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ACHIEVING RESILIENCE THROUGH DIGITALIZATION, SUSTAINABILITY AND
SECTORAL TRANSFORMATION

BASIC AND APPLIED SCIENCES

ABSTRACTS



General Sir John Kotelawala Defence University
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ORAL PRESENTATIONS

A Cross-Sectional Study to Determine the Association Between the Sleep Quality and Meal Patterns of Undergraduates of a Selected Educational Institute in Sri Lanka

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Abstract

A quality sleep is crucial for the academic performance, psychological wellbeing and overall health of undergraduates. Since nowadays unhealthy dietary habits such as skipping meals, snack overconsumption and nocturnal eating are quite common, this study aimed to determine the association between sleep quality and meal pattern of undergraduates. An institutional-based cross-sectional study was carried out among undergraduates ($n = 165$) of BCAS Campus, Colombo 03. A self-administered questionnaire developed based on Pittsburgh Sleep Quality Index (PSQI) and meal pattern questionnaire was used for data collection. Global PSQI and meal pattern score (MPS) were computed. The level of statistical significance was set at $p < 0.05$. The mean \pm SD of the age of the participants was 23.68 years \pm 5.70. There were 53.3% ($n = 88$) of females and 46.7% ($n = 77$) of males. The mean \pm SD of the hours of sleep was 6:16 hrs \pm 1:23 and the mean \pm SD of Global PSQI Score was 7.04 \pm 3.17. Sleep disturbances were less commonly observed. Usual bedtime after 2300 hrs and academic year were significantly associated with global PSQI score ($p < 0.05$). A weak, positive correlation ($r = 0.115$, $p > 0.05$) was observed between global PSQI and MPS. However, regression analysis revealed that this association ($\beta = 0.149$, $p < 0.05$) was not significant. The undergraduates showed a reasonable meal pattern and there was no significant association between sleep quality and the meal pattern. However, despite differences in gender, academic year and courses, they exhibited poor sleep based on overall Global PSQI Score indicating the need of addressing the problem of poor sleep among undergraduates.

Keywords: *Sleep quality, Sleep, Meal, Undergraduates, Insomnia*

Stakeholders' Perceptions on Adoption of Eco-friendly Technologies to Minimize Chemical Fertiliser Use in Paddy Farming

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Abstract

It is accepted that Eco-Friendly Technologies (EFTs) can be used to reduce the use of Chemical Fertilizers (CFs) significantly and to gain in economic, social, and environmental benefits. Thus this study was aimed to analyse the perceptions of key stakeholders who are interested in paddy production in Sri Lanka. The purposive sampling techniques were practised to elect respondents (n = 167) representing four main segments; Farmers, Experts, Government Administrators and Private Industry Professionals. A series of personal interviews and online survey techniques supported by a structured questionnaire were carried out to gather data. In here each respondent was asked to evaluate 30 statements using a ten-point linear numeric scale, ranging from “extremely disagree” (0) to “extremely agree” (10). In analyses of data, comparison of Median values indicate that those stakeholders' perceptions varied significantly in the face of diverse scenarios. It was revealed that in the context of environmental aspects, the stakeholders are in a favoured position on adoption of EFTs above the use of CFs. The outcome of Non-Parametric Kruskal-Wallis Test shows that there is no significant difference among the Median values of responses among the stakeholder groups, statistically proving that their overall perceptions lie in favour of EFTs over CFs ($p = 0.253$, 95% Confidence Level). This signals the importance of institutionalization of those parties responsible for regulation (e.g., setting the standards, licensing/certification of) and facilitation (capacity building, rewarding of stakeholders) in the Agro-food value and plant nutrients supply chains with a solid national and overarching agricultural and fertilizer policy frameworks at its earliest.

Keywords: *Adoption, Chemical fertilizer, Eco-friendly technologies, Paddy farming, Stakeholder perceptions*

The Impact of COVID-19 on Major Sectors in the Sri Lankan Economy

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Abstract

The COVID-19 pandemic significantly impacted both public health and the economy of Sri Lanka, leading to a prolonged economic recession. Enforcement of control measures, such as lockdowns and trade restrictions, adversely affected various sectors of the economy. To foster recovery and enhance resilience in the face of future pandemics, policymakers must gain a comprehensive understanding of the specific impacts of COVID-19 on each sector. Therefore, this study aims to analyze the performance of the seven major sectors of the Sri Lankan economy during the pandemic period and to quantify the effect of different factors of the pandemic such as lockdown, number of COVID patients, and deaths, individually on each sector. To analyze the performance of sectors (dependent variable), a panel regression was utilized considering the aforementioned factors of the pandemic as independent variables. Additionally, a descriptive representation was used to provide further insight into the results. The research considered the contribution to the GDP of sectors in the Sri Lankan economy as a measure of the performance of each sector. The results of the panel regression imply that both the health and education sectors had been negatively affected by the number of COVID patients. The lockdowns have reduced the performance of the manufacturing and agriculture sectors, but the pandemic has not affected the construction, fishing, and transportation sectors. Thus, the pandemic has resulted in diverse impacts on various sectors, with some remaining unaffected and others experiencing different effects, emphasizing the importance of developing sector-specific strategies to address their unique challenges.

Keywords: *COVID-19, Panel regression, GDP contribution*

Developing a Sulfur-based Antifungal Solution for Dermatophytosis and Assessment of its Antifungal Activity *in-vitro* against *Microsporum canis* – A Pilot Study from Sri Lanka

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Abstract

Dermatophytosis is a skin condition affecting the cosmetic appearance and the quality of life of people. This is caused by many species of dermatophytes, among them is *Microsporum canis*, a fungus in canine and feline skin. Thus, treating infected animals minimizes the risk of zoonotic infection. However, topical solutions to treat affected canines are scarce in the local market. Thus, this study was executed aiming to develop an antifungal solution containing sulphur against *Microsporum canis*. Using calcium oxide, sulfur and distilled water a calcium polysulfide solution was prepared using a modified protocol. The presence of calcium was confirmed by simple flame test and sulfide ions by adding 10% cadmium chloride solution. Sulfide ion concentration was determined by modified titrimetric and novel spectrophotometric methods. The antifungal activity was assessed by an *in-vitro* antifungal assay using Diameter of the Zone of Inhibition (DIZ) of disc diffusion method and Percentage Inhibition of Diameter Growth (PIDG). The solution was reddish brown colour and had a characteristic odour of rotten eggs. It produced an orange-color flame and a yellow-color precipitate indicating the presence of calcium and sulfide ions. Titrimetric and novel spectrophotometric studies revealed that the formula was CaS_{5.5}. The solution exhibited significantly higher antifungal activity against *Microsporum canis* compared to the positive control ($p < 0.05$). The lowest concentration had 117.5% PIDG and the highest had 168.5% PIDG. This preliminary evidence showed that CaS_{5.5} is a suitable formula to develop an efficacious, safe and a cheap topical antifungal solution to treat canines affected with dermatophytosis.

Keywords: *Dermatophytes, Lime-sulphur, Ring worm, Sri Lanka*

Signal to Noise Ratio Analysis for Potential versus Time of the Under-Utilized Fruit Plant *Dovyalis hebecarpa* (Ketambilla) Under the Stimulus of Moisture Supply

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Abstract

Ceylon gooseberry (*Dovyalis hebecarpa* or Ketambilla) is an under-utilized fruit crop in Sri Lanka. It produces a deep purple berry, that is rich in antioxidants, pigments and vitamins serving numerous medicinal and commercial applications. Plant electrophysiology is the study of electrochemical phenomena of plant tissues in response to stimuli. This study aimed to investigate how the electrophysiology of three versions of Ketambilla, bud, seed and cuttings plants, changed upon application of moisture as an external stimulus. The plant electrophysiology data was obtained throughout the study as in vivo potential variations versus time through a non-destructive method. Platinum microelectrodes were inserted into the plant stem as working and reference microelectrodes and the data was recorded using a Potentiostat/Galvanostat. Potential versus time and overlay plots were constructed. The data was analysed by calculating the Signal to Noise Ratio (SNR) and SNR (dB) values. The results showed that all the experiments produced peaks, where the SNR (dB) value was above 0 dB, indicating that signal level was greater than noise level. The experiments conducted on bud plants with 20 ml of moisture, cuttings plants with both 10 ml and 20 ml of moisture, showed a notable change in the working electrode potential upon addition of stimuli. Overall, Ketambilla bud plants gave the best response with the highest SNR (dB) as 1.184 (SNR 15.274) at 20 ml of moisture stimulus. The findings on the dependence of plant electrophysiology upon an external stimulus, can be utilized to understand the stress response of the plant better.

Keywords: *Moisture stimulus, Signal to noise ratio, Plant electrophysiology*

Green Synthesis of Graphene *via* Electrochemical Exfoliation

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Abstract

Synthesis of graphene is one of the best ways to value-add graphite. Electrochemical exfoliation for graphene synthesis attracts interest due to its simplicity, cost-effectiveness, and green approach compared to other methods. The limitation of electrochemical exfoliation is restacking nature. One of the effective strategies to overcome this limitation is the optimization of solvent parameters that critically affect the electrochemical exfoliation. Therefore, this study aims to optimize the electrochemical exfoliation for graphene synthesis considering the Hansen solubility parameter of solvents to overcome restacking of graphene layers. After optimizing the electrochemical exfoliation parameters, it was applied for water and 5% N, N-dimethylformamide (DMF). Synthesized graphene was characterized structurally and electrochemically in the presence of potassium ferricyanide. Fourier transform infrared spectroscopy, Raman spectroscopy, and X-ray diffraction data confirmed the formation of few-layer graphene. Scanning electron microscopic images confirm the mean lateral size of graphene is in the nano-range. UV-visible data confirm the characteristic peak for graphene is around 268 - 274 nm, and the graphene dispersibility is high in DMF. Cyclic voltammetry data illustrate the peak currents for graphene/Nafion-modified glassy carbon (GC) electrodes, graphene-DMF, and graphene-water, are 46.3 and 30.4 μA respectively compared to Nafion-modified GC electrode which was 0.99 μA . Moreover, electrochemical impedance spectroscopy confirms the high ion diffusion behavior of graphene-DMF-modified GC electrodes compared to other electrodes. These characterization data confirm the favorable effect of solvents with compatible Hansen solubility parameters such as DMF on the electrochemical exfoliation and the potential of the novel strategy to easily synthesize graphene by manipulating solvent properties.

