effluents containing pollutants and suspended solids. Conventional synthetic flocculants such as polyacrylamide and polyethyleneimine cause secondary pollution because they are mostly non-biodegradable and can be toxic to human and aquatic life. Therefore, this study aims to develop a biodegradable, eco-friendly cationic starch-based flocculant by combining cassava starch (CS) and jackfruit seed starch (JSS). CS and JSS will be selected due to their high starch yield, excellent viscosity, ease of modification, biodegradability, and wide availability in tropical regions. Additionally, starch molecules contain hydroxyl groups that allow for easy chemical modification through cationization. CS and JSS will be extracted by the distilled water extraction method. Starch blends will be prepared by varying ratios as 100% JSS (control 1), and 100% CS (control 2), JSS:CS (3:2,1:1 and 2:3 ratios), respectively. Chemical modification will be carried out by cationization, using N-(3-chloro-2-hydroxypropyl) trimethylammonium chloride (CHPTAC) with an alkaline catalyst, introducing quaternary ammonium groups via nucleophilic substitution. This permanent positive charge improves flocculation by neutralizing negatively charged particles in wastewater. Similarly, it aggregates fine particles into settleable flocs. CHPTAC-modified starch improves settling rate, floc size and turbidity removal. Characterization will be carried out for amylose content, swelling power, solubility, viscosity, pH, thermogravimetric analysis, Fourier Transform Infrared spectroscopy, X-ray diffraction, and degree of substitution. These parameters affect the water absorption, thermal stability, and particle-polymer stability, which affect the flocculant's performance. Flocculation performance will be evaluated through jar tests measuring turbidity reduction and settling rates in simulated wastewater samples. Furthermore, properties of the developed cationic starch flocculant will be compared with the properties of conventional synthetic flocculants. The synergistic use of these two starches will improve flocculation efficiency, sedimentation and also support waste valorization and environmentally friendly wastewater treatment solutions.

Keywords: *Cassava Starch, Cationic Starch, Flocculants, Jackfruit Seed Starch, Wastewater Treatment.*

Recent Advances and Applications of Artificial Intelligence and Related Technologies in the Dairy Industry

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Artificial Intelligence (AI) and associated technologies have emerged as transformative tools across the dairy value chain with the increasing demand for efficiency, sustainability, and quality in the dairy industry. This review aims to explore the recent advances in AI applications within the dairy industry, underlining their role in driving innovation and operational excellence. The review comprehensively examines AI technologies, including Machine Learning (ML), Internet of Things (IoT), predictive analytics, and automated systems, and their integration into diverse stages of dairy production. AI enables precision livestock management through disease prediction, estrus detection, automated milking, and feed intake estimation. Machine vision and deep learning models support health monitoring, yield prediction, and reproductive success, while AI-powered robotic systems modernize milking, feeding, and cleaning operations. In milk collection and transportation, AI reduces spoilage and human error through predictive analytics, IoT sensors, blockchain-enabled traceability, and optimized routing. Quality assurance benefits from advanced techniques like spectroscopy, electronic noses, and computer vision for real-time assessment of milk composition and contamination. In processing, AI facilitates lactose removal, yield forecasting, process automation, and product consistency across liquid milk, milk powder, cheese, ghee, yogurt, and ice cream manufacturing. AI also powers smart packaging with active and intelligent systems that track spoilage and extend shelf life through responsive feedback. Quality inspection technologies leverage AI-integrated imaging and sensor-based platforms, ensuring non-destructive, fast, and accurate assessment of dairy products. Storage and warehousing benefit from digital twin systems, predictive maintenance, and AI-driven logistics. In supply chain and market analytics, AI models forecast demand, optimize inventory, and enhance consumer insights. Despite these advances, challenges such as infrastructure gaps, high implementation costs, data privacy, and skill shortages hinder full adoption, mainly in small-scale operations. Even so, AI presents transformative potential for sustainable, efficient, and high-quality dairy production, paving the way for Dairy 4.0.

Keywords: *Artificial intelligence, Automation, Dairy industry, Machine learning, Sustainability.*

ID: FST28

Development of Chocolate Spread by Incorporating Dates(*Phoenix dactylifera*),Red Kidney Bean (*Phaseolus vulgaris*)Paste, and Unripe Banana Flour (*Musa spp.*(Kolikuttu))

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The increasing pace of modern lifestyle has driven consumer demand for convenient, healthy, and ready-to-eat food products. In Sri Lanka, spreads are commonly used with bakery items; however, most commercially available spreads contain synthetic additives and lack sustainable, nutrient alternatives, highlighting the gap in the market. This study aims to develop a sustainable, plant-based, chocolate spread using dates, red kidney beans (RKB), unripe banana flour (UBF), and cocoa powder (CP) as the primary ingredients. Formulation optimization resulted in the production of a control sample (57% dates, 40% RKB paste), and three experimental samples containing varying proportions; F1 (54% dates, 36% RKB paste, 4% UBF, and 3% CP), F2 (60% dates, 30% RKB paste, 5% UBF, and 2% CP), and F3 (54% dates, 36% RKB paste, 5% UBF, and 2% CP), while maintaining a constant amount of vegetable oil and citric acid. Based on a 7-point hedonic scale, 30 semi-trained panelists identified F2 as the most acceptable formulation. The F2 sample was further analyzed for physicochemical properties; water activity (0.925±0.002), pH (5.41±0.098), meltability (5.86±0.78%), reflecting the spread is unsuitable for toast or baked applications, emulsion stability (2.94±4.16%), and spreadability (625±25g/cm^{-1}). Proximate analysis indicates moisture content (20.36±1.14%), total ash (1.17± 0.02%), crude fat (12.15± 1.30%), crude fiber (2.98±0.28%), and total sugar (11.57±0.49%). Microbial tests confirmed that refrigerated condition is the best storage method up to 30 days, with the total plate count (45×10^4CFU/g) and yeast and mold count being under the detection limit (the detection limit is 15-150 CFU) for the chocolate spread sample at refrigerated conditions. The study confirms the potential of dates, red kidney bean paste, and unripe banana flour to develop a plant-based chocolate spread without added sugar and preservatives, using dates as a natural sweetening agent and unripe banana flour as a natural thickening agent.

Keywords: *chocolate spread,emulsion stability,meltability,plant-based spread,shelf life.*

ID: FST31

Development of a Biodegradable pH-Responsive Indicator Strip Using Concentrated Whey and *Clitoria ternatea* Anthocyanins for Freshness Monitoring of Milk, Meat, and Fish

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Food spoilage and foodborne illnesses remain critical concerns, especially for perishable foods. Current freshness assessment methods are often inaccurate, expensive, or unsuitable for household use, leading to consumption of deteriorated products or unnecessary waste. This study developed a biodegradable, pH-responsive indicator strip as a simple, eco-friendly tool for real-time freshness monitoring under household storage conditions. Whey was thermally concentrated at 85-90°C with continuous stirring until volume halved to preserve protein functionality, then dried at 70±2 for 30 minutes and ground into powder. The strip was formulated using concentrated whey and gelatin in a 4:1 ratio and incorporated Clitoria ternatea anthocyanins at 0,3,5,7 mL 100 mL^{-1} (C, T1, T2, T3). The T2 formulation demonstrated optimal performance with 0.056±0.01 mm thickness, 19.61±0.03% moisture, 50.86±6.16% water solubility, and water vapour transmission rate of 426.41±25.29 g m^{-2} day^{-1}.Tested on fresh and spoiled milk, chicken, and fish samples, showing consistent, reproducible colour changes aligned with pH-based spoilage levels. Distinct visible colour transitions included violet in fresh milk (pH $\sim$ 6.6), pink in spoiled milk (pH $\sim$ 5.0), and greenish-yellow in spoiled meat and fish (pH $\sim$ 7.0), detectable without instruments. Colorimetric parameters ($L^\star$, $a^\star$, $b^\star$) varied significantly ($p<0.05$; $n = 3$) under refrigerated (4±1°C) and room temperature (25±2°C) conditions, with greater colour stability in refrigerated storage. Biodegradability assessment (ASTM D5988) showed 82.3±1.20% degradation within 21 days, outperforming conventional plastics that persist for decades. This study introduces a novel freshness indicator that integrates waste-derived whey protein with natural anthocyanins, offering a sustainable, practical, consumer-friendly solution for active packaging. The strip can be applied to packaging or containers to provide an easy-to-read freshness status, enhancing food safety and reducing waste. Future studies should focus on improving water resistance and evaluating consumer acceptance in real market settings.

Keywords: *Clitoria ternatea, whey, active packaging, pH-indicator, anthocyanin*

ID: FST33

Development Quality Evaluation Of Bael Fruit (*Aegle Marmelos*) Incorporated Probiotic Frozen Yogurt

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Bael fruit is seasonal and underutilized, often leading to waste, despite its high potential for value addition. Few bael-based products are available in the market, despite their rich nutritional and functional benefits. This study focused on the development and quality evaluation of bael fruit incorporated probiotic frozen yogurt (BPY). Bael pulp was added at 5%, 10%, and 20% (w/w) to cow milk-based yogurt mixtures, and the fermentation kinetics (maximum acidification rate, peak acidification time, time required to reach pH 4.5) were assessed compared to the control (yogurt without bael pulp). Physiochemical properties (pH, moisture, water activity, titratable acidity, total soluble solids (TSS), syneresis), functional properties (syneresis, melting rate, overrun, total phenolic content, probiotic viability), rheological characteristics (texture, viscosity) and proximate composition (crude fat, ash, crude fiber, total sugar) were analyzed using standard methods. A sensory evaluation was conducted with 30 semi-trained panelists, using a seven-point hedonic scale. Shelf life was evaluated by microbial quality, pH, and titratable acidity over two weeks. Statistical significance of the results was assessed using one-way ANOVA and Tukey's comparison. The overruns ranged from 5.00%-16.67% and there wasn't positive/negative relationship with bael concentration. The 20% w/w BPY sample showed significantly lower time to reach pH 4.5 than other formulations. Consequently, the 20% w/w BPY sample showed significantly higher TSS (25.46±0.01) ($p<0.05$) than other formulations. There was a positive relationship between bael concentration and probiotic viability, where a 20% w/w BPY sample showed higher probiotic viability ($6.33\times107\pm0.005$ CFU/mL) on M17 agar. Furthermore, 5% w/w BPY showed significantly higher overall acceptability (5.97±0.77). Total plate count remained within standard limits after two weeks. The findings suggest that bael pulp incorporation can enhance the nutritional and probiotic properties, making it a viable option for value-added dairy product development.