Keywords: *Graphene, Electrochemical exfoliation, Restacking, Solvents*

Effect of Sugar Component Changes during Processing of High Grown Black Tea using High Performance Liquid Chromatography Technique

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Abstract

Black tea, produced through a series of processing steps including withering, rolling, roll breaking, aeration, and drying of young tea shoots from *Camellia sinensis* (L.) plant, is cultivated in various agro-ecological regions in Sri Lanka. Among these regions, high grown teas from Dimbula, Nuwara-Eliya, Udupussellawa, and Uva are renowned for their distinct specialty qualities. Unfortunately, the tea industry has been facing challenges due to the adulteration of tea with sugar compounds, leading to a decline in the quality of Sri Lanka tea. This research aims to investigate the sugar contents, specifically fructose, glucose, and sucrose, in different grades of manufactured black tea from various high grown agro-ecological regions. Samples were collected from randomly selected tea factories, and the sugar contents were determined using High Performance Liquid Chromatography (HPLC). Additionally, professional tea tasters evaluated the sensory qualities of Broke Orange Pekoe Fannings (BOPF) grade and Dust 1 grade tea samples, providing complementary data for the study. The analysis revealed significant variations in sucrose content among black teas from different agro-ecological regions. The study established the average values for fructose, glucose, and sucrose in orthodox black tea produced in high grown elevation in Sri Lanka as 9.24 mg/g, 11.01 mg/g, and 16.42 mg/g, respectively. These findings provide valuable insights into the sugar composition of black tea, highlighting the impact of agro-ecological factors on sugar contents. This research contributes to addressing the issue of sugar adulteration in the tea industry, enabling quality control measures to preserve the authenticity and integrity of Sri Lanka's black tea production.

Keywords: *Agro-ecological region, Black tea, Quality*

Microbiological Quality of Commercially Available Ready-to-Eat Meat Street Food Doner Kebab in Colombo District, Sri Lanka

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Abstract

Foodborne illnesses are a significant global concern and Doner kebab, a popular street food, which grilled meatloaf renowned for its diverse nutritional composition which is prone to microbial contamination. The present study aimed to determine the microbiological quality of street food, Doner kebab in the Colombo district, Sri Lanka. One hundred fifty (n = 150) Doner kebab samples were purchased randomly from three regions of the Colombo district including Aluthkade, Kibulawala, and Kailiza. The microorganisms were isolated and identified via conventional standard biochemical keys including Indole, MR-VP, Citrate, Motility, TSI, Urease, Bile, Oxidase, and Gram stain. The analysis was obtained from MicrosoftExcell 2010 and SPSS V23.0. Eight pathogenic bacterial species namely; *Klebsiella* spp. (13%), *Pseudomonas* spp. (07%), *Escherichia coli* (20%), *Enterobacter aerogenes* (20%), *Salmonella* spp. (20%), *Shigella* spp. (07%), *Vibrio* spp. (07%) and *Protease* spp. (07%) were identified. Among lactose-fermented microorganisms *Escherichia coli* (37%), *Enterobacter aerogenes* (25%), and *Klebsiella* spp. (38%) were detected while among non-lactose fermented microorganisms, highest percentage 44% of *Salmonella* spp. following equally 14% of *Shigella* spp., *Proteus* spp. *Vibrio* spp. and *Pseudomonas* spp. were detected. All three regions were contaminated with at least three types of microorganisms. Compared to the Aluthkade, Kalubowila (P = 0.020, $p < 0.05$), Aluthkade, Kalisa (P = 0.003, $p < 0.05$) and Kalubowila, Kalisa (P = 0.000, $p < 0.05$) showed a significant different in contamination. The highest significant *Escherichia coli* (40%) contamination was detected in Aluthkade while *Enterobacter aerogenes* (40%) and *Salmonella* spp. (40%) in Kailiza ($p < 0.05$) All three regions showed the highest pathogenic contamination thus, implementing measures to reduce the contaminations are important.

Keywords: *Pathogenic microorganism, Doner kebab, Bacterial contamination*

Impact of Domestic Cooking Process on Total Phenolic and Total Flavonoid Contents in Selected Commercially Available Rice (*Oryza sativa L.*) Varieties in Sri Lanka

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Abstract

Sri Lankan rice (*Oryza sativa L.*) is well known for its therapeutic value due to the presence of bioactive phenolic and flavonoid compounds. This study aimed to assess if the domestic cooking process affect their content. Twenty-five rice samples representing different traditional, improved and imported varieties which are commercially available in Sri Lanka were selected. The total phenolic content (TPC) and total flavonoid content (TFC) were analysed in raw, washed and cooked fractions which were produced by a standardized domestic cooking process. The TPC and TFC values were compared according to the rice variety, pericarp colour and average cooking time. The TPC and TFC of aqueous extraction of lyophilized grain powders were quantified (triplicates) spectroscopically and results were expressed as Gallic Acid Equivalents (GAE) and Quercetin Equivalents (QE) mg g⁻¹, in dry weight basis respectively. The results indicated that, both TPC and TFC in the tested grains were significantly reduced from raw, washed and cooked fractions gradually ($p < 0.05$). The mean (\pm SD) reduction of TPC and TFC due to the cooking process were 53.30% (\pm 14.35) and 26.90% (\pm 8.76) respectively. The highest TPC (3.73 mgGAE g⁻¹) and TFC (1.88 mgQE g⁻¹), in cooked rice were found in traditional, red *Pachchaperumal (Siyapath-el)* variety while the lowest values were found in imported, white *Indian Basmati* (TPC = 0.95 mgGAE g⁻¹) and improved, white, *Sudu Kekulu* variety (TFC = 1.12 mgQE g⁻¹). TPC varied significantly ($p < 0.05$) in the order of Traditional > Improved > Imported while TFC showed a similar non-significant ($p > 0.05$) trend. Both TPC and TFC in red pericarp varieties were significantly higher than white varieties ($p < 0.05$). TPC strongly correlated with TFC in raw ($\tau_b = 0.618$, $p < 0.05$) and cooked fractions ($\tau_b = 0.540$, $p < 0.05$). Longer average cooking time (per 100 g portion of raw rice) showed a weak positive correlation to the percentile reduction of TPC ($\tau_b = 0.053$, $p > 0.05$). The domestic cooking process significantly reduces the content of bioactive components in rice grains, which may affect their Nutra-pharmaceutical potential.

Keywords: *Cooking, Bioactive compounds, Rice*

The Effect of Genetic Introgression on Phenotype in *Dicrurus* Drongos Across a Climatic Gradient in Sri Lanka

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Abstract

Hybridization or introgression enables species to mix traits, allowing horizontal gene flow and varying parental alleles and phenotypes. Belihuloya, located in the intermediate zone is a transitioning point between dry and wet zones, where two sister species, the Sri Lanka Drongo (*Dicrurus lophorinus*), limited to the wet zone, and the Greater Racket-tailed Drongo (*Dicrurus paradiseus*), found in the dry zone come into contact. The objective of this study was to determine the clinal variation of two species from Sri Lanka's wet to dry zones. Field sampling was done across the identified contact zone and the allopatric zones located on either side of the contact zone in Belihuloya. The analysis was done using 14 morphometric traits, 6 partially informative Single Nucleotide Polymorphisms (SNPs) identified in two molecular markers ND2 and Cytb, and 21 environmental variables. Results suggest a clinal variation in ND2 and Cytb genomic markers. The clinal models in the program CFit-7 suggested the center of the cline is located 29.24 km east of Belihuloya. The cline is narrow with a width of 19.52 km. The clinal variation of all the morphometric and environmental variables was visualized by fitting cubic splines in the program R. Among them, the variation of the total tail length of drongos and the precipitation of the coldest month aligned with the genetic cline. In this species pair, the tail length which concords with the clinal variation and the pattern of the precipitation plays a strong role in the maintenance of the hybrid zone.

Keywords: *Climatic gradient, Dicrurus, Hybridization, Introgression, Phenotype, Belihuloya*

Hematology and Blood Parasites in Avian Communities Along an Altitudinal Gradient of One Kilometer in the Sub-Montane Zone of Sri Lanka

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Abstract

Parasites thrive by consuming host resources, causing a decline in host fitness. This burden drives host evolution, exerting selective pressure on both. The main objective of the study was to investigate parasitic profile and host immune responses in avian hosts along altitudinal gradients in Sri Lanka. This research took place in the Issengard Biosphere Reserve, located in Belihuloya, Sri Lanka. which features a 1 km altitudinal gradient from 480 - 1420 m. A total of 49 adult birds representing 18 species from 13 families, were mist netted and blood samples were collected to assess the host response against blood parasites in avian communities at 100 m intervals along this altitudinal gradient. The research employed weight-normalized seven parameters to evaluate host response in birds at each elevation, which included Red Blood Cell (RBC) count, hemoglobin concentration, White Blood Cell (WBC) count, WBC differential count, thrombocyte count, RBC shape index, and body temperature. Blood parasites were found in 26.53% (13/49) of the birds from 6 different species when blood smears were examined. *Microfilaria* larvae were found in 12.24% (6/49) of the birds from 3 species, while *Haemoproteus* sp. was found in 14.28% (7/49) of the birds from 4 species. The multiple multivariate linear regression findings reveal a notable inverse association between total WBC count and elevation, while body temperature increases significantly with elevation. Moreover, as elevation increases, there is a significant rise in the elongation ratio of RBCs, particularly in response to higher intensity of *Haemoproteus* infection.