Keywords: *bael fruit pulp, fermentation kinetics, probiotic frozen yogurt, value-added dairy product.*

ID: FST36

Concept Development of a Circadian-Aligned Functional Beverage with Palmyrah Tuber Flour And Pumpkin Seeds

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Modern dietary habits often overlook the role of circadian rhythms in regulating metabolism, hormonal activity, and sleep. This concept study proposes the formulation of a novel plant based functional beverage 'Palmyrah Moon Milk' designed for evening consumption. The selected ingredients are rich in bioactive compounds such as tryptophan, magnesium, and polyphenols, which may support melatonin synthesis, antioxidant activity, and physiological relaxation in alignment with circadian rhythms. The formulation combines *Borassus flabellifer* (palmyrah) tuber flour and soaked *Cucurbita pepo* (pumpkin) seeds, with addition of *Cinnamomum verum* (cinnamon) and Myristica fragrans (nutmeg), blended in a plant-based milk base. The planned analyses include Proximate composition (moisture, ash, protein, and fat content), where moisture analysis is crucial for understanding the beverage's total solids, shelf stability, and nutritional consistency. Fat content will be used to estimate energy contribution, considering that fat provides approximately 37 kJ g^{-1}(9 kcal g^{-1}). Bioactive analysis will include total phenolic content via the Folin–Ciocalteu method, and antioxidant capacity using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay. Prebiotic potential of the product will also be tested as Palmyrah is rich in fibers. Physicochemical properties such as pH, viscosity, and °Brix will also be assessed. A Sensory evaluation with 30 semi trained panelists will be conducted to explore consumer acceptability terms of taste, aroma, mouthfeel, and overall preference. This pitch explores the feasibility of creating a plant-based evening beverage aligned with principles of circadian and functional nutrition. The findings from this study will serve as a foundation for developing scientifically informed, consumer-friendly night-time functional beverages.

Keywords: *Antioxidant Activity, Borassus flabellifer,Circadian Nutrition,Functional Beverage, Sleep Support.*

ID: FST39

Development and Quality Evaluation of an Edible Coating for Prolonging the Shelf Life of Peeled Onions (*Allium cepa* L.) Under Ambient Storage Conditions

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Peeled onions, valued as convenient, ready-to-use ingredients, significantly reduce preparation time and labor. However, removal of the protective outer layer drastically shortens their shelf life. In regions lacking reliable cold storage, this rapid deterioration leads to considerable food waste. While edible coatings have effectively extended the shelf life of minimally processed fruits and vegetables, their application to peeled onions remains underexplored. This study aims to develop a low-cost, biodegradable edible coating to extend the shelf life of peeled onions stored at ambient temperature. Medium-sized, fully matured Vethalan onions will serve as the model substrate. Coating formulations will be based on corn starch as the primary film-forming agent, incorporating Aloe vera gel at 20%, 40%, 50%, and 60% (w/w), calcium chloride at 0.5% and 1.0% (w/w), turmeric extract at 0.2% (w/w) as a natural antimicrobial, glycerol at 0.5–1.5% (w/w) as a plasticizer, and carboxymethyl cellulose at 0.5% (w/w) as a stabilizer. Coatings will be applied by dip-coating and air-drying, with concentrations optimized through preliminary trials. Turmeric extract's antimicrobial activity will be tested by agar diffusion assays, and then the edible coating will be evaluated to confirm retained effectiveness. Surface morphology will be characterized using Scanning Electron Microscope. Samples will be stored at 28–32 °C for 14 days and evaluated on days 0, 3, 7, 10, and 14 for weight loss, firmness, color, moisture content, microbial counts (total plate count, yeast, and mold), and sensory attributes by a semi-trained panel using the hedonic test. Statistical analysis will be performed using Minitab software to identify significant differences among treatments. The anticipated outcome is an effective, biodegradable coating that extends peeled onion shelf life without refrigeration, thereby enhancing the commercial viability of minimally processed onions and reducing food waste.

Keywords: *Aloe vera gel, ambient storage, edible coating, peeled onions, shelf-life extension.*

ID: FST40

Coloring the Future Green: Biowaste-Derived Natural dye From *Citrus reticulata* Peels

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The environmental impact of synthetic dyes used in the textile industry is a growing concern due to their toxicity and contribution to water pollution. Despite growing interest in natural dyes, there is a critical lack of systematic studies optimising extraction from citrus peel biowaste, directly comparing solvent efficiencies, and correlating phytochemical profiles with performance in both textile and food applications. This research explores the potential of utilising mandarin orange (*Citrus reticulata*) peel biowaste as an eco-friendly source of natural dye, contributing to sustainable textile and food production. The research will be carried out in three phases. Initially, mandarin orange peels will be sourced, thoroughly washed, dried at 45-50°C, and ground into a fine powder to enhance pigment accessibility. In the second phase, pigments will be extracted by heating (60-70°C) and soaking the materials in water, ethanol, and glycerin, while carefully controlling the conditions to keep the pigments intact. In this study, the quantified phytochemicals included polyphenolics and flavonoids. Polyphenolic content will be determined using gallic acid as the standard, while quercetin will be used as the standard for flavonoid quantification. The antioxidant or radical scavenging potential will be assessed using the DPPH radical scavenging assay, with ascorbic acid as the reference standard. All analyses will be performed spectrophotometrically. Finally, the extracted dyes will be applied to cotton fabrics using alum as a mordant, and the dyed fabrics will be evaluated for color intensity and stability. Colorfastness tests, including wash, rub, and light fastness, will evaluate dye performance on textiles. Additionally, to assess their potential as food colorants, the dyes will be added to beverages, desiccated coconut, and yoghurt to observe visual appeal and stability under different storage conditions. This study demonstrates value addition by transforming citrus peel waste into eco-friendly natural dyes, supporting environmental protection, reducing synthetic dye dependency, and contributing to sustainable production practices aligned with Sustainable Development Goals.

Keywords: *Biowaste valorisation, Circular economy, Citrus reticulata, Food colorant, Natural dye.*

Development of a Biodegradable Packaging Material Using De-oiled Cinnamon Waste

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The increasing reliance on plastic packaging, especially food and consumer packaging, has generated serious environmental concerns due to its non-biodegradable nature and long-term ecological impact. To overcome this problem, natural and renewable resource-based biodegradable materials have emerged as potential alternatives to synthetic polymers. The current research aims at the development of a biodegradable film packaging from cassava starch and de oiled Cinnamomum verum bark waste, while cassava starch offers better film-forming capability, it is usually limited because of its high water sensitivity and poor mechanical strength. The addition of de-oiled cinnamon waste powder is expected to enhance the aforementioned properties due to its fibrous structure as well as bioactive components like cinnamaldehyde and eugenol that possess antimicrobial and antioxidant activities. Preparation of the film will involve extracting cassava starch from fresh cassava roots and incorporating various levels of cinnamon waste with glycerin incorporated as the plasticizer. The film formation will be done using gelatinization and solvent casting techniques. The produced films will then be subjected to a series of analyses, including physicochemical analyses (moisture content, solubility, thickness, and water vapor permeability) by using standard laboratory methods, mechanical analysis (tensile strength and elongation at break), biodegradability under soil burial test, and antimicrobial activity against selected microbial strains. The films produced are expected to have improved mechanical and barrier properties along with improved biodegradability and antimicrobial activity. These films can be used for primary and secondary packaging of dry food, herbal products, single-packaging wraps, and biodegradable pouches. Moreover, the use of de-oiled cinnamon waste imparts functional benefits and promotes sustainable management of agricultural residues. The study adds to the field of green packaging innovation and helps bring about circular economy practices in the packaging industry.

Keywords: *Agro-industrial waste, antimicrobial film, biodegradable packaging, cassava starch, sustainable material.*

ID: FST47

Development of a Functional Cracker with Papaya Flour: A Sustainable Approach to Reduce Post-harvest Losses

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Papaya (*Carica papaya*) is a widely cultivated fruit in Sri Lanka with post-harvest losses estimated at around 40%, due to its high susceptibility to mechanical damage and microbial spoilage. Development of a Papaya cracker using dry papaya fruit flour introduces an approach to a functional, nutritious, and shelf-stable snack while addressing post-harvest losses. This study aimed to use papaya fruit at three ripening stages: unripe, ripe, and over-ripe by taking trace yellow, 50% yellow, and full yellow colored fruits. The snack was prepared by converting papaya from three ripen levels into flour and incorporating them into crackers at 10%, 20%, 30% substitution levels with wheat flour. A sensory evaluation conducted by 30 semi trained panelists using 5-point hedonic test revealed that the 20% papaya flour cracker of ripe stage achieved the highest overall acceptability among the tested samples. The cracker with 20% ripe papaya flour exhibited the physiochemical properties including a pH of 5.7, moisture content of 7.63%, bulk density of 395 kgm^{-3}, water absorption of 1.17 (g/g), true density of 2810 kgm^{-3}, sinkability of 12 seconds, wettability of 25 seconds, and an ash content of 11.5% showing favourable conditions during the formulation tests. Microbial analysis confirmed the product's safety with Total Plate Count (TPC) ranging from $1.4x10^5$ to $1.85x10^5$ CFU/g remaining within acceptable limits for baked goods. The pH and texture of the papaya cracker were comparable to conventional wheat-based crackers supporting consumer acceptability. These findings indicate the potential of incorporating papaya flour into baked products as a sustainable solution to reduced food waste.

Keywords: *functional cracker, papaya cracker, post-harvest loss, ripening stage, sustainable food.*

Development And Evaluation Of Plant-Based Gummies Enriched With Aloe Vera, Soursop, Orange And Basil Seed

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Gummies are soft and chewy confectioneries that are widely consumed due to their appealing taste and texture. With growing interest in functional foods and clean label the focus has shifted towards developing plant-based gummies that offer functional and sensory benefits. Traditional gummies are typically made with gelatin derived from animal proteins, which restricts consumption by vegetarians. This study aimed to develop and evaluate plant–based gummies incorporating aloe vera, soursop, orange, and basil seeds. The plant-based gummies were formulated by using tropical fruit pulp that consists of aloe vera (27.9%), soursop (23.2%), and orange (13.9%), basil seed (4.6%), Agar-agar and pectin (1.8%), invert sugar (28.3%), and citric acid (0.29%). Three plant-based formulations were developed by adjusting the agar-to-pectin ratio to 1:1, 3:1, and 1:0, while keeping the other ingredients constant. The control sample is a gelatin gummy that was prepared in the laboratory. Sensory evaluation was conducted for three formulations that evaluated 30 semi-trained panelists using a 5-point hedonic scale to assess appearance, texture, and overall acceptability. Texture Profile Analysis was used to determine the mechanical properties of the three plant-based formulations, and the formulation most similar to the control was selected. The selected formulation was the gummy that prepared agar to pectin ratio 1:1. The selected formulation was further analyzed for physicochemical properties, including pH (3.47±0.01), total soluble solids (50.47±1.12 °Brix), moisture content (18.50±0.27%), and water activity (0.46± 0.0087). Microbiological safety was evaluated using total plate count (1.08×10^4 CFU/g) and yeast and mold enumeration. Nutritional properties and shelf-life stability were also assessed. The gummies are stable at room temperature for one month without preservatives. The shelf-life is extended to six months with preservatives. The selected gummy formulation exhibits desirable physicochemical stability and acceptable microbial stability, indicating safe consumption.

Keywords: *Agar-agar, Pectin, Plant-based gummies, Soursop, Tropical fruit.*

ID: FST64

Development and Shelf Stability Assessment of Coconut Water (*Cocos nucifera*) and Herbs Incorporated Whey Beverage with Botanical Infusion

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The dairy industry in Sri Lanka produces large amounts of nutrient-rich whey, which remains underutilized. This study developed a health-focused drink by blending whey protein, electrolyte-rich coconut water, and chia seeds, with hibiscus extract added for antioxidant benefits and natural color. Three formulations with varying whey-to-coconut water ratios (65:12%, 55:22%, and 38.50:38.50%) were tested. The optimal formula, 38.50% whey, 38.50% coconut water, 15% hibiscus extract, 5% natural sweetener, 1.50% lemon juice, and 1.50% hydrated chia seeds, was selected based on the highest overall sensory acceptability (n=30, 7-point hedonic scale). The selected beverage was stored in transparent (treatment) and amber (control) bottles to assess shelf stability, as coconut water typically requires light-protective packaging and hibiscus anthocyanins are sensitive to light, heat, and pH changes. Proximate composition (moisture, ash, total sugar), physicochemical properties (pH, titratable acidity, color, viscosity), total phenolic content (Folin–Ciocalteu method), and microbiological assessments (total plate count, yeast and mold counts) were analyzed over 14 days of refrigerated storage. ANOVA showed significant differences ($p \leq 0.05$) among formulations for taste, color, mouthfeel, and overall acceptability. Moisture, ash, and viscosity were unaffected by packaging, while total sugar was slightly higher in the control (5.98±0.02 g/100 mL) than treatment (5.19±0.01 g/100 mL). The treatment showed higher pH (4.98±0.01–5.12±0.02), while controls showed within the expected range of 5.0–4.0 (4.98±0.01–4.5±0.04). Colorimetric analysis showed a higher $a^\star$ in the control (+1.25) than treatment (+0.12), indicating better red color retention. The control also had higher phenolic content (41.14±0.26 mg GAE/mL) than the light-exposed sample (31.65±0.55 mg GAE/mL). Microbial counts stayed within acceptable limits ($<10^3$ CFU/mL bacteria, $<10^2$ CFU/mL yeast/mold), with better shelf stability in control ($\leq 10^2$ CFU/mL bacteria, $<10^1$ CFU/mL yeast/mold). The beverage's natural ingredients and functional benefits make it suitable for health-focused consumers seeking alternatives to soft drinks.

Keywords: *Coconut water, Functional beverage, Hibiscus extract, Whey.*

Development Of Biodegradable Food Packaging Coated With Wax Extracted From Sugarcane Filter Press Mud

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The increasing demand for sustainable packaging solutions has spurred interest in biodegradable and cost-effective alternatives to conventional plastic and synthetic wax-coated paper-based food packaging. The processing of sugarcane (*Saccharum officinarum L.*) generates substantial quantities of agro-waste, notably filter press mud, which is rich in wax, proteins, fibers, and minerals. During processing, sugarcane wax becomes concentrated in the filter press mud, increasing by 10- to 100-fold. This study primarily aims to develop a biodegradable, wax-coated paper-based food packaging extract from filter press mud. Toluene and benzene will be used as solvents for crude wax extraction using Soxhlet, as their combined ability to dissolve different nonpolar components ensures broader solubility, higher yield, and efficient recovery, while isopropyl alcohol will be used for purification. The preparation of wax-coated paper packaging involves applying sugarcane wax onto paper-based food packaging. The prototype will be assessed by comparing its properties with conventional paper-based food packages, focusing on water vapour transmission, biodegradability, and oil barrier properties. Given the adverse health and environmental effects of synthetic waxes and high cost of natural waxes, utilizing sugarcane wax for food packaging is proposed. Although sugarcane wax from filter press mud has not been traditionally used for food packaging, it shows potential as a coating in paper packaging due to its biodegradability. Wax removal facilitates its use in packaging and enhances the nutrient uptake efficiency of the remaining mud when applied to soil. This approach converts agro-waste into biodegradable coatings, using abundant materials and low-cost processing for scalable, affordable and sustainable packaging.

Keywords: *Benzene, Biodegradability, Filter Press Mud, Food Packaging, Sugarcane Wax*

Development and Characterization of a Gluten-free Dough Enhancer from Plant-based Ingredients

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Gluten-free products are gaining popularity due to increasing health concerns and gluten intolerance. Gluten-free flours result in poor dough elasticity due to the absence of gluten protein. Therefore, texture enhancers are essential to improve the structural quality of gluten -free baked goods. Synthetic enhancers are available but raise clean-label concerns among consumers. This study aims to develop a natural texture enhancer using sprouted finger millet (*Eleusine coracana*), cassava starch (*Manihot esculenta*), flaxseed powder (*Linum usitatissimum*) and vinegar. These ingredients were chosen by considering their functional properties such as enzyme activity, viscosity, and natural gel-forming ability. Sprouted finger millet, prepared by germinating the grains under controlled condition for 24 hours, will be expected to contribute amylase activity and probiotic fiber, while cassava starch extracted in laboratory, flax seed powder and vinegar will be intended to mimic gluten's viscoelastic behavior. All ingredients will be cleaned, dried at 50°C - 55°C, milled, and sieved to achieve particle size less than 100 µm. The initial formulation will only consists of 50% sprouted finger millet, 30% cassava starch and 20% flaxseed powder then add 5ml of vinegar added to improve dough functionality. The developed enhancer will be incorporated into superfine white rice flour at 10%, 20% and 30% levels (w/w), with a control sample containing no enhancer. The developed texture enhancer will be incorporated into gluten-free bread made with white rice flour. Textural properties of both dough and bread will be evaluated using texture analyzer. Sensory evaluation will be carried out to assess sensory attributes and overall acceptability. The results will be compared with wheat flour bread. The current ratios are based on functional characteristics, and further optimization will be done through trails or Response Surface Methodology (RSM). This formulation will support the development of clean-label, naturally enhanced gluten-free bakery products.

Keywords: *Clean-label formulation, Dough functionality, Enzymatic activity, Flax seed powder, Gluten-free baking*

ID: FST70

Development of a Plant-based Printable Ink from Oats(*Avena sativa*)and Okra (*Abelmoschus esculentus*) Mucilage for 3D Food Printing Application

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The rising demand for functional, sustainable, and tailored foods has generated interest in three dimensional (3D) food printing technologies, which aim to produce visually appealing and nutrition, nutritionally optimized foods using layer-by-layer precision deposition. Since oats consist of high β-glucan content, oats are tasteless, have satisfactory viscosity, and contain health benefits like glycemic management and cholesterol reduction. However, oats alone exhibit poor structural stability upon printing, necessitating formulation enhancement. Okra mucilage, a polysaccharide-rich hydrocolloid derived from fresh okra pods, offers gel forming, emulsifying, stabilizing, antioxidant, and prebiotic properties that are expected to improve the rheological characteristics and mechanical integrity of the printed structures. Commercial oat flour and 2–6% (w/w) okra mucilage solution will be prepared as raw materials for this experimental study preparation. Rheological characterization will be conducted using a rotational rheometer to assess shear-thinning behavior, viscoelasticity (G, G), flow behavior index (n), and consistency coefficient (K). Printing trials using a customized extrusion-based 3D printer will evaluate extrudability, size tolerance, shape retention, and interlayer adhesion. Physicochemical properties including moisture content, pH, water activity, and gel firmness, will be analyzed following AOAC standard methods. Data will be analyzed using ANOVA, Tukey's post hoc test, and Pearson correlation to identify significant differences and optimal formulation performance. The ultimate aim of this research is to develop a printable, stable, and nutrient-rich oat-okra mucilage hydrogel ink suitable for producing customized 3D-printed foods, particularly for children, the elderly, and individuals with special dietary needs. Potential applications include customized energy bars, breakfast meals, and pasta or noodle products tailored to specific nutritional requirements.

Keywords: *Functional Foods, Hydrogel Ink, Oat Flour, Okra Mucilage, 3D Food Printing*

ID: FST71

Development of Functional Flour from Corn Cobs as a Sustainable Food Ingredient for Dietary Applications

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Corn cobs are often discarded as waste in the food industry and remain largely underutilized as a food source. Globally, where corn is widely cultivated and hunger persists, utilizing corn cobs to make flour offers a sustainable opportunity to enhance food security and reduce waste. This study will explore the use of corn cobs as a functional food ingredient for producing fiber-rich flour. Mature corn cobs will be collected, and kernels removed to obtain the white inner pith. The pith will be pressure-cooked at 10 PSI (around 112°C) for 30–60 minutes to soften the fibrous structure. After cooking, Lemon juice will be added to slightly lower the pH to 4.5–5.5, which helps break down fibers. The pith will be cut into smaller pieces and treated with food-grade cellulase enzyme to reduce lignin complexity and enhance digestibility. The enzymatically treated pith pieces will be tray dried at three to four different temperatures to evaluate the effect of drying conditions. The optimum temperature will be selected based on the properties of the resulting flour. Once identified, this selected low temperature will be used to dry the remaining enzymatically treated samples to ensure consistent moisture removal before grinding into a fine powder. Coarse lignin will be sifted out, resulting in corn cob flour rich in dietary fiber. The flour will be analyzed for functional, physicochemical, and microbiological properties. This study aims to contribute to global food sustainability by transforming corn cobs, an underutilized agricultural by-product, into functional flour, reducing industrial waste and introducing a novel ingredient for diverse food applications worldwide.