Keywords: *Avian hematology, Altitudinal gradient, Host fitness*

Antifungal Efficacy of Biogenic Waste Derived Colloidal/Nanobiochar against *Colletotrichum gloeosporioides* Species Complex

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Abstract

Anthrax disease, caused by *Colletotrichum* spp., is the primary cause of postharvest losses in *Musa* spp. While various physical, chemical and biological methods have been developed to control this disease, their implementation in crop protection systems faces significant challenges. Nanotechnology holds great promise for improving the longevity and effectiveness of agricultural products, thereby ensuring economic and environmental sustainability. This study was aimed to investigate the inhibitory effect of colloidal biochar (CBC)/nanobiochar (NBC) derived from corn cob (CC) and *Gliricidia sepium* wood (GW) against *Colletotrichum gloeosporioides* species complex. CC and GW - CBC/NBC properties were thoroughly characterized using UV-Vis, Fluorescence, FTIR Spectroscopy and SEM analyses. Concentrations of CC and GW - CBC/NBC ranging from 0.4 to 20 g/L were tested in the study. Among the tested concentrations, CC - CBC/NBC at 1, 1.2, 1.6, 2, 4 and 8 g/L, as well as GW CBC/NBC at 0.4, 0.6, 0.8, 1, 1.2, 1.6, 2, 4, 8, 12 and 20 g/L, exhibited substantial reductions in mycelial densities. A notable reduction in the fungal growth rate was observed when using Zeolite, CBC/NBC at various weight percentages (10 to 50 wt/wt%). This suggested that the incorporation of CBC/NBC into the zeolite matrix contributed to the antifungal activity. However, high concentrations of CC - CBC/NBC (12 and 20 g/L) revealed higher mycelial densities, indicating a potential loss of effectiveness or even promotion of fungal growth. This study provides valuable insights into the potential antifungal activity of CC and GW - CBC/NBC against the *Colletotrichum gloeosporioides* species complex.

Keywords: *Anthrax, Colletotrichum gloeosporioides, Biochar, Nanobiochar, Antifungal activity*

Assessing the Efficacy of Pumpkin Waste-mediated Zinc Oxide Nanoparticles in Enhancing Agro-waste Valorization through Antioxidant Activity Evaluation

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Abstract

The utilization of agro-waste to synthesize nanoparticles (NPs) has drawn significant fascination owing to its crucial role in promoting environmental sustainability. This study focused on utilizing agro-wastes of Suprema F1 variety, pumpkin leaf (PL), pumpkin peel (PP), and pumpkin seeds (PS) and synthesizing ZnO NPs to examine the antioxidant potential. By utilizing aqueous extracts of the agro-waste under various conditions, (ion precursor concentration, the ratio of plant extract to ion solution, pH, irradiation methods [solar, microwave, UV], incubation time) the best conditions for synthesizing ZnO NPs with higher yields were identified. NPs were characterized using UV-vis spectroscopy, FTIR, SEM, TEM, and XRD analysis. Antioxidant potential was assessed using DPPH, ABTS, and FRAP assays. The formation of ZnO NPs was preliminarily characterized through surface plasmon resonance peaks within the range of 340 - 350 nm. FTIR analysis indicated the presence of the hexagonal phase of ZnO, while SEM analysis revealed the hexagonal morphology of NPs, with sizes below 320 nm observed through TEM analysis. XRD analysis confirmed the formation of desired hexagonal wurtzite crystalline structure of ZnO. The results revealed that plant extracts have lower antioxidant activity than phyto-genic ZnO NPs, and PL-mediated ZnO NPs exhibited the highest DPPH (IC₅₀; 42.81 ppm) and ABTS• + (IC₅₀; 170.99 ppm) radical scavenging activities. The antioxidant potential of PL-ZnO NPs compared with ascorbic acid (AA) was 1.42 mg AAE/g as measured by FRAP assay. *In vitro*, antioxidant potentials revealed that PL-ZnO NPs had higher antioxidant potential than PP and PS-mediated ZnO NPs. Suprema F1 agro-waste converted into eco-friendly ZnO NPs with effective antioxidant activities.

Keywords: *Antioxidant potential, Suprema F1, ZnO NPs*

***Trichoderma citrinoviride* as a Potential Biocontrol Agent for *Fusarium* and *Colleotrichum* Species, a Causative Agent of Onion Leaf Curl and Anthracnose Disease**

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Abstract

Red onion cultivation has become more challenging since 2020 due to the prevalence of onion anthracnose and leaf curl disease primarily caused by fungal pathogens *Colleotrichum* and *Fusarium* spp. This study aimed to identify the causative agents of onion leaf curl and anthracnose disease (muul azhugal) in vedhaalam onion variety collected from Jaffna district farms and to assess the potential of *Trichoderma citrinoviride* for disease suppression both in-vitro and under greenhouse conditions. Isolated organisms were tested for the infectivity using healthy onion plants, and the pathogens were re-isolated from the similar symptomatic plants. Pathogens were molecularly identified by nucleotide sequencing of internal transcribed region 1 (ITSS1). The *in vitro* antagonistic assay was performed in triplicate in dual culture assay. Greenhouse experiment trials were conducted in a Completely Randomized Design with three treatments (control, both pathogen and *Trichoderma*, and *Trichoderma* only) with five replicates each. Observations included the appearance of symptoms (chlorosis, twisting, and bulb rot) and time taken for the symptoms to appear was recorded. Results from *in vitro* antagonistic assay demonstrated the complete inhibition of pathogens by the *Trichoderma citrinoviride*. Under greenhouse conditions the disease symptoms emerged 14 days after inoculation of pathogen. Notably around 60% reduction in disease incidence was achieved when *Trichoderma citrinoviride* was treated to pathogen inoculated soil. Ongoing field trials aim to validate the results further. In conclusion the study highlights the efficacy of *Trichoderma citrinoviride* in suppressing onion anthracnose and leaf twister disease, offering a promising avenue for disease control in onion cultivation.

Keywords: *Trichoderma citrinoviride*, *Onion anthracnose*, *Leaf twist*, *Biocontrol*

Effects of Banana Leaves and Paddy Straw on the Growth, Nutrition Composition, Bioactive Compound Levels, and Antioxidant Activity of *Pleurotus ostreatus* (American Oyster Mushroom)

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Abstract

Pleurotus ostreatus (American oyster mushroom) is one of the most commonly cultivated mushroom species in the world and is known to grow faster than other edible mushrooms. They are cultivated on various agricultural waste substrates which are rich in lignin and cellulose. In this study, *Pleurotus ostreatus* was grown on Paddy Straw (PS) and Banana Leaves (BL) in different ratios (100%, 75:25, 50:50) to find out the most efficient Substrate Combination (SC). Lowry assay and phenol-sulfuric assays were done to measure the total protein and carbohydrate contents. Total Antioxidant Capacity (TAC), DPPH (IC₅₀) and Total Phenolic Content (TPC) assays were done to evaluate the antioxidant capacity. Moreover, qualitative tests for bioactive compounds, and a comparison of morphological parameters were conducted. Based on the results, a significantly high total protein concentration, total carbohydrate concentration, and a significantly high TAC were reported in 75% PS 25% BL SC compared to both 100% SCs. Moreover, a significantly high TPC was recorded in 75% PS 25% BL SC compared to 100% PS. The lowest IC₅₀ values were observed in both 100% SCs. Based on the parameters of the mushrooms, 100% PS displayed the highest values for weight, cap diameter, and stipe thickness. Bioactive compounds such as saponins, polyphenols, and terpenoids were present in all SCs. In conclusion, it can be suggested that 100% PS can be used to gain high yields of *Pleurotus ostreatus*. However, to enhance the nutritional value and antioxidant capacity, PS can be mixed with BL at a ratio of 75:25.

Keywords: *Agricultural waste, Oyster mushrooms, Polyphenols, Proteins, Carbohydrates*

***In silico* Distribution Analysis of Chromosomal CpG Islands in Rice (*Oryza sativa* L. spp. japonica)**

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Abstract

CpG islands are regulatory elements in a genome with high CpG dinucleotide density, influencing gene expression and genomic stability. These regions are important to rice biology. Despite the extensive body of research on CpG islands, the understanding of their distribution and characteristics at the chromosomal level remains limited. Hence, *in silico* analysis of chromosomal CpG islands in rice (*Oryza sativa* L. spp. japonica) is a computational approach to elucidate the chromosomal distribution and distinctive features of CpG islands within the genome of this agriculturally significant plant species. Genomic data from the GenBank and EnsemblPlants databases were utilized, with contigs NC_029256.1, NC_029257.1, NC_029258.1, NC_029259.1, NC_029260.1, NC_029261.1, NC_029262.1, NC_029263.1, NC_029254.1, NC_029265.1, NC_029266.1, NC_029267.1 representing chromosomes 1 to 12, respectively. Consistent G+C percentages were observed across all chromosomes, with GpC showing a higher frequency compared to CpC, CpG, and GpG. CpG islands were identified in the chromosomes using the Gardiner-Garden and Frommer algorithm, based on a minimum 200-bp region with an observed CpG/expected CpG (O/E ratio) of 0.6 or higher and a GC content greater than 50%. The statistical analysis unveiled significant enrichment of CpG islands (O/E ratio > 0.6) across all chromosomes. Additionally, the study employed the identification of CpG islands within the genomic loci of all chromosomes, revealing that, on average a maximum of 35% of these islands were situated within gene sequences. Chromosomes 11 and 12 exhibited comparatively lower proportions of CpG islands in contrast to the remaining chromosomes. Notably, a minimum of 68% of genes spanning all chromosomes harboured CpG islands. Mostly positioned within gene promoters, CpG islands govern gene expression through methylation, impacting growth, stress response, and development in rice. Epigenetic inheritance of CpG patterns aids trait transmission. Thus, unravelling CpG complexities promises better rice crops. In conclusion, this study offers invaluable insights into the chromosomal-level characteristics of CpG islands in rice, facilitating the advancement of our understanding of CpG island research and its intricate integration with chromosomal organization.