Keywords: *cellulase enzyme, fibrous structure, functional food, pith*

Development and Characterization of a Multi-Functional Metabiotic Powder from Cheese Whey

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With increasing demand for shelf-stable, health-promoting food ingredients, this study explores the development of a metabiotic powder derived from cheese whey, a byproduct of the dairy industry. Fermentation was carried out using 1.5L of whey inoculated with 0.75g of ABT-5 culture (Chr. Hansen), containing *Lactobacillus acidophilus*, *Bifidobacterium* spp., and Streptococcus thermophilus, under controlled conditions (72 hours at 37°C, pH 4.2). The substrate was supplemented with 15g of banana flour as a prebiotic and 25g of sugar to enhance microbial growth. The fermented mixture was then dried using a hot air oven to obtain the final powder. Fourier Transform Infrared Spectroscopy (FTIR) revealed prominent peaks at ∼3300cm^{-1} (O–H/N–H stretching), ∼2900cm^{-1} (C–H stretching), and ∼ 1700cm^{-1} (C=O stretching), indicating the presence of organic acids and short-chain fatty acid derivatives. Bands observed between 1000–1200cm^{-1} confirmed the synthesis of exopolysaccharides (EPS), which were absent in unfermented controls. EPS content was quantified at 406.7µg/mL, constituting approximately 4.07% of the final product, using the phenol-sulfuric acid method. Antimicrobial assays demonstrated inhibition zones of ≥5mm against Escherichia coli and Listeria monocytogenes, while unfermented controls showed no activity. Ampicillin controls (≥12mm) validated the assay. These findings confirm that whey-based fermentation, enriched with plant-derived prebiotics, can yield a stable, bioactive powder rich in EPS and other antimicrobial compounds with potential metabiotic effects. This product shows potential for use in beverages, bakery items, and confectionery without refrigeration. Future work will focus on SCFA profiling via gas chromatography and sensory evaluation in various food matrices.

Keywords: *ABT-5 culture, Antimicrobial activity,, Cheese whey fermentation, Exopolysaccharides (EPS), Metabiotics*

ID: FST78

Development of Active Packaging Materials Based on Cassava Starch Incorporated with Pandan Leaf (*Pandanus amaryllifolius*) Fiber and Extract

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Starch-based packaging materials have drawn the attention of recent studies. This study focused on developing active packaging material using cassava starch, Pandanus amaryllifolius fiber, and extract, as limited studies have used extract and fibers from pandan for packaging materials development. First, peel starch composite (PSC) and flesh starch composite (FSC) were developed using starch extracted from the peel and flesh, respectively. Then, fiber composites (FC) were formulated by incorporating fiber into FSC at varying levels. The pandan fiber was added at four different concentrations: 0.4 g (0.4 FC), 0.8 g (0.8 FC), 1.2 g (1.2 FC), and 1.6 g (1.6 FC) per 1 g of starch in FSC. The same amount of ethanol extract of pandan leaves/ pandan extract (PE), Carboxy methyl cellulose, and citric acid was added with beeswax coating to all composites. Finally, mean thickness (MT), moisture content (MC), water activity (WA), water solubility (WS), hardness (by rupture test), and oil absorption of composites were determined. There was no significant difference between MT, MC, WA, WS, and hardness of the FSC and PSC ($p>0.05$). WS of the FSC and PSC were 42.54±4.40% and 43.84±3.49%, respectively. Also, the hardness of the FSC and PSC was 1226.33±16.74 g and 1248.00±12.12 g, respectively. WS of FC decreased from 34.33±1.95% to 11.43±0.74%, while the hardness of the FC increased from 1323.30±18.3 g to 1498.67±6.11 g with an increment of fiber content. No oil absorption was observed in any material. Additionally, the calculated IC 50 value (DPPH scavenging assay) for the PE was 905.79 ppm, and FSC prepared with the same extract showed an IC 50 value of 1202.77 ppm. It can be concluded that cassava peel starch can also be used same way as flesh starch to develop a composite. Also, the addition of fiber significantly increases the hardness while reducing WS.

Keywords: *Active packaging, Cassava, Fiber, Food packaging, Pandanus amaryllifolius*

ID: FST79

Consumer Awareness and Perception of Energy Drinks for Gamers Available in the Sri Lankan Market

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Gaming beverages are specially formulated functional drinks designed to enhance cognitive performance, support brain function, provide hydration, and improve reaction time through the inclusion of bioactive compounds, vitamins, and neurostimulants. This study aimed to evaluate consumer awareness and perception of gaming beverages in the Sri Lankan beverage market. A retrospective online survey comprising 31 structured questions was conducted using a Google Forms questionnaire. The questionnaire was distributed to 200 video game participants, aged 19-40 years, who were selected through a random sampling method across all districts of Sri Lanka. The collected data were used to analyze demographic characteristics, consumer awareness, consumption patterns, perceptions, and purchasing behaviors. The study found that 77% of participants were aware of gaming beverages. Among participants (97 females and 103 males), a significantly higher level of awareness was observed among male participants compared to females, with gender showing a statistically significant influence ($p = 0.016$). Among the different categories, participants showed the highest awareness of energy drinks (82.6%), followed by hydration drinks (66.7%). The primary sources of this awareness were social media (54%) and in-store displays (47%), highlighting the influence of digital and retail marketing channels. Of those aware of gaming beverages, 69.5% expressed willingness to consume them. A significantly higher consumption rate was observed among male participants ($p = 0.043$). The main reasons for consumption were performance enhancement (54.5%), refreshment (50.6%), and enjoyment (48%). In contrast, the main limitations to consumption included a lack of interest (62.5%) and the high cost of these products (58.5%). Additionally, findings revealed that 34.5% of participants believed that Sri Lanka does not provide a satisfactory selection of gaming beverages. These results highlight the potential for developing healthier gaming beverages at affordable prices, formulated with reduced calorie content and natural, locally sourced ingredients, aligning with consumer expectations and market trends.

Keywords: *Beverage, Consumer Awareness, Consumer Perception, Energy Drinks, Gaming Drinks*

ID: FST80

Evaluating the Perception of Consuming Biotic-Based Foods (Probiotics, Prebiotics, Synbiotics, and Fermented Foods) Among Undergraduate Students at SUSL

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The global interest in biotic-based foods, such as probiotics, prebiotics, synbiotics, and fermented foods, has grown due to their proven benefits in supporting gut health and overall well-being. However, limited research exists on consumer awareness and perception of these foods among undergraduates in Sri Lanka. Since undergraduates can play a vital role in spreading knowledge and raising awareness about biotic foods, this study aimed to assess the knowledge, perception, and consumption patterns of biotic-based foods among undergraduate students at Sabaragamuwa University of Sri Lanka (SUSL). A structured questionnaire using a five-point Likert scale was distributed among 262 students (50.8% females, 49.2% males) across eight faculties. Data was analysed using descriptive statistics and chi-square test to evaluate group differences. The results revealed that female students possess significant knowledge than male students ($p<0.05$). Among the types, 82.7% of students were familiar with probiotics, followed by fermented foods (63.7%), prebiotics (50.2%), and synbiotics (36.7%). When considering examples rather than scientific names, all students are familiar with fermented foods. Awareness varied by academic discipline, with higher familiarity among students from, faculty of Applied Sciences (94%), Agricultural Sciences (91%), and Medicine (90%). Yogurt was the most commonly consumed biotic-based food (84.7%), followed by cheese (53.8%) and pickles (52.3%). Prebiotic foods were consumed most frequently, while intakes ranged from two to three times per week to daily consumption. The primary reasons for the consumption of biotic foods were taste (59.8%), health benefits (50.8%), and gut health improvement (42.9%), while rejection was due to taste preferences (37.8%), lack of awareness (29.7%), and price (28.4%). Among the participants, 67% agreed to consume biotic foods if foods were recommended by healthcare professionals. These findings highlight the moderate level of awareness and consumption of biotic-based foods, showing the need for targeted educational initiatives to improve functional food literacy.

Keywords: *Biotic foods, Consumption frequency, Perception, Probiotic, Prebiotic*

ID: FST81

Development of Functional Rasam Cube Using Dehydrated Moringa (*Moringa oleifera*) Pods and Tamarind (*Tamarindus indica*) Without Synthetic Additives

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Moringa oleifera known as the miracle tree, is a nutrient-dense plant rich in essential vitamins, minerals, fiber, and antioxidants. Rasam is a South Asian spiced soup that aids digestion. This study focused on the development of functional rasam cube rich in fiber and micronutrients by incorporating moringa pods and *Tamarindus indica* without using synthetic binders or preservatives. The binding and preservation properties of moringa pod peel and tamarind were harnessed. Separated the moringa peel (MP) and moringa flesh (MF), then dehydrated at 55°C for 18 hours (MF) and 50°C for 8 hours (MP) to produce powder. The formulation included tamarind pulp, coconut oil, salt, spice mix comprising cinnamon, cloves, nutmeg, mace, cumin seeds, garlic, curry leaves, red chili, black pepper, ginger, and coriander. A control sample (spices + tamarind) was compared with three formulations: F1 (MF 50% + MP 10%), F2 (MF 40% + MP 20%), and F3 (MF 30% + MP 30%). Texture Profile Analysis (TPA) on CT3 analyzer (20 g force, TA18 sphere probe), color measurements using colorimeter, viscosity of rasam solutions, and five-point hedonic sensory evaluation by a semi-trained 30-member panel identified F2 as the most acceptable formulation through one-way ANOVA ($p<0.05$). Further analysis of F2 revealed desirable attributes (n=3): low water activity (0.62±0.01), bulk density (0.69±0.02 g cm^{-3}), solubility index (93.52±1.25%), and dispersion time (57±2.1 s). Proximate analysis indicated moisture (10.8±0.15%), fiber (5.6±0.12%), fat (4.4±0.09%), protein (2.8±0.07%), and ash (3.55±0.05%). Functional and safety evaluations included DPPH radical scavenging antioxidant activity (IC_{50} 89.9 µg mL^{-1}), vitamin C content (2.25±0.08%), total phenolic content (TPC) express as Gallic Acid Equivalents (45.6±0.95 mg GAE g^{-1}), peroxide value (6.2±0.11 meq kg^{-1} fat), pH (4.46±0.04), acceptable total plate count, total yeast and mold counts. The study confirms the potential of moringa pods as natural functional ingredients in clean-label, plant-based dehydrated food products.