Keywords: *CpG islands, Rice, Chromosomal distribution*

Evaluation of Native Rhizobia as Potential Candidates for Developing Biofertilizers for Improving Legume Cultivation in Dry Zone Sri Lanka

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Abstract

Biofertilizers are currently receiving much attention due to the adverse effects associated with conventional synthetic fertilizers on human and environmental health. The major limitation of biofertilizers is their poor performance due to less adaptability to soil abiotic factors in the field. The objective of this study is to identify plant growth-promoting native rhizobia with tolerance to common soil stress conditions that can be developed as inoculants for legume cultivation in dry zone Sri Lanka. Root nodules were collected from non-edible legumes (*Alysicarpus vaginalis*, *Senna tora* (L.), *Leucaena leucocephala*, *Tephrosin purpurea*, *Mimosa pudica*, *Desmodium continuum*, and *Derris scandens*) in different sampling sites of Anuradhapura district (Thambuttegama, Thalawa, Anuradhapura Town, Mihinthale, Galnewa, Kekirawa, and Mahailluppallama). Sixteen strains were isolated on the Yeast Mannitol Agar medium with Congo Red. They were coded for convenience and screened for plant growth-promoting traits with three replicates. Nine isolates showed nitrogen fixation, inorganic phosphate solubilization, and indole-acetic acid synthesis capabilities. These strains were screened against the abiotic stress tolerance with three replicates. All strains survived at 3.0% salt condition. Three out of nine (TBII-1, TBAS-2, and KEPT-1) showed the highest saline tolerance (5.0% salt). TBII-1 and KEPT-1 strains thrived at 45 °C showing adaptability to high-temperature. At 0.1%, 0.2%, and 0.4% of PEG, KEPT-1 had the best survival. The majority of the isolates grew best at pH levels ranging from pH 5 to 8. Three rhizobial strains (TBII-1, TBAS-2, and KEPT-1) were identified as potential candidates for formulating biofertilizers for edible legume cultivation in the Anuradhapura district of Sri Lanka.

Keywords: *Non-edible legumes, Rhizobia, Biofertilizers*

Bioassay on the Stability of Pigments Extracted by Bacteria Isolated from Wastewater

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Abstract

Microbial pigments are substances that can absorb light in the visible range and emit color while playing an important role in the physiology and molecular processes of microorganisms. Pigment production is a method of adaptation to various extreme environments and was the reason for choosing waste sources to isolate pigment-producing bacteria in this study. Microbial pigments have a massive commercial potential in the food, agriculture, pharmaceutical, textile, cosmetic and dietary industries due to their biodegradability and environmental compatibility and are anticipated to reach 33 to 49 billion dollars by 2027. This study aimed to screen and identified bacteria that could produce pigments, extract them, and determine how they behave at different pH and temperature levels. Three bacterial species namely *Corynebacterium* sp., *Streptococcus* sp., and *Staphylococcus* sp. capable of producing pigments were isolated from various water samples, including canals, gutters, and industrial wastewater dumping sites, using the enrichment culture plate technique, and were morphologically and biochemically identified. Out of three isolated species the *Streptococcus* sp., was carried forward. The pigment was extracted using solvent-solvent extraction and centrifugation techniques. A significant increase in light absorption was observed at 9°C and 40°C when compared with that of 30°C for the beta-carotene produced by *Streptococcus* sp. and stability was observed at a temperature of 30°C ($P < 2.2 \times 10^{-16}$). The stability of the pigment was observed at pH 7 and a significant increase in light absorption was observed for pH 1 when compared with pH 4, 7, 10 and 13 ($P < 2.2 \times 10^{-16}$).

Keywords: *Extraction, Microbial pigments, Stability, Streptococcus*

Weathering of Plastic Nurdles Discharged from the X-press Pearl Ship Disaster

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Abstract

This study assessed the weathering and size reduction of plastic nurdles discharged during the X-press Pearl ship accident in May 2021. Sand samples were collected from Sarakkuwa Beach, Sri Lanka, at three time points: 1 month, 4 months, and 16 months after the accident. Nurdles were extracted from the sand using NaCl density separation followed by wet peroxide digestion and analyzed with stereomicroscopic image, and Fourier transform infrared (FTIR) analysis. The volume reduction of weathered nurdles was determined via the densitometric titration method. Microscopic images of weathered nurdles exhibited higher surface roughness, cracks, and voids where FTIR spectra of them demonstrated several new bands, attributed to $-C=O$, $-S=O$ stretching vibrations, and $-CO-O-CO-$ bending vibrations, which did not appear in pristine nurdles. The presence of $-S=O$ in yellow-colored pellets may be due to the surface adsorption of elemental S, which was onboard the X-press Pearl ship. The mean volume reduction of nurdles collected in June and September 2021 was 44.59% and 53.67%, respectively, while the nurdles collected in September 2022 exhibited a 57.53% volume reduction, indicating size reduction due to weathering. The rapid weathering process was attributed to UV irradiation, atmospheric oxygen exposure, and wave action. This study highlights the rapid weathering of plastic nurdles at Sarakkuwa Beach and emphasizes the risk of generating nanoplastics from microplastic pellets through photoaging. Future studies are recommended to continue monitoring the size reduction of these nurdles and their presence in seagrass beds, seaweeds, and fish.

Keywords: *Marine microplastics, Nurdle spillages, Polyethylene, Photo-oxidation, Nanoplastics, X-press Pearl*

***In vitro* Cytotoxicity Assessment of Glyphosate on the Vero Cell Line**

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Abstract

Glyphosate, a widely used broad-spectrum herbicide in agricultural practices, has been a subject of ongoing debate regarding its potential adverse effects on human health. This research aimed to investigate the cytotoxicity effect of glyphosate on the Vero cell line, a common continuous mammalian cell line utilized for toxicological studies. Vero cells were exposed to varying concentrations of glyphosate, spanning environmentally relevant levels to higher doses [0.1 ppm, 0.2 ppm, 0.3 ppm, 0.4 ppm, 0.5 ppm, 0.6 ppm, 0.7 ppm, 0.8 ppm, 3 ppm]. Cytotoxicity assessment was done using MTT and SRB cell viability assays, along with morphological analysis via phase contrast and fluorescence microscopy. Preliminary findings revealed a compelling dose-dependent cytotoxic effect of glyphosate on Vero cells ($p < 0.05$). Notably, higher glyphosate concentrations demonstrated a significant increase in the percentage of cell mortality. Moreover, morphological alterations such as loss of confluency, and varied fluorescence patterns were observed, suggesting the increasing occurrence of apoptosis with increasing concentration levels of glyphosate. These results contribute and conclude valuable insights into the potential cytotoxic effects of glyphosate on mammalian renal cells. The dose-dependent nature of this cytotoxicity highlights the importance of meticulous assessment of exposure levels to determine potential risks associated with glyphosate exposure. As glyphosate remains a crucial component in modern agricultural practices, understanding its impact on human health is of paramount importance. Further investigations into the underlying molecular mechanisms of glyphosate-induced cytotoxicity would enhance our understanding of its toxicological profile.

Keywords: *MTT, SRB, Cytotoxicity, Apoptosis, IC₅₀*

An *in vitro* Investigation of *Zanthoxylum rhetsa* (Thanahalu) and its Anti-cancer Potential Against MCF7 and DLD1 Cancer Cell Lines

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Abstract

Most medicinal plants presently employed in traditional medicine are used without much scientific evidence, this suggests a need to explore reliable investigations of their pharmaceutical potential. Therefore, in this research, we prepared methanolic extracts of the thorn, bark, leaf and also a mix of the bark and thorn of *Z. rhetsa*. We tested the anti-inflammatory, anti-oxidant and cytotoxicity of all the above-mentioned parts of this plant. The bark and thorn of this medicinal plant is mainly employed for the treatment and management of breast cancer in traditional medicine. A phytochemical analysis was conducted by Folin Ciocalteu's method: Total Phenolic Content (TPC) and aluminium chloride colorimetric method: Total Flavonoid Content (TFC). *In vitro* anti-inflammatory study was conducted by Human Red Blood Cell (HRBC) membrane stabilization assay, while the *in vitro* anti-oxidant study was performed by the 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay. The cytotoxicity of the extracts was tested by 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) assay. The phytochemical analysis revealed that the highest concentration tested (1 mg/ml) of *Z. rhetsa* bark showed the highest TPC value of 0.388 ± 0.003 mg/ml Gallic acid equivalent g. The bark and thorn extract showed the highest flavonoid content out of all extracts, 0.069 ± 0.001 mg/ml Quercetin equivalent g. The DPPH assay exhibited the highest inhibition of $72.927 \pm 0.293\%$ for the bark extract. The HRBC assay showed the highest anti-inflammatory activity for the thorn extract, $95.276 \pm 0.006\%$. The cytotoxicity effect of the highest concentration (1 mg/ml) tested showed an inhibition of $72.940 \pm 1.048\%$ for the bark and thorn extract against the MCF7 breast cancer cell line while a growth inhibition of $83.572 \pm 1.676\%$ was observed against the DLD1 colon cancer cell line by the leaf extract compared to control. These results indicate that the bark and thorn extract exhibited good cytotoxicity against the breast cancer cells which validates the use in traditional medicine. More experiments will be conducted to determine the anti-cancer activity of this extract in breast cancer cells.