Keywords: *Antioxidant Activity, Fiber-Rich Binder, Functional Food, Moringa oleifera, Rasam Cube, Tamarindus indica*

Development and Characterization of Low-Glycemic Sugar Substitute from Ripened Wood Apple (*Limonia acidissima*)

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Low-glycemic index (GI) sugar substitute is highly valued to reduce the rapid spikes in blood glucose and insulin levels that occur after consuming high-GI sugars. Natural low-GI sugar substitute helps to reduce the risk of type 2 diabetes, obesity, and cardiovascular diseases by supporting better glycemic control. Wood apple (*Limonia acidissima*) is an underutilized indigenous fruit widely grown in Sri Lanka that is naturally aromatic, sweet, and rich in dietary fiber, pectin, minerals, and bioactive compounds. The presence of soluble fiber and pectin helps slow down glucose absorption and some experiments estimate that it contains glycemic index ranges from 35–45. The main objective is to extract, and concentrate of a low-glycemic index sugar substitute produced from ripened wood apple and evaluate the physico-chemical and functional properties. The deseeded ripened pulp of wood apple is blended with water in different ratios and followed in open-pan boiling. The pulp ratio can be used as 25%, 35% and 45% as replicate samples. The syrup is analyzed for Total Soluble Sugars, pH, titratable acidity, viscosity, antioxidant activity, and colour. The glycemic index was determined using in vitro starch hydrolysis to yield a mean GI value which is lower ($p<0.05$) than commercial glucose syrup of GI value as approximately 55. All the tests were performed in triplicate samples and data were statistically analyzed using one-way ANOVA followed by Tukey's test. A sensory evaluation is conducted with 30 semi-trained panelists to assess taste, aroma, colour, and overall acceptability. The expected outcome is to produce a natural sugar substitute with a lower glycemic index by retaining functional properties. The study contributes to improve post-harvest utilization, value addition for local farmers, and the promotion of healthier sweetening alternatives.

Keywords: *antioxidant activity, low-glycemic index, natural sugar substitute, physico-chemical properties, sensory evaluation, syrup*

ID: FST86

Design of a Nutrient-rich, Vegan, Pulses-based Cube with Adaptogenic and Gut Health Benefits

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The demand for plant-based, convenient, functional beverages is increasing, yet many instant options lack high-quality protein, evidence-backed adaptogens, or targeted gut health benefits. Despite their rich protein, fiber, and prebiotic content, many locally grown pulses remain underutilized in Sri Lanka. This study aims to develop a nutrient-rich, vegan instant beverage cube incorporating pulses, adaptogens, and gut-supportive components, offering a sustainable and functional alternative for health-conscious, vegan, and/ or gluten-intolerant consumers. The formulation combines finely milled chickpeas (*Cicer arietinum*) and mung beans (*Vigna radiata*) with ashwagandha (*Withania somnifera*) extract, cinnamon (*Cinnamomum verum*), and coconut milk powder. Ingredients will be blended and agglomerated using 10% maltodextrin solution for improved solubility, moulded into cubes, and dried to <5% moisture (AOAC 925.10) to achieve an anticipated 6–12 month shelf life under ambient storage. Functional properties will be assessed through total phenolic content (Folin–Ciocalteu) and antioxidant activity (DPPH radical scavenging assay). The potential of gut health will be evaluated by incorporating microencapsulated *Bacillus coagulans* (CGI314 strain) and determining viable counts on selective MRS agar media during storage. Pulses are expected to provide essential amino acids, dietary fiber, and slow-release carbohydrates. Ashwagandha and cinnamon contribute anti-inflammatory, antioxidant, and adaptogenic benefits. The use of pulses also supports sustainable agriculture through nitrogen fixation and low environmental impact. Literature evidence indicates the feasibility of producing a shelf-stable, instant cube with both nutritional and functional properties. Future work will optimize the formulation, validate the probiotic stability, and conduct sensory evaluations to assess consumer acceptability.

Keywords: *Functional food, Plant-based nutrition, Adaptogens, Instant beverage cube, Pulses*

Development of Functional Hot Beverage Using *Cucumis melo* L. (kakiri) as a Natural Ingredient

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*Cucumis melo*L., commonly known as kakiri, is an underutilized vegetable native to Sri Lanka, especially cultivated in the dry zone. It plays an important role in Ayurveda treatments due to its ability to act against urinary stone issues. The objective of this study is to develop a novel functional hot beverage using the whole kakiri fruit, including the peel, flesh, and seeds, to valorize post-harvest surplus while promoting health and wellness. Well-ripened kakiri will be selected, washed, and cut into small pieces while separating the seeds. The flesh will be dehydrated at 60-80°C for at least three hours, and seeds will be dehydrated at around 50°C for 1-2 hours. After dehydrating, ground flesh and seeds will be added to the infusion bags according to the most suitable proportion. The most appropriate proportion will be selected based on the color, aroma, and brewing time. Then the infusion will be subjected to physicochemical analysis, including pH, total soluble solids, titratable acidity, and antioxidant capacity. To assess consumer acceptability, sensory evaluation will be done using a structured hedonic scale with a semi-trained panel. Descriptive analysis will be performed immediately following the hedonic test to gather detailed sensory profiling and high-performance liquid chromatography (HPLC) will be used for the profiling of bioactive compounds. The developed infusion is anticipated to offer health-promoting properties, particularly in urinary health management, while addressing the growing market demand for functional beverages in Sri Lanka.

Keywords: *Cucumis melo L., functional beverage, infusion bag, kidney stones*

ID: FST91

Development and Evaluation of a Composite Flour from Brewers' Spent Grain and Chia Seed Flour for Bakery Applications

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This study focused on developing a high-fiber composite flour by incorporating Brewers' Spent Grain (BSG) and chia seed flour into wheat flour, to enhance nutritional value and promote sustainable by-product utilization. It was initially tested in bread with three formulations, all of which showed partial leavening and poor texture. Substituting chia with sesame seed flour improved moisture retention slightly but did not resolve textural issues of bread. The composite flour was then evaluated in an instant cookie mix formulation. The revised mix contained BSG (28.17%), wheat flour (17.86%), chia seed flour (11.28%), cocoa powder (4.23%), sugar (35.12%), baking powder (2.41%), salt (0.62%), and milk powder (0.31%). A sensory test by thirty semi trained panelists using a 5-point hedonic scale determined the most suitable cookie mix formulation. The resulting cookies demonstrated textural qualities, flavor, and color, despite a slight bitter aftertaste and moisture absorption during post-baking storage. Texture was evaluated using a Texture Profile Analyzer. The compression test revealed a hardness of 275.20 g during the first compression cycle and 242.20 g during the second cycle. The cookie sample exhibited low adhesiveness (0.05 mJ) and moderate springiness (2.27 mm). Proximate analysis showed the final cookie mix contained 9.38 g of crude fiber, 5.69 g of total fat, 36.65 g of total sugar, and 3.72 g of total ash per 100 g of mix. These results confirmed an improvement in fiber and mineral content in the cookies. These findings indicated that the composite flour is better suited for cookies than bread and applicable to health-focused, sustainable bakery development.

Keywords: *Brewers' Spent Grain, Chia seed, Composite flour, Nutritional enhancement*

ID: FST93

Evaluation of the Sensory and Chemical Impact of Ranawara(*Senna auriculata*) Flower Extract on Ready-To-Drink Iced Tea

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This study addresses the lack of sustainable and nutritious iced tea options in Sri Lanka, where busy lifestyles have increased the demand for healthy instant beverages. The research aimed to develop a Ready-to-Drink iced tea using Ceylon Black Tea and Ranawara (*Senna auriculata*) flowers, emphasizing its functional properties and consumer acceptance. Nine formulations were evaluated through proximate analysis, microbial analysis, sensory evaluation, and phytochemical testing. Formulation 398, with a 3:2 tea-to-Ranawara extract ratio and 50% soda water, was the most preferred in sensory evaluation by 30 semi-trained panelists using a 7-point hedonic scale. Proximate analysis showed a moisture content of 94.217±0.28%, with negligible ash and fat. Physicochemical analysis revealed bioactive compounds, including polyphenols (262.044±1.571 mg GAEq L^{-1} and DPPH scavenging activity (IC_{50}, µg mL^{-1}) of 154.319, contributing to its antioxidant properties. The sugar content was 5.367±0.252%, salt content 0.058±0.012%, and caffeine content 120.4±1.414 mg L^{-1}. Turbidity was 179.333±3.055 NTU, indicating clarity, with titratable acidity at 0.138±0.005% citric acid and a stable pH of 6.307±0.055 over 7 days. A slight reduction in Brix value was observed, from 5.2° to 5.1° over 7 days. Qualitative phytochemical screening confirmed the presence of tannins, quinones, flavonoids, saponins, and terpenoids, supporting the beverage's functional composition. Microbiological analysis showed minimal contamination, with total plate count and yeast and mold counts reported as TFTC (Too Few To Count) during the 21-day shelf-life evaluation. Colorimetric analysis recorded stable color retention, with $L^\star$ values of 40.51±4.36, $a^\star$ of 4.12±0.35, and $b^\star$of 24.09±2.38. Formulation 398 demonstrated the best sensory acceptability, microbiological safety, and high antioxidant content, highlighting its potential as a value-added RTD iced tea. The nutrient-rich iced tea addresses the market gap and offers new insights for the iced tea industry. Future research should focus on scaling production, improving sustainability, and meeting regulatory requirements for health claims.

Keywords: *Antioxidant, Ceylon Black Tea, Functional Beverage, Ranawara (Senna auriculata), Ready-to-Drink (RTD) Iced Tea*

Valorization of Cocoa By-Products into a Functional Skimmed Milk-Based Beverage: Formulation, Sensory Evaluation, Physicochemical and Antioxidant Properties Assessment

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Cocoa production generates large amounts of by-products, with 80–90% typically discarded, highlighting the urgent need for sustainable valorization methods, especially in Sri Lanka, where such value-added products are currently unavailable in the market. This study aimed to develop a functional beverage from cocoa by-products, incorporating skimmed milk and optimize formulations through sensory and physicochemical analysis. Initial formulations with and without cocoa powder revealed no significant differences in paired tests. Hedonic scale ranked C_3 (3:1 pod-to-shell ratio) highest. The second batch with mucilage pulp favored T_5 (15%). Paired tests showed significant differences between C_3 and T_4–T_6. Selected samples of T_5 were subjected to total plate count test, total yeast and mold count, proximate analysis, physicochemical properties and phytochemicals tests after 0, 3, 6 and 9 days of storage in refrigerated conditions at 4°C. The shelf life was significantly affected by total plate count but less affected by total yeast and mold count. Variations in parameters were identified namely, pH (from 5.936±0.041 to 5.05±0.079), soluble solids °Brix (from 13.3±0.1 to 13.7±0.264), titratable acidity (from 0.175±0.007 to 0.203±0.005) moisture content (from 81.004±0.885 to 81.977±0.945) and the color retentions in colorimetric analysis were $L^\star$ of 50.67±0.101489, $a^\star$ of 4.31±0.041633 and $b^\star$ of 8.38±0.045826. The pH slightly declined as the acidity was increased. Proximate analysis of formulation T_5 revealed a crude fiber content of 0.895±0.009%, a fat content of 3.621±0.572% and an ash content ranging from 0.227±0.205% to 0.377±0.123%. Phytochemical evaluation showed a total phenolic content of 95.044±1.099 mg GAE L^{-1} and DPPH scavenging activity (IC_{50}, µg mL^{-1}) of 12.8832. Cocoa processing by-products can be effectively repurposed into value-added functional beverages with desirable nutritional and sensory properties. This product will address the current market gap due to the absence of similar offerings, while also contributing to the existing body of knowledge.