Keywords: *Zanthoxylum rhetsa*, Cytotoxicity, Breast cancer

POSTER PRESENTATIONS

Impact of Low Energy Availability and Menstrual Dysfunction of Women's Kho - Kho National Team in Sri Lanka

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Abstract

Kho - Kho is a very strategic and difficult sport and it is one of the two most widely used traditional tags. Low Energy Availability (LEA) (with or without disordered eating) and Menstrual Dysfunction (MD) common among young women who participate in sports. This study aimed to identify the impacts of low energy availability and menstrual dysfunction of the Sri Lanka National Women Kho-Kho team. A descriptive cross-sectional research design was used to this study. A total of 15 national female Kho-Kho players who aged between 26 to 30 were recruited in the study according to total sampling method. LEA was measured using 3 days diary recall, 3 days physical activity log. Eating Disorders (ED) were assessed using EDE-Q, menstrual dysfunction was assessed using the LEAF-Q standard questionnaire. The data were analyzed by using SPSS software Kruskal-Wallis test. According to that analysis, LEA was highly prevalent among the athletes (87%) and EA (13%). EDs were highly related to the shape concern (33.33%) and weight concern (26.66%) among athletes. MD percentage of the Kho-Kho team was reported as a 13.33%. Therefore, athletes in Sri Lanka National Women's Kho-Kho team should be made aware primary amenorrhea (20%), secondary amenorrhea (6.66%), oligo menorrhea (13.33%), and menorrhagia (26.66). The MDs were prevalent among the athletes at a level that should take attention. The study's findings allow us to draw the conclusion that the athletes in Sri Lanka's National Kho-Kho team have serious issues. When considering the menstrual dysfunctions among the selected athletes, it can be recommended that they have to pay more attention regarding the nutrition intake which affect the menstrual function as higher number of issues of menstrual cycle were reported among LEA athletes. Especially LEA among athletes of this condition, and further remedies should be taken to prevent the risk factors of LEA and MD and regular inspection should be performed on the risk factors to enhance their overall health.

Keywords: *Fat free mass, Kho-Kho, Low energy availability, Menstrual dysfunction*

Preliminary Study on the Association between FLT3 Ligand Level in Plasma and Peripheral White Blood Cell Counts in Non-Hodgkin Lymphoma Patients and Healthy Individuals

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Abstract

FLT3-ligand (FL) in human plasma stimulates the proliferation of white blood cells (WBC) and suppresses lymphomas. This study was aimed at detecting FL levels in non-Hodgkin lymphoma (NHL) patients and healthy individuals to find the correlations between FL and absolute WBC counts. Ethical clearance was obtained from the ethical review committee of KDU. EDTA plasma samples (n = 12) of confirmed NHLs (before chemotherapy) and healthy (n = 7) were analyzed by ELISA to quantify FL. NHLs were divided into 03 subpopulations; FL < 10 pg/ml (subgroup I, n = 5), 10 - 100 pg/ml (subgroup II, n = 4), and > 100 pg/ml (subgroup III, n = 3). Absolute-Lymphocyte-Count (ALC), Absolute-Neutrophil-Count (ANC), Absolute-Eosinophil-Count (AEC), Immature-Granulocytes (IMG), Neutrophils/Lymphocytes (NLR), and Lymphocytes/Monocytes (LMR) were compared statistically by SPSS-26: Mann-Whitney analysis among sub-groups. ANC, NLR, and IMG were significantly higher ($p < 0.05$) and AEC was lower ($p < 0.05$) in subgroup I than in II. IMG was significantly higher ($p < 0.05$) and AEC was lower ($p < 0.05$) in subgroup I than in III. AEC was significantly higher ($p = 0.05$) in subgroup II than in III. The average FL was 41.5 pg/ml in the healthy group. ALC, AEC, and LMR were significantly higher ($p < 0.01$) and total WBC, ANC, IMG, and NLR were lower ($p < 0.01$) in the healthy group than in NHL sub-group I. IMG, LMR, and NLR were significantly higher ($p < 0.05$) in the healthy group than in sub-group III. IMG was significantly higher ($p < 0.01$) in the healthy group than in sub-group II. It was shown that NHLs with lower FL had more deviated WBC counts, NLR, and LMR than other NHLs and healthy individuals. This preliminary study is currently being expanded to monitor the patients to detect the survival rate according to the initial FL level in NHL patients.

Keywords: *Non-Hodgkin lymphoma, FL, White blood cells and cell ratios*

Molecular Docking Studies of Phytochemicals from *Persea americana* to Treat Alzheimer's Disease

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Abstract

Alzheimer's disease (AD) is a fatal brain disorder that progressively degenerates brain cells. It poses a significant burden on healthcare and social care systems. Currently, there are only five drugs available to treat AD, but their use is limited due to their adverse effects, toxicity, and limited targets in AD pathology. As a result, finding an effective compound to fight AD is critical. Antagonizing beta-site APP cleaving enzyme 1 (BACE-1) and Acetylcholinesterase Enzyme (AChE) has become a novel therapeutic approach. This study is aimed to uncover potential drug candidates from 8 phytochemicals from *Persea americana* (Avocado) to target BACE-1 and AChE through protein-ligand docking using Autodock vina 1.2.6. 3D structures of the targets were downloaded from RCSB, and the structures of the phytochemicals were retrieved from the NCBI PubChem database and then the docking procedure was executed. Receptor-ligand interactions were observed in BIOVIA-DS and pharmacological properties were analysed using SwissADME webtool. Naringin showed the lowest binding affinity (-9.7 kcal/mol) against BACE-1 and luteolin showed the lowest binding affinity (-10.1 kcal/mol) against AChE. With respect to H-bond, GLN73 and GLY34 were identified as common amino acids of BACE-1 while TYR71, VAL69 and PHE108 were identified to involve in hydrophobic bonds. Considering H-bond in AChE, TYR121 and GLU199 were identified in common while TRP84 was identified with respect to hydrophobic interactions. Luteolin obeys the Lipinski's rule whereas naringin does not obey pharmacokinetic properties. Based on the results, luteolin found to be a promising drug candidate to target both the receptors. In vivo and in vitro research can be developed based on this research findings.

Keywords: *AChE, Alzheimer, BACE-1, Autodock*

Enhanced Vector Transport of Ciprofloxacin by Aged Polyethylene Microplastics in the Presence of Organic Matter

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Abstract

The comparative assessments of an emerging pollutant, ciprofloxacin (CPX) adsorption to both pristine and aged polyethylene (PE) microplastics and their desorption at different environmental factors and possible binding mechanisms are rarely discussed. This study evaluates the adsorption of CPX to pristine and aged PE microplastics (< 250 μm , 1 g L⁻¹ at different pH (3 – 10), reaction time (72 h), and initial CPX (1 - 30 mg L⁻¹) in humic acid (HA)- mixed water (0.5 - 2.5 mg L⁻¹) to reveal the potential binding mechanisms. Desorption of microplastic-bound CPX was performed at stimulated human stomach and gut fluids through batch sorption studies. Fourier Transform Infrared (FTIR) spectroscopy was performed to characterize PE microplastics. The presence of O-containing functional groups in the resultant FTIR spectra of aged microplastics confirmed their photooxidation. Within the optimum pH 6.0 - 7.0, aged PE microplastics in 2.5 mg L⁻¹ HA-mixed water showed higher adsorption (2.25 mg g⁻¹) than pristine microplastics (1.71 mg g⁻¹). Best-fitted Elovich and non-linear pseudo-second-order kinetic models indicated the chemical adsorption of CPX by pristine and aged microplastics, respectively. Non-linear cooperative adsorption behaviour for CPX binding to both PE microplastics was well agreed with the Hill isotherm model. The companionship of intermolecular hydrogen bonds, nucleophilic, Van der Waals, and $\pi - \pi$ interactions was the leading CPX adsorption mechanism. The pH-dependent desorption of microplastic-bound CPX exhibited a higher bio accessibility in stomach (15.32%) than in gut fluid (9.56%). These findings suggest that PE microplastics are potential vectors of CPX migration in HA-mixed water, influenced by solution pH and degree of aging.

Keywords: *Aging, Desorption, Organic pollutants, Vector transport, Chemisorption*

Microplastics in Beach Sediments of Kalutara Coastal Line, Sri Lanka: Abundance and Characteristics

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Abstract

Beach microplastic pollution is a globally widespread problem, posing an immediate threat to the health of aquatic species. Data regarding microplastic contamination in beach sediments in Sri Lanka is still lacking, specifically for the Kalutara coastal line, which is an important beach due to tourism. This study was performed to assess the abundance, and characteristics; shape, color, and polymer types of microplastics in beach sediments of coastal line Kalutara (500 m distance towards South and North from Kalutara Bridge). Five sand samples were collected from each side within a quadrant (30 cm × 30 cm) and 5 cm depth. Microplastics were extracted from 1 kg of dried sediment through density separation using saturated NaCl followed by digestion using Fenton's reagent. Since most of particles were found on 2 – 5 mm sieve, they were subjected to further characterization. After the identification of their polymer type by Attenuated Total Reflection Fourier transform Infrared (ATR-FTIR) spectroscopy, the number of microplastics were counted. The average microplastic abundance was 14.0±1.9 particles/kg. Both lowest (3.0 particles/kg) and highest (26 particles/kg) abundances were recorded for the South coastline indicating an uneven microplastic pollution. Similar abundances (4.0 particles/kg) were recorded for the sediment collected at sea mouth of both South and North coastlines. Film- shaped (48.57%) and microplastics in white color (39.29%) were most frequently found. Twenty-eight polymer types were identified, and high-density polyethylene was the most abundant (23.57%). The findings conclude polythene bags as a major source and provide a baseline for future studies on microplastics pollution.

Keywords: *Polyethylene, Sediments, ATR-FTIR, Microplastic films*

Sri Lankan Grapes Used as Sensitizer in Dye-sensitized Solar Cells

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Abstract

Dye-sensitized solar cells (DSSCs) belong to the third-generation photovoltaic technology. The sensitizer development is mainly focused on natural dyes because of low-cost, and environment friendliness. The most significant pigments that give flowers and fruits their colour are anthocyanins. Due to the presence of anthocyanins in the grape skin, the grapes were peeled out and the 2 g of the peels were ground to extract the 0.2 ml of dye without adding any solvent. We created a unique methodology using Sri Lankan grapes grown in Jaffna. The KI/I₂ based electrolyte and carbon counter electrode were the other components of DSSC. The TiO₂ paste was prepared by mixing Titanium Dioxide and Mono ethylene glycol (MEG). TiO₂ thin layer was deposited on transparent Indium doped Tin Oxide (ITO) conductive glass using doctor blade method. The J-V characteristic curves of fabricated cells were analysed. Solar energy conversion efficiency of $\eta = 0.286\%$ was obtained with a short circuit current of $J_{sc} = 1.23 \text{ mA cm}^{-2}$, an open circuit voltage of $V_{oc} = 0.48 \text{ V}$ and a fill factor of 0.48. The large absorption peak of the grape-dye is visible between 400 and 660 nm. The absorbance spectrum demonstrates that the grape-dye molecules and TiO₂ particles formed a charge transfer complex. This study is focused to identify a natural dye that works well as a sensitizer in Sri Lanka that can benefit economically underdeveloped nations. The result shows that, Sri Lankan grapes dye has good potential in future development of DSSC.

Keywords: *DSSC, Sensitizer, Anthocyanin, Grapes*

Street Food Safety-Related Knowledge and Attitudes among University Students in Sri Lanka: A Cross-sectional Web-Based Study

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Abstract

Street food is considered a significant source of foodborne illnesses. Thus, the safety of street food has come under scrutiny. This study aimed at investigating knowledge and attitudes towards street food safety among university students at a private university in Colombo, Sri Lanka. The data was gathered using a Google Form-based online survey questionnaire. Across six study programs and all academic years, 332 student volunteers were chosen at random. The data was examined using SPSS v. 26. Statistical significance was defined as $p > 0.05$. Descriptive and inferential statistics were used for analysis. One score was assigned for true, and zero for false and uncertain. On a four-level Likert scale, "agree" received 4 points for a correct response and 1 point for an incorrect response. Scores lower than 22, 22 to 35, and higher than 35 are considered low, average, and good knowledge, respectively. Scores below 26, 26 to 35, and above 35 are considered poor, average, and good attitudes, respectively. No significant correlation ($p > 0.05$) was found between food safety knowledge and the socio-demographic parameters evaluated, and there was no significant difference between the knowledge levels of male and female students (p value = 0.267). Only the study program was significantly associated with the total attitude score (p value = 0.002). Most consumers (53.6%) were aware of the risks of food contamination. The least amount of consumers were very concerned about contracting a food-borne illness from street foods (7.2%), willing to change their inappropriate food safety practices (15.7%), and reduce street food consumption after knowing negative effects (15.7%). In conclusion, 89.5% and 48.5% had an average level of knowledge and a poor level of attitudes regarding street food safety, respectively. Thus, continuous food safety education programs are necessary to educate university students.

Keywords: *Street foods, University students, Knowledge, Attitudes, Food safety*

Antioxidant Properties of Flavoured Ceylon Black Tea Consumer Packs

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Abstract

Ceylon tea is reported to have numerous health benefits. However, limited studies have evaluated health benefits of Ceylon flavoured teas. This study examined the antioxidant properties (AP) of ten flavoured black teas (Broken Orange Pekoe Fannings: BOPF grade) namely cardamom, earl grey, apple, lemon, ginger, exotic chai, peach, raspberry, cherry and mixed fruit teas. Non-flavoured black tea (BOPF) served as the control. Total Polyphenolic Content (TPC), Total Flavonoid Content (TFC), Ferric Reducing Antioxidant Power (FRAP) and DPPH & ABTS radical scavenging activities were used to study the AP (n = 3 each). Results showed significant differences ($P < 0.05$) among the samples and compared to control for the tested AP. TPC, TFC, FRAP, DPPH and ABTS AP of tested teas ranged from 204.07 4.12 - 120.58 6.65 mg GAEs/g of extract, 57.40 0.60 - 26.19 0.29 mg QE/g of extract, 389.31 2.27 - 269.26 5.6434 mg TE/ g of extract, 3995.22 103 .47 - 2287.36 10.32 mg TE/ g of extract and 3300.07 13.82 - 2350.16 35.34 mg TE/ g of extract respectively. Interestingly, cardamom tea exhibited significantly ($p < 0.05$) high TPC (204.07 ± 4.12 mg GAEs/g of extract) and TFC (57.40 ± 0.60 mg TE/ g of extract) while raspberry tea and non flavoured black tea showed the highest FRAP compared to all the tested teas. The DPPH radical scavenging activity was highest in ginger tea and non flavoured black tea while ABTS radical scavenging activity was highest in non flavoured black tea. It is concluded that flavouring could either enhanced or reduced the AP of BOPF grade flavoured Ceylon black tea consumer packs.

Keywords: *Flavoured tea, Ceylon tea, Black tea, Antioxidant properties*

Isolation of Glyphosate-tolerant and Degrading Bacteria from Agricultural Fields for Future Soil Bioremediation Studies

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Abstract

Agricultural soil contamination caused due to immense use of pesticides in agricultural fields has evolved into a global health and environmental hazard. A number of microorganisms are able to survive under extreme conditions in the presence of acquired tolerance due to the prolonged exposure to contaminants by utilising pesticides and their metabolites as the source of carbon, nitrogen or phosphorus. The aim of the current study was to isolate glyphosate-tolerant and degrading bacteria from glyphosate-contaminated soil collected from an agricultural field in Sabaragamuwa province, Sri Lanka that can be applied for soil remediation aspects. Two bacterial strains isolated from glyphosate-contaminated soil were analysed spectrophotometrically for 96 hrs. by measuring the bacterial growth at 600 nm with the use of biotic control with no pesticide and by measuring the pesticide concentration at the absorbance maxima of glyphosate with abiotic control containing uninoculated Nutrient Broth supplemented with glyphosate, in order to evaluate the dose-response and pesticide degrading ability respectively. The two isolated strains, namely *Arthrobacter* sp. and *Bacillus* sp. survived in the presence of different glyphosate concentrations (0 mg/L - 100 mg/L) with glyphosate-degrading potentials. The *Arthrobacter* sp. indicated the highest percentage of glyphosate degradation of 93.84% followed by *Bacillus* sp. with 76.37% during 96 hrs. Moreover, statistical analysis of the study disclosed that glyphosate degradation percentages between the two strains were not significantly different ($p > 0.05$). However, both strains indicated a statistical significance ($p < 0.05$) in degradation percentage compared to the abiotic control, thus indicating the potential of using both strains for future bioremediation studies.

Keywords: *Arthrobacter* sp., *Bacillus* sp., Bioremediation, Degradation, Glyphosate

Screening the Radical Scavenging Activities of the Solvent Extracts from Brown Marine Algae: *Padina commersonii*

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Abstract

Padina commersonii is a marine brown macroalgae commonly found in Sri Lankan water. It is showing remarkable therapeutic potential due to comprising of a rich source of natural products. This study aimed to evaluate antioxidant activity in terms of the radical scavenging activity of *P. commersonii*. In this study, freeze-dried *P. commersonii* was subjected to three hours of sonication in 80% methanol. By precipitating with ethanol, the de-polysaccharide fraction of methanolic crude was isolated. The de-polysaccharide fraction in the methanolic extract was then fractionated by liquid-liquid partitioning into hexane, chloroform, ethyl acetate, and water. The existing phytochemicals and the bioactivities of the separated fractions were analyzed. The highest Total polyphenolic content (TPC) was observed in the Ethyl acetate fraction (7.44 ± 0.29 mg GAE/g). Radical scavenging activities including 2,2-diphenyl-1-picrylhydrazyl (DPPH), hydroxyl, and alkyl were performed to investigate the antioxidant activities. Ethyl acetate fraction exhibited the lowest IC₅₀ values for DPPH (0.71 ± 0.03 mg/ml), alkyl (0.017 ± 0.001 mg/ml), and hydroxyl radicals (0.25 ± 0.01 mg/ml) while proving superior radical scavenging performance in comparison to other fractions. Ethyl acetate fraction was further fractionated through a reverse phase Octadecyltrimethoxysilane (ODS) open column followed by the Thin Layer Chromatography (TLC) studies. Resulted in four fractions which were evaluated for radical scavenging activity and the lowest IC₅₀ values for DPPH (0.014 ± 0.001 mg/ml), alkyl (0.010 ± 0.001 mg/ml), and hydroxyl radicals (0.100 ± 0.003 mg/ml) were found in fraction-2 (F2). Collectively, the findings have showed that free radical scavenging activity has a positive correlation with the TPC of the ethyl acetate fraction. Furthermore, the F2 fraction was collected as the best fraction with antioxidant activity and required further purification to isolate and characterize the polyphenolic compounds which are responsible for the antioxidant activity. This research might be effective to find possible lead compounds from *P. commersonii* for drug discovery as well as for the development of future therapeutic medication.