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

Formulation of a Nutraceutical Powder from Lotus (*Nelumbo nucifera*) Seeds

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Nelumbo nucifera known as Nelum Eta in Sri Lanka, is an underutilized plant that possesses significant nutritional and therapeutic potential. The seeds are rich in plant-based protein, dietary fiber, essential minerals, and bioactive compounds such as flavonoids and alkaloids. Lotus seeds are also recognized for their antioxidant, anti-inflammatory, and neuroprotective properties. This concept proposes the development of a nutraceutical powder from mature lotus seeds for use in functional food applications. The process will involve harvesting, dehulling, controlled drying, and fine grinding techniques to produce a shelf-stable, nutrient-dense powder. Nutritional analysis from literature sources indicates a high content of protein, magnesium, potassium, and complex carbohydrates with a low glycemic index. According to existing studies, the presence of kaempferol and other antioxidants contributes to stress reduction, improved sleep quality, and cardiovascular protection. Hence, the powder will be tested for its antidiabetic and antioxidant properties using tests such as DPPH, TPC tests, as well as for nutritional proximate analysis and anti-inflammatory activity. The proposed product aims to meet the growing consumer demand for plant-based and wellness-oriented food solutions, particularly those suited for diabetic and heart health management.In its conceptual stage, the study identifies lotus seed powder as a promising base for incorporation into smoothies, porridges, health drinks, and snack bars. Future development will include formulation trials, proximate and phytochemical analyses, stability studies, and potential clinical validation to assess health impacts and functional efficacy.The proposed innovation aligns with the promotion of sustainable, local crop valorization and functional food development inspired by traditional ingredients and emerging global nutrition trends.

Keywords: *nutraceuticals, functional food, plant-based ingredients, bioactive compounds, wellness promotion, clean-label trends*

Production and Characterization of Volatile Flavor Compounds in Sweet Fermented Rice Made from a Local Rice Variety

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Sweet-fermented rice is a well-known traditional food product consumed in Southeast Asia for its distinctive sweet taste, slight acidity, and negligible alcohol content, typically manufactured from microbial fermentation of glutinous (sticky) rice. This research concept aims to manufacture sweet-fermented rice from chosen Sri Lankan rice cultivars like Suwandel, Kalu Heenati, and White Kekulu with a view to determining their suitability for fermentation-based product development. Rice samples will be washed and soaked in water. Then the rice will be steamed until it becomes soft. The cooled rice will be covered and incorporate controlled fermentation by using a traditional or standardized starter culture (adapted yeast-mold consortium *Rhizopus oryzae* and *Saccharomyces cerevisiae*)under ambient temperature. Primary fermentation parameters such as total soluble solids (TSS), Brix value, pH, titratable acidity, and alcohol content will be analyzed daily using refractometry, pH meter, and high-performance liquid chromatography (HPLC) during the fermentation. The fermentation process was terminated at the point where the pH reached its minimum, no alcohol was detected, and the maximum sugar yield was obtained. For flavor profiling, isolation can be done using solid-phase microextraction (SPME), and identification can be done using gas chromatography mass spectrometry (GC-MS) with external standards for quantification. A trained panel will assess aroma, sweetness, and sourness using a 5-point hedonic scale for sensory testing. These analyses will enable the assessment of sugar utilization, acidification, and ethanol production with respect to time. The findings of the research will be expected to identify the most appropriate rice variety for sweet fermentation, optimize the fermentation process, and contribute to the development of a value-added, culture-based fermented rice product with Sri Lankan raw materials.

Keywords: *Fermentation parameters, Sri Lankan rice, Traditional rice fermentation, Value-added rice product, Volatile flavor compounds*

ID: FST102

Development of an Antioxidant Rich Herbal Tea Bag from *Psychotrya Sarmentosa, Coriandram Sativum* and *Cinnomum Verum*

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Herbal teas are popular for their health benefits, particularly their antioxidant and medicinal properties. This study aimed to develop a functional herbal tea bag using selected medicinal plants; *Psychotria sarmentosa, Coriandrum sativum,* and *Cinnamomum verum.* Four different formulations were prepared based on the antioxidant compounds present in the ingredients, alongside a control sample without *Psychotria sarmentosa.* All tea samples were first evaluated for antioxidant activity using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay and total phenolic content was assessed using the Folin-Ciocalteu method. Sensory evaluation was conducted to assess taste, aroma, color, and overall acceptability. The most favorable formulation, selected based on combined antioxidant. phenolic, and sensory data underwent further testing for acute toxicity, microbial count, total ash content, crude fiber, moisture content, water activity, and pH. The pH of all tea formulations was also recorded during sensory evaluation. The results showed that the inclusion of *Psychotria sarmentosa* significantly enhanced antioxidant and phenolic content, contributing to higher radical scavenging activity and favorable organoleptic properties. The selected formulation also met acceptable safety and quality standards. This study demonstrates that the combination of *Psychotria sarmentosa, Coriandrum sativum* and *Cinnamomum verum* can be successfully used to produce a functional herbal tea with health-promoting properties, particularly antioxidant support and potential pain relief.

Keywords: *Psychotria sarmentosa, antioxidant activity, sensory evaluation, phenolic content, herbal tea*

Physical Sciences, Chemical Technology and Computing

Deep Learning and Ensemble Models for Brain Tumor Classification Using Medical Imaging

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The proposed study focuses on the early and accurate detection of brain tumors using advanced machine learning and deep learning techniques, combined with medical imaging data to improve patient outcomes. Relevant information is gathered in the research by utilizing a Kaggle-based dataset and a publicly available collection of medical imaging data. Augmentation and clean-up preprocessing methods are applied to increase dataset diversity. The dataset is divided into 80% training and 20% testing with deep learning approaches such as Convolutional Neural Networks (CNN), MobileNetV2, and Multi-Layer Perceptron (MLP). To enhance robustness, 5-fold cross-validation is used to evaluate model performance. The system is developed as a web-based application using the Streamlit framework to demonstrate real-time clinical applicability. The CNN model achieves an accuracy of 93% , while MobileNetV2 reaches 94%. Integrating MLP achieves a significantly higher accuracy of 97% compared to baseline models like VGG16 and ResNet50, which show 90% and 92% accuracy, respectively. Cross-validation confirms the stability and reliable performance of the ensemble model, with over 95% precision and recall. This indicates that the model is highly dependable in classifying tumors. The high accuracy and user-friendly deployment through Streamlit make this system suitable for real-world clinical use. It enables fast and accurate diagnosis of brain tumors without requiring integration with external databases, ultimately facilitating quicker decision-making and improving patient care.

Keywords: *Brain tumor detection, Deep learning, Machine learning, Multi-model classification, Web deployment*

Enhancing Data Visualization and Analysis: A Streamlit-Based Survey Analysis Project

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Survey data analysis functions are essential tools for extracting valuable insights in fields such as software industry, healthcare, and social sectors. Current methods that rely on static reports and manual entry create lengthy and time-consuming processes. Thus, this study aims to develop an interactive, automated system that enhances survey analysis. This system provides an efficient platform for managing data, generating dynamic visualizations, and conducting trend analysis. Further, it supports real-time data analysis using user-friendly interfaces for decision-making with enhanced efficiency. Data integrity is maintained, and human intervention is reduced by automating the process. The system was developed following the waterfall model, which included requirement analysis, system design, implementation, testing, and deployment. Following the stakeholder requirements, gathering data and cleaning was carried out to improve the data quality. The system was developed using Python libraries such as 'Pandas' and 'Matplotlib' for data handling, and Streamlit for building a web interface. Testing focused on validating the accuracy, system performance and functionality through iterative feedback loops. Feature-rich graphical interfaces combined with real-time statistics enable businesses and researchers to gain clearer insights about their customers, aiding informed decision-making. The research demonstrates how automated survey processing enables fast and reliable management of large datasets through a real-time dashboard that improves both speed and accuracy. It also improved data visualizations and trend detection, simplifying the interpretation of insights. The developed platform provides a foundation for future integration of machine learning to enable advanced predictive analytics.

Keywords: *Data Visualization, Interactive Dashboards, Python, Real-Time Analytics, Streamlit Web Application*

Advanced Web Security Protocols for Encrypted Session Sharing

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The SafeShare project addresses the critical need for secure and temporary session sharing in corporate environments vulnerable to session hijacking, cookie theft, and unauthorized access. This study introduces a browser-integrated and desktop-based system that applies AES-256 encryption to protect web session cookies and implement customizable, time-bound expiration to limit access exposure. The research followed an iterative, user-centered design methodology that included requirement gathering, system design, development, and validation phases. System functionality and usability were tested through structured tasks, penetration tests, and user feedback surveys. Experimental evaluations demonstrated AES-256 encryption's reliability across 50+encryption integrity tests, with no key mismatches or data leaks. Brute-force simulations (via Hydra, John the Ripper) failed to compromise session data. Usability testing involved administrative users completing key tasks (e.g., encryption, session expiry modification), with 94% reporting ease of use and intuitive workflows. However, to address security without compromising usability, features such as clipboard integration, automated cookie handling, and real-time feedback were implemented and assessed. Session expiration accuracy was validated on multiple browsers, achieving 100% compliance across all intervals (15 mins to 24 hrs). The results support SafeShare's effectiveness as a secure and practical alternative to traditional password-sharing methods. It meets modern compliance requirements (e.g., GDPR, CCPA), strengthens defense against web-based attacks, and maintains high user acceptance. Future work may explore mobile expansion, biometric authentication, and anomaly detection. This research contributes a validated, design-driven framework for secure session sharing, bridging encryption, usability, and regulatory compliance.