Keywords: *Padina commersonii*, Brown algae, Antioxidant activity, Radical scavenging activity, Polyphenols

Antioxidant Potential of Some Selected Underutilized Fruit Species Grown in Sri Lanka

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Abstract

Despite having a wide variety of fruits and being one of the world's biodiversity hotspots, Sri Lanka's resources are still mostly untapped. Secondary metabolites known as antioxidants have the power to lessen oxidative stress that can lead to a number of diseases, including cancer, inflammatory disorders, cardiovascular diseases, and age-related diseases. Underutilized fruits in Sri Lanka are reported to have antioxidant properties, however, comparative studies are limited. The present study was carried out to investigate the bioactivity compounds and antioxidant capacity of four heat pump-dried underutilized fruit powders collected, including *Cynometra cauliflora* L. (Sin: Naminan), *Manilkara zapota* L. (Sin: Sapodilla), *Flacourtia indica* L. (Sin: Ugurassa), and *Elaeocarpus serratus* L. (Sin: Veralu) were used in this study. Methanolic (100%) extracts (MEs) of fruits were evaluated for Total Polyphenolic Content (TPC), Ferric Reducing Antioxidant Power (FRAP), and Oxygen Radical Absorbance Capacity (ORAC) (n = 3 each). Results showed significant differences (P < 0.05) between extracts. Among the studied fruits, *F. indica* exhibited the highest antioxidant activities for TPC, TFC, and ORAC. The mean TPC, TFC, FRAP and ORAC antioxidant properties of MEs were 8.95 ± 0.25 mg Gallic acid equivalent/g, 8.75 ± 0.07 mg Quercetin equivalent/g, 51.39 ± 0.24 mg, and 15.58 ± 3.34 mg Trolox equivalents/g heat pump dried fruit powder, respectively. TPC and ORAC values are significantly (p < 0.05) different and have a moderate positive correlation however, TPC and FRAP values have significantly different negative moderate correlations. TFC and FRAP values have significantly different negative high correlation but TFC and ORAC values have weak positive correlation. Monomeric anthocyanin was not detected for four fruit types. The results revealed that these underutilized fruits can be used to develop formulations with improved antioxidant capacity as sources of natural antioxidants.

Keywords: *Underutilized fruit, Antioxidant properties, Correlation*

Screening of Antioxidant Capacity of *Pouteria campechiana* (Kaha laulu), *Psidium guineense sw* (Ambulpera) and *Aegle marmelos* (Beli) Fruits

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Abstract

Antioxidants are important as therapeutic agents in preventing a wide range of human pathologies associated with oxidative stress. Due to certain drawbacks in synthetic antioxidants, the attention is focused on the discovery of natural antioxidants. The present study was aimed to compare the antioxidant potential of different extracts of three selected underutilized fruit crops available in the North Central Province of Sri Lanka. The fruit carp of *Pouteria campechiana* (Kaha laulu), *Psidium guineense sw* (Ambulpera) and *Aegle marmelos* (Beli) were extracted in ethanol by maceration. Then the dried crude extracts were subjected to solvent partition with hexane and ethyl acetate. Water fraction of the extracts were obtained by freeze-drying. A concentration gradient (0.0625, 0.125, 0.25, 0.5, 1.0 mg/ml) of crude extracts and the resulting fractions was screened for free radical scavenging activity by DPPH assay. Ascorbic acid was used as the positive control. All three crude extracts and the majority of fractions exhibited a dose-dependent free radical scavenging activity. The maximum activity shown by crude extracts of *P. campechiana*, *P. guineense sw* and *A. marmelos* were $40.33 \pm 0.6\%$, $65.67 \pm 0.23\%$ and $63.83 \pm 0.94\%$ respectively. Hexane fraction of *P. campechiana*, *P. guineense sw* and *A. marmelos* showed highest scavenging activity of $15.94 \pm 0.82\%$, $26 \pm 0.94\%$ and $11.91 \pm 1.29\%$ respectively. The maximum activity exerted by Ethyl acetate fractions was $92.22 \pm 0.34\%$, $84.17 \pm 0.16\%$ and $88.72 \pm 0.25\%$ for *P. campechiana*, *P. guineense sw* and *A. marmelos* respectively. The highest activity exhibited by aqueous fractions of *P. campechiana*, *P. guineense sw* and *A. marmelos* were $30.66 \pm 0.23\%$, $62.58 \pm 1.06\%$ and $52.41 \pm 1.76\%$ respectively. The results of the present study revealed that all three tested fruit carp extracts possess considerable antioxidant capacity. Among them ethyl acetate fraction exerted maximum activity reflecting their suitability to apply for the development of antioxidant food supplements in future.

Keywords: *Antioxidants, Radical scavenging, Pouteria campechiana, Psidium guineense sw, Aegle marmelos*

Antibacterial Activity of Different Fractions of Two Underutilized Fruit Crops in Sri Lanka: *Tamarindus indica* (Siyabala) and *Cynometra cauliflora* (Nam-Nam)

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Abstract

Due to adverse effects exerted by currently applying synthetic food preservatives, there is a timely need of discovery of natural food preservatives. The present study was aimed to discover the antimicrobial potential of fruit extract of *Tamarindus indica* (Siyabala) and *Cynometra cauliflora* (Nam-Nam) grown in north central province of Sri Lanka against common food spoilage bacteria. The ethanol extracts of unripe fruit carp which was prepared by maceration, was dissolved in distilled water after evaporating all ethanol for partition with hexane and ethyl acetate. The antibacterial activity of crude extract and the fractions was assessed by agar disc diffusion method. Four concentrations of each sample were screened against *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Klebsiella pneumonia* and *Acinetobacter baumannii*. Among all fractions, the water fraction showed the highest yields for both fruit extracts (*C. cauliflora*: 51%, *T. indica*: 60.71%). The ethanol crude extract (500 mg/ml) of *C. cauliflora* (500 mg/ml) inhibited the growth of *E. coli* (7.66 mm), *S. aureus* (11 mm) and *P. aeruginosa* (11.33 mm), while the water fraction (500 mg/ml) inhibited all five strains (*E. coli*: 8 mm, *S. aureus*: 10.33 mm, *P. aeruginosa*: 12.66 mm, *K. pneumoniae*: 6.33 and *A. baumannii*: 13.33 mm). The 500 mg/ml concentration of ethanol crude extract (*E. coli*: 10 mm, *S. aureus*: 13 mm, *P. aeruginosa*: 15 mm, *K. pneumoniae*: 14 mm and *A. baumannii*: 14 mm) and the water fraction (*E. coli*: 10.66 mm, *S. aureus*: 15 mm, *P. aeruginosa*: 7 mm, *K. pneumoniae*: 10 mm and *A. baumannii* : 11 mm) of *T. indica* inhibited all bacterial strains. The hexane fraction of *T. indica* only inhibited the growth of *S. aureus* (10 mm). Ethyl acetate fraction of both fruit extracts did not exhibit antibacterial effect against tested strains. The results of present study prove the possibility of application of the tested fruit extracts to develop natural food preservatives.

Keywords: Antimicrobial, *Tamarindus indica*, *Cynometra cauliflora*, Food preservatives

***In vitro* Antioxidant and Anti-inflammatory Activity of “Denabadiya Kasaya”: A Traditional Polyherbal Formulation Used for the Treatment of Fever Including Dengue**

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Abstract

“Denabadiya Kasaaya” is an intricate formulation rooted in Sri Lankan traditional medicine, crafted from a blend of eight distinct herbs which is prescribed for fever and flu like symptoms including dengue fever. We assessed the phenolic, flavonoid and antioxidant content of this preparation by Folin Ciocalteu method (Total Phenolic Content; TPC), Aluminum chloride method (Total Flavonoid Content; TFC), and by 1,1-diphenyl-2-picrylhydrazyl (DPPH) assay respectively. We also analysed the anti-inflammatory activity by the Human Red Blood Cell membrane stabilization (HRBC), and by the protein denaturation assays. The cytotoxicity of this preparation was assessed by the MTT assay. TPC of the formulation was recorded as 5.2 mg/g Galic Acid equivalent. TFC value of the sample was 5.3 mg/g Quercetin equivalent. For the DPPH assay, IC₅₀ was > 1 mg/mL while standard ascorbic acid showed an IC₅₀ of 0.016 mg/mL. The anti-inflammatory activity of the preparation was recorded as IC₅₀ of > 1 mg/mL for Protein denaturation assay while standard Ibuprofen showed an IC₅₀ of 0.85 mg/mL. HRBC assay depicted an IC₅₀ of < 0.0625 mg/mL, while standard Ibuprofen showed an IC₅₀ of 0.31 mg/mL. Finally, minimal cytotoxicity effects in Vero cells were found by the MTT assay where 55.7% cell growth inhibition was observed at 24 h for the highest concentration tested: 1 mg/ml. This preparation exhibits considerable anti-inflammatory activity. Further research will be conducted to determine its antiviral activity.

Keywords: *Dengue fever treatment, Traditional plant extract, Denabadiya Kasaya*

Anti-oxidant and Anti-inflammatory Activity of Various Crude Extracts of *Flacourtia inermis* (Lovi) and *Averrhoa bilimbi* (Billin) plants

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Abstract

Averrhoa bilimbi (Billin) and *Flacourtia inermis* (Lovi) plants belong to underutilized fruit plants in Sri Lanka. These plants are comprised of valuable phytochemicals such as flavonoids, and phenolics which can act as anti-oxidants, anti-bacterial, anti-inflammatory and anti-cancer agents. Therefore, in this paper, we hope to focus on a comparative account of the anti-oxidant and anti-inflammatory activity of two varieties of fruit and leaf extracts. The extracts were prepared by three methods where two aqueous extracts were prepared by a hot water (100°C) extraction method and a maceration extraction method. The third extract was prepared by methanol maceration method. Total Phenolic Content was evaluated by Folin Ciocalteu method, while the anti-oxidant activity was determined by DPPH assay (2,2-diphenyl-1-picryl-hydrazyl-hydrate). The anti-inflammatory activity of the extracts was evaluated by human red blood cell membrane stabilization (HRBC) assay and albumin denaturation assay. Out of all extracts, the highest value for total phenolic content was demonstrated by the *F. inermis* fruit macerated water extract: 340.69 ± 4.04 mg GAE/g. When considering the DPPH assay, the hot water extract of *A. bilimbi* fruit and methanol extract of *F. inermis* fruit showed similar inhibition values as 72.60% and 71.49% for 1mg/ml respectively. When considering the anti-inflammatory activity, the water macerated *F. inermis* leaves extract showed the highest inhibition value of 91.44% for 1 mg/ml of the extract by HRBC assay and the water macerated *F. inermis* fruit extract showed the highest inhibition value of 92.30% for 1 mg/ml for the albumin assay as well. These results can be used for further analysis and where novel value-added food supplements could be developed for the local and export markets.

Keywords: *Averrhoa bilimbi*, *Flacourtia inermis*, Anti-oxidant activity, Anti-inflammatory activity

A Comparative Analysis of Phytochemical Composition, Anti-oxidant and Anti-inflammatory Activity between *Garcinia quesita* and *Garcinia zeylanica* Fruit Rind by Five Extraction Methods

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Abstract

Garcinia quesita and *Garcinia zeylanica* are endemic to Sri Lanka. *Garcinia* rind extracts are used to treat ulcers, asthma, diabetes mellitus, and hyperlipidemia by the traditional medicine practice. However, studies on photochemical, antioxidant activity and anti-inflammatory activity of them have not been documented enough. Therefore, this study aimed to conduct a comparative account on the fruit rinds of both plants. Fruit rind extraction was conducted by five different methods i.e., by two hot water extractions at temperatures of 100°C and 55-60°C, by autoclaving at 115°C, 1 bar, and by two macerations using water and ethanol. Subsequently, antioxidant activity using (2,2-diphenyl-1-picryl-hydrazyl (DPPH)) assay, anti-inflammatory activity using Human Red Blood Cell (HRBC) membrane stabilization assay and albumin denaturation assay, Total Phenolic Content (TPC) and Total Flavonoid Content (TFC) were determined for all extracts. All the extracts of *G. quesita* demonstrated higher activity compared to the corresponding extract *G. zeylanica*. Out of them, ethanol extract of *G. quesita* showed the highest value for TPC (576.79 ± 4.04 mg GAE/g) and highest value for TFC (322.51 ± 2.21 mg QE/g). For the DPPH assay, ethanolic extract of *G. quesita* showed 71.82% of inhibition for the highest concentration tested which is (1 mg/ml). Further, the extract of *G. quesita* prepared by the ethanol maceration method showed an inhibition of 82.42% for the HRBC assay for 1 mg/ml, and an inhibition of 77.62% for the albumin denaturing assay for 1 mg/ml. It can be concluded that *G. quesita* demonstrates higher antioxidant and anti-inflammatory activity and higher TPC and TFC values compared to *G. zeylanica*.

Keywords: *Garcinia quesita*, Anti-oxidant activity, Anti-inflammatory activity

Nest Site Selection, Cavity Characteristics, and Cavity Use of *Dinopium* Flamebacks in Sri Lanka

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Abstract

Ecology of *Dinopium flamebacks* (woodpeckers) in Sri Lanka is not fully comprehended. This study investigates the nest site selection, cavity characteristics, and cavity-use by secondary cavity users of *Dinopium flamebacks* in Sri Lanka. Two square kilometer areas in Kaduwela, Eppawala, and Talaimannar were used as the study sites. Nests were located using the line transect method, while cavities were studied using a USB-android endoscope camera. Coconut, Rain (Maara), and Palmyra (Thal) trees were prominently chosen by these flamebacks for nesting, constituting 64%, 50%, and 75% of nests in Kaduwela (n=33), Eppawala (n=52), and Talaimannar (n=40) respectively. We found a range of heights and tree species utilized by *Dinopium flamebacks* for nesting (n=133), ranging from 6 feet in a betel nut tree to 50 feet in a palmyra tree. Active nest sites (n=7) exhibited 31.49 ± 20.04 % canopy cover, 6.07 ± 0.32 cm nest opening diameter, 61.85 ± 24.50 cm nest hole circumference, 37 ± 9.90 cm nest chamber height, and 4.99 ± 2.73 m nest-to-ground distance, with circular or oval-shaped openings. 57.14% of active nests (4 out of 7 in Kaduwela and Eppawala) were encircled and camouflaged by vines. Nest density varied based on habitat, with higher densities observed in coconut plantations in wet and arid zones and in forest habitats in the dry zone (Two-way ANOVA, $p = 0.02$, $n = 102$). Rose-ringed parakeets (*Psittacula krameri*) were identified as a major invader, accounting for 51% of observed nest takeovers. Studying nest site characteristics is crucial for comprehending nesting behaviour and habitat requirements. This knowledge is useful for designing effective conservation strategies and preserving suitable habitats for cavity-nesting communities.

Keywords: *Dinopium*, *Flamebacks*, *Nest site selection*, *Secondary cavity nesters*, *Sri Lanka*

Determination Of Pathogenic Bacteria in Commercially Available Fresh Green Leafy Vegetables in Western Province, Sri Lanka

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Abstract

Foodborne illnesses from pathogenic microorganisms are a global health concern. Fresh green leafy vegetables are vital but prone to contamination, necessitating precautions. The present study aimed to determine the pathogenic bacterial contamination in the fresh green leafy vegetable samples from Pettah, Wellawatte, and Nugegoda areas in Western Province, Sri Lanka. A total of 250 fresh green leafy vegetables, were purchased from commercial markets, with five different varieties represented. From each group of 50 samples, microorganisms were isolated and identified using conventional standard methods and biochemical tests such as Indole, Citrate, MRVP, TSI, Motility test, chromogenic culture, and Gram-staining. The analysis was obtained from Microsoft Excel 2010 and SPSS V23.0. Eight pathogenic bacterial species namely; *Escherichia coli* (20%), *Shigella* spp. (25%), *Klebsiella* spp. (50%), *Enterobacter* spp. (15%), *Proteus* spp. (10%) and *Salmonella* spp. (25%), *Citrobacter* spp. (15%) were identified from green leafy vegetables. The *Lactuca sativa* shows the highest significant pathogenic contamination *Escherichia coli* (60%) and *Salmonella* spp. (60%), followed by 20% of contamination each of *Klebsiella* spp. and *Proteus* spp. compared to other varieties ($P = 0.003$, $p < 0.05$). All three regions exhibited substantial contamination with a minimum of five microorganism types, with the Pettah region displaying the highest contamination at 100% followed by Wellawatta and Nugegoda but there is no significant difference in contamination ($P = 0.115$, $p > 0.05$). The Pettah region demonstrated a significant prevalence of *Salmonella* spp. contamination at 57.14%, whereas Nugegoda exhibited *Klebsiella* spp. at 50% ($p < 0.05$). Poor hygiene issues of vendors identified as key facts contributing to the pathogenic contamination.

Keywords: *Pathogenic microorganism, Contamination, Green leafy vegetables*

Extraction and Characterization of Fibers from *Caryota urens* L. (Kithul) Leaves

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Abstract

Caryota urens L. (Sinhala: Kithul; English: Fishtail palm) is an indigenous plant naturally grown in the wild. Kithul leaf has a high fiber content and could be a good alternative to many fibers with industrial applications. However, extremely limited research has been conducted on this topic. This study focused on extraction and characterization of fibers from Kithul leaf. Kithul leaf samples were collected utilizing a systematic random sampling approach to ensure representative and unbiased selection. Authentication of the plant materials was achieved through rigorous comparison of botanical features. Fiber was extracted by alkali and acid digestion method. Different physical and chemical properties of extracted fibers were assessed using internationally accepted standard methods. Further, characterization of Kithul leaf fibers was performed using Scanning Electron Microscopy (SEM). Results showed significant differences among the tested physical and chemical properties of Kithul leaf fibers. The fiber diameter, length, elongation at break, tensile strength, moisture content, and total lignin content varied from $0.24 \pm 0.04 - 0.64 \pm 0.16$ mm, $29.48 \pm 2.36 - 86.91 \pm 5.40$ cm, $9.14 \pm 4.88 - 12.77 \pm 4.58$ mm, $7.77 \pm 2.49 - 45.56 \pm 14.60$ N, $10.03 \pm 0.79 - 13.24 \pm 0.50\%$, and $21.44 \pm 0.07 - 28.51 \pm 0.03\%$ respectively. Further, Kithul leaf fibers can be broadly categorized as short fibers (2 types namely A&B) and long fibers (2 types namely C&D). SEM images clearly showed the length variations in short and long fiber types of Kithul leaves. It is concluded that fibers with varying physical and chemical characteristics can be extracted from Kithul leaves. These fibers may have many potential industrial applications, thus further studies could be recommended in purification and characterization Kithul leaf fibers.

Keywords: *Kithul leaf fibers, Physical properties, Chemical properties*

Responses of Avian Communities to a Submontane Elevational Gradient

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Abstract

Biogeography comprises the study of patterns of the geographic distribution of organisms and the factors which govern those patterns. The study was implemented from the Samanalawewa river basin (480 m Mean Sea Level (MSL)) to Haagala peak (1420 m MSL), at Issengard Biosphere Reserve, Belihuloya, in the Sabaragamuwa province in Sri Lanka. Along the 10 horizontal line transects at 100 m intervals, bird identification, as well as measuring of vegetation and habitat parameters were conducted over nine months at one month intervals