Keywords: *AES-256 Encryption, Compliance, Cybersecurity, Secure Session Sharing, Session Hijacking, Usability Evaluation, Web Session Expiration*

Machine Learning and Deep Learning Approaches for Heart Disease Prediction

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Cardiovascular diseases (CVDs) continue to be the main reason for worldwide deaths which requires early identification and treatment. This study analyzes twelve current investigations between 2021 and 2025 which utilize machine learning (ML) and deep learning (DL) methods to predict heart conditions. The analyzed research uses ensemble machine learning models AdaBoost and CatBoost and deep learning architectures including Convolutional Neural Networks (CNNs) and Long Short-Term Memory (LSTM) networks as well as hybrid models combining CNN-LSTM and Random Forest-CNN and XGBoost-ANN. The predictive features that most studies use consist of age and gender and chest pain type and resting blood pressure and cholesterol level and fasting blood sugar levels and maximum heart rate readings and ECG results and exercise-induced angina and ST depression and major vessel count. The prediction accuracies from these models fall between 84% and 98% while certain algorithms manage to exceed 95% accuracy through cross-validation or testing on balanced and cleaned datasets. The application of suitable dataset selection together with proper feature selection and exploratory AI models enhances healthcare professional transparency. The combination of multi model data with hybrid models and standard evaluation metrics creates opportunities to enhance system reliability for timely clinical decision-making and improved patient management. The review presents a unique approach through its analysis of modern ML and DL methodologies by focusing on current trends such as IoT real-time data collection and Federated Learning privacy protection alongside existing challenges of dataset bias and high computational requirements and validation gaps.

Keywords: *Cardiovascular Disease, Deep Learning, Federated Learning, Hybrid Models, Machine Learning*

ID: PST37

Retrieval Augmented Virtual Assistant for Vehicle Troubleshooting Using Domain Specific Knowledge

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The rise in smart virtual assistant popularity has increased the call for domain-specific, real-time technical support systems. This paper presents the design and implementation of a car trouble-shooting assistant that helps automobile owners diagnose and repair frequent mechanical issues. Unlike existing rule-based conversational agents, the proposed solution employs Retrieval-Augmented Generation (RAG) that incorporates a large language model and a vector-based retrieval system to deliver accurate, context-sensitive responses from a filtered technical knowledge base. The solution employs Lang Chain for orchestration, Open AI embeddings to represent documents semantically, Chroma as the vector store and prompt templates to generate responses. Preprocessed vehicle repair manuals in the form of PDF files were embedded and indexed for facilitating fast semantic search. The backend app is coded in Fast API to render high-performance and scalable API services and an angular frontend provides an interactive user interface. The assistant was also tested with a 200-question set of real-world troubleshooting questions and achieved an 87% relevance score while reducing hallucinated responses by over 70% compared to a baseline LLM with no retrieval aid. The system is both modular and cross-domain reusable because it makes it simple to replace the knowledge base for adaptation to other domains. This work presents a lightweight, real-world natural language processing and information retrieval implementation for technical support with documented performance gains and enhanced reliability over standard chatbot approaches.

Keywords: *Augmented Generation (RAG), Domain-Specific Chatbot, Natural Language Processing (NLP), Retrieval Semantic Search, Vehicle Troubleshooting*

Blockchain Based E-Voting System Using Biometrics

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The digitization of voting process through electronic voting systems marks a significant step toward modernizing democratic processes. The traditional e-voting methods continue to face challenges such as security vulnerabilities, voter fraud and lack of transparency. Various blockchain based e-voting systems have been developed incorporating fingerprint verification and decentralized identity management through smart contracts. These systems aim to enhance voter authentication, ensure data integrity and prevent tampering. A systematic literature review was conducted covering the period from 2018 to 2024, focusing on research related to Biometrics integration and Blockchain based e-voting systems. Relevant Scholarly articles were retrieved from IEEE Xplore, Google Scholar, ResearchGate and ScienceDirect. Each selected study was critically analyzed to evaluate the technological approaches, identify recurring limitations, and highlight gaps in scalability, security, accessibility and practical deployment. Despite the promise of blockchain's decentralized and tamper-proof structure, existing solutions are limited by high computational and infrastructure demands, scalability issues and challenges in integrating with existing electoral frameworks. The review also evaluates emerging methods such as homomorphic encryption, zero-knowledge proofs, and novel consensus algorithms like Proof of Vote (PoV) for their applicability in secure and auditable voting processes. A key emphasis is placed on ease of use, accessibility, and inclusiveness, especially for elderly populations and rural voters, highlighting the importance of user-centric interface design and low-barrier access. While several prototype systems and conceptual models are discussed, the paper identifies a lack of real-world pilot testing and performance metrics, underscoring the need for self-tallying models and lightweight consensus mechanisms. This review contributes to the ongoing global discourse by identifying technical gaps, proposing future research directions, and emphasizing the synergy between blockchain and biometrics as a foundation for a secure, transparent and inclusive e-voting framework suitable for modern democratic societies.

Keywords: *Biometrics, Blockchain, Consensus Algorithms, E-voting, Security and Transparency*

ID: PST45

Deep Learning Approach to Bacterial Leaf Blight Disease Identification Case Study in Sri Lanka

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In the Agriculture industry, rice cultivation has become more popular because rice has become the main food of the people in most countries. In Sri Lanka, rice cultivation is a key agricultural activity, supporting a large portion of the population. When cultivating crops as an industry, a certain amount of the harvest is inevitably damaged. When considering crop damage, natural disasters, pest damage, and crop diseases take a major place. Annually, about 800 million metric tons of rice are produced globally, and about 10% - 30% of it is destroyed due to diseases. Numerically, that amounts to 80 million metric tons. By correctly diagnosing the disease at the initial stage, crop damage can be minimized and quality can be increased. In large-scale cultivation, manually diagnosing diseases is not practical. Therefore, it requires a technological solution. In this study, a deep learning based novel model was developed to identify bacterial leaf blight disease. In this process, disease diagnosis is accurately carried out using a CNN for image processing. Here we have trained this model using 700 images. In the training process, the data set is divided into two parts 80% for training and 20% for testing. The model obtained 96.5% of training accuracy and 95% of testing accuracy. This shows that this model is suitable for accurately identifying Bacterial Leaf Blight disease. Future work will focus on expanding the model to recognize all eight major rice diseases prevalent in Sri Lanka, thereby enhancing the model's applicability and impact on national food security. Furthermore, we hope to make this model available to the general public through a mobile application.

Keywords: *Bacterial Leaf Blight, CNN, Deep Learning, Rise Disease Detection, Sri Lanka*

ID: PST54

Deep Learning Approach for Automated Detection of Brown Spot Disease in Rice Leaves Using CNN

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Millions of people around the world, including Sri Lankans, consume rice as their primary food source. Globally, more than half of the world's population eats rice daily. Therefore, the demand for rice is high, and the health of rice plants plays a crucial role in ensuring global food security. Rice plants are susceptible to several diseases at different stages of their growth. One of the most prevalent is brown spot disease, caused by a fungus. This disease appears as brown spots on various parts of the plant, including leaves, leaf sheaths, glumes, and grains. Yield losses from brown spot disease can range from a few percent to as much as 90% in severe cases. Conventional disease detection methods require expert knowledge and are often slow and time-consuming, making them impractical for large-scale monitoring. The purpose of this study is to introduce an AI-based solution using a Convolutional Neural Network (CNN) to detect brown spot disease by analyzing images of rice leaves. The methodology consists of key steps, including data collection, data preprocessing, model training, testing, and validation. To enhance the dataset size and improve training efficiency, several data augmentation techniques such as rotation, flipping, and zooming were applied. The dataset was divided into 70%, 20%, and 10% for training, validation, and testing respectively. The model achieved a training accuracy of 94.27%, a validation accuracy of 95.27%, and a test accuracy of 92.62% in identifying brown spot disease. These results prove that the proposed CNN model is highly effective in accurately detecting brown spot disease. With its capability for real-time deployment on mobile or field devices, the model reduces overall costs and offers accessible solutions for farmers and agricultural experts, thereby helping to protect rice cultivation and ensure food security.

Keywords: *Brown Spot Detection, CNN, Deep Learning, Rice Leaves*

Evaluating the Effectiveness of Fine-Tuned Bert for Semantic Classification of Phrasal Verbs

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Phrasal verbs are context-dependent expressions that often carry idiomatic meanings, making them particularly challenging for machine understanding and semantic classification. In this study, we investigate the effectiveness of fine-tuning Bidirectional Encoder Representations from Transformers (BERT) for phrasal verb disambiguation in diverse contexts. Our objective is to enhance semantic classification performance by improving the contextual representation of phrasal verb usage in a foundational transformer model. We prepared a custom dataset with varied sentence structures and phrasal verb usages to fine-tune a pre-trained BERT model. The model's performance was evaluated using multiple metrics, including cosine similarity, BLEU, ROUGE-L, Jaccard similarity, and METEOR. The results demonstrated consistent improvements across all metrics after fine-tuning: cosine similarity increased from 0.5889 to 0.6189, BLEU from 0.2570 to 0.3150, ROUGE-L from 0.4623 to 0.4901, Jaccard similarity from 0.3484 to 0.3648, and METEOR from 0.3555 to 0.3607. These findings indicate that the fine-tuned BERT model better captures the nuanced meanings of phrasal verbs in context, enhancing its capabilities for downstream NLP tasks such as question answering, machine translation, and semantic search. Our methodology highlights the potential of transformer-based models in handling linguistic ambiguity, contributing to more semantically aware language understanding systems. We conclude this research by mentioning baseline foundational transformer models like BERT can upskill once it learned from the hard labels. This can lead to language models that perform better in understanding the meaning of the text rather than predicting the next token, while also differentiating between meanings. The entire code can be found it here: https://anonymous.4open.science/r/bert-semantic-classification/

Keywords: *BERT, Context-Aware Model, Fine-Tuning, Phrasal Verbs, Semantic Classification*

ID: PST57

Puurfect Care: A Mobile Application for Enhanced Pet Safety and Management

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The purpose of "Puurfect Care" is to develop a comprehensive mobile application aimed at enhancing pet safety and management by providing real-time pet location tracking, automated health management, and community-driven recovery support. This study addresses the shortcomings of traditional pet care methods and fragmented digital solutions lacking accessibility and integration. Employing an iterative, user-centered design approach, the application is built using the Flutter framework for cross-platform compatibility and Firebase for backend data management and notifications. The system incorporates a custom GPS tracker combining an ESP32 microcontroller, u-blox Neo-6M GPS module, and SIMCom 800L cellular module for accurate location data, while Google Maps API facilitates geofencing and safe zone monitoring. Requirements were gathered through interviews with pet owners and veterinarians, followed by prototyping and user acceptance testing, with a focus on accessibility for elderly users. Findings indicate that while the platform improves usability, reliability, and community engagement in pet safety and health management, certain limitations remain, such as the relatively large size of the GPS tracker for small animals and dependency on strong internet connectivity for timely message transmission. Practically, "Puurfect Care" offers pet owners a unified, accessible tool that integrates real-time monitoring and health adherence features, promoting safer and more effective pet care practices. This project contributes originality by combining hardware and software solutions into a single user-friendly ecosystem tailored to diverse user needs, including elderly pet owners. Future enhancements could focus on miniaturizing tracking devices and improving offline functionality to increase accessibility and reliability.

Keywords: *Community Alerts, Geofencing, Health Management, Location Tracking, Mobile Application, Pet Care*

WISP: Building a Community-Focused Safety Platform

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Sri Lanka continues to struggle with personal safety as a persistent and pressing issue, affecting the daily lives, police records show that in 2022 there were 11,762 reported crimes against women and 4,960 gender-based violence cases (Sri Lanka Police Annual Report p.45,47). If the high crime and kidnapping statistics of 1,443 kidnapping/abduction cases to date as well an increase in incidents of public harassment are added to the mix, what the numbers above reveal are real gaps with old age safety solutions that only offer basic SOS without context or multi-lingual help. In response to this crucial need of the hour, we introduce WISP (Where Instant Support Please), a unique mobile safety app tailor made for Sri Lanka. Built with Flutter and Firebase for cross-platform reliability, WISP is loaded with advanced features like Google Maps API integrated real-time GPS tracking, gesture-triggered emergency alerts, and bilingual Sinhala/English interface to bridge the language gap. Intuitive interface: The design started with gathering feedback from some of vulnerable users to inform our user-centered design methodology. The WISP app's modular architecture enables future integration of AI threat detection like predictive risk analysis while maintaining zero trust security principles, ensuring continuous user verification and data protection as the system evolves. Combing cutting-edge technology with local knowledge of criminal challenges and data extracted from police records, WISP has redefined the personal security solutions space by adopting a predictive, on-demand value proposition that is tailor made for Sri Lankan crime. In so doing, this research provides a foundation for the development of context-aware safety applications in high-risk environments: grounded both in a soundly engineered framework as well as empirically validated design principles.

Keywords: *Emergency Response, Flutter, Gesture-Based Alerts, Mobile Application, Personal Safety*

Analysis of Precipitation Variability in India Using Continuous Wavelet Transform and Wavelet Power Spectrum

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This study examines precipitation data across 118 locations in India from 1901 to 2019 using traditional statistical methods, regression analyses, Mann-Kendall trend tests, and wavelet techniques. The objective was to identify both long-term and short-term precipitation variations across temporal and spatial scales. Despite the availability of extensive historical rainfall data in India, few studies have simultaneously applied modern time-frequency methods with classical trend analysis. Data obtained from India Meteorological Department (IMD) were analyzed using continuous wavelet transform and wavelet power spectrum to detect periodicities and variability patterns. Results indicated significant spatial and temporal variability in precipitation trends, with Jamnagar exhibiting the highest coefficient of variation (2.33) and Srinagar the lowest (0.85), indicating more stable precipitation patterns. Among the locations analyzed, only Jammu exhibits an upward trend, while Raurkela, Panchkula, and Shimla display a downward trend, as indicated by the results of the Mann-Kendall test, SQMK test, and Innovative Trend Analysis (ITA), which is also evident in the Wavelet Power Spectrum (WPS) analysis. In WPS for these four locations, the intensity 1-year band is more centralized, indicating that this time series contains a significant annual signal. Wavelet analysis revealed multi-decadal and inter-annual fluctuations linked to natural climate variability. These findings have practical implications for water resource management and agricultural planning, particularly in regions experiencing declining precipitation trends. This work provides a methodological framework for integrating wavelet analysis into climate variability studies.

Keywords: *Precipitation, Temporal Patterns, Wavelet Analysis, Wavelet Power Spectrum*

ID: PST117

Sports Sciences and Physical Education

Effect of Upper Body Explosive Training Programme on Upper Body Power Among Sabaragamuwa University Women's Football Goalkeepers

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Goalkeepers are among the most speed- and power-oriented athletes in football, requiring exceptional physical capabilities to execute rapid, decisive actions. Upper body power particularly the ability to generate explosive strength in the upper limbs plays a vital role in a goalkeeper's ability to defend the goal effectively. The purpose of this study was to investigate the effect of an upper body explosive training program on upper body power in women's football goalkeepers from the Sabaragamuwa University women's football team, with the aim of providing valuable insights to improve physical performance and enhance goalkeeping efficiency. The study involved two female goalkeepers (mean age: 22.5 $\pm$ 0.70 years; height: 167 $\pm$ 4.24 cm; weight: 60 $\pm$ 7.07 kg; training experience: 7 $\pm$ 1.41 years). Over an 8-week period, participants underwent a structured upper body explosive training program focusing on exercises specifically designed to enhance upper limb power. The Overhead Medicine Ball Throw Test was used to assess upper body power before and after the intervention. Data analysis was performed using Microsoft Excel 2016, with pre–post comparisons applied to determine changes in performance. Results indicated substantial improvements in throw distance, with Participant Athlete 1 increasing by 43% and Participant Athlete 2 by 37%. These outcomes highlight the program's significant impact on developing explosive upper body strength, which directly contributes to improved goalkeeping performance, including quicker reaction times, stronger clearances, and greater defensive reach. This study provides strong evidence that sport-specific, targeted training interventions can markedly enhance a goalkeeper's physical capabilities. By focusing on explosive upper body power, such programs can improve not only individual performance but also contribute to overall team success. Further research with larger sample sizes is recommended to validate these findings and explore long-term benefits, thereby supporting the advancement of more efficient and successful goalkeeping strategies.

Keywords: *Explosive power, Goalkeeper, Upper body power, Women's football*

ID: SSPE53

The Impact of Referee Decisions on Player Performance and team Behavior: A Study of the Sabaragamuwa University Soccer team, Sri Lanka

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This study explores the impact of refereeing decisions on the performance and behavioral tendencies of soccer players at Sabaragamuwa University of Sri Lanka. Adopting the quantitative research approach, data were collected through a structured questionnaire from purposive sample consisted of 32 male undergraduate players with 5 to 10 years of national or club-level experience. Questionnaire with 23 items categorized under referee decision perception, impact on performance and impact on behavior by utilizing a 5-point Likert scale ($M \geq 3.5$: favorable perception, $M \leq 3.0$: unfavorable perception). Descriptive statistics were used to analyze the data via SPSS, focusing on mean and standard deviation. Results indicated that among referee decision perceptions, frequency of referees' fair decisions (M=3.6, SD=0.798) and influence over match results (M=3.5, SD=1.100) reflected favorable sentiments, while confidence in accuracy (M=3.5, SD=0.770), perceived bias (M=2.7, SD=0.940), and rule consistency (M=3.2, SD=0.945) reflected unfavorable trends. Regarding performance, favorable effects were noted in impact on performance (M=2.8, SD=1.214), recovery time after incorrect decisions (M=2.9, SD=1.430), poor calls' impact on team coordination (M=3.4, SD=0.959), and boost from favorable decisions (M=3.3, SD=0.945), while loss of concentration (M=2.8, SD=0.899), pressure after warnings (M=2.7, SD=0.740), and overall influence on performance (M=3.2, SD=0.860) had negative perceptions. For behavioral outcomes, positive influence was seen in emotional responses (M=3.1, SD=1.057), arguing with referees (M=3.0, SD=0.910), post-match consideration (M=3.0, SD=1.049), and influence on opposition interaction (M=3.0, SD=0.875), while fouls from frustration (M=2.5, SD=1.120) and cards for dissent (M=2.2, SD=1.013) indicated negative perceptions. These findings indicate that players overall perceive referee decisions as having a more positive than negative influence on their performance and behavior during matches.

Keywords: *Behavior, Descriptive Statistics, Performance, Referee Decisions, Sabaragamuwa University, SPSS*

A Study on Identifying Pre-Competition Anxiety Level Among Male Beach Volleyball Players aged 17-20 in the Northern Province of Sri Lanka

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The study examined pre-competition anxiety levels among aged 17-20 male beach volleyball athletes in the Northern Province of Sri Lanka during their competition preparation period. The primary purpose of this research involved studying how concern progressed of anxiety overtime and effectiveness of coping strategies. Research used a longitudinal mixed method both quantitative and qualitative methods. The Competitive State Anxiety Inventory-2 (CSAI-2) questionnaire was used to assess 40 participants throughout three measurement periods, started 14 days ,7 days and 2 days before their competition. The study employed semi-structured interviews as a qualitative data collection method to obtain an understanding of participants anxiety experiences and their coping mechanisms from 10 participants. The statical findings according to descriptive statistics, their mean scores upgraded from 59.68 at 14 days to 67.73 at 7 days to 71.70 2 days before the competition. The Friedman test results indicated that anxiety levels differed meaningfully between the three measurement points ($p < 0.001$). Wilcoxon Signed-Rank Tests validated the significant increase of anxiety when comparing 14 days with 7 days ($p < 0.001$) and 7 days with 2 days ($p = 0.003$). The data showed that anxiety levels increased between 14 days and 2 days through a Paired Samples t-Test ($p < 0.001$). The Spearman's correlation results demonstrated poor connections between anxiety measures across measurement points ($p > 0.05$) showed distinct patterns of anxiety growth in participants. Qualitative thematic analysis revealed four significant themes, temporal anxiety fluctuations with anxiety peaking 2 days before competition, adaptive coping strategies where players shifted from physical techniques to social reliance as anxiety intensified, critical role of support system and lack of mental preparation programs. The research showed that young athletes need formal psychological networks dedicated to anxiety management, which improves their mental preparation and performance results in beach volleyball.

Keywords: *Anxiety, Beach volleyball, Coping strategies, CSAI-2, Pre-competition*

ID: SSPE63

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ISSN 3093-5733

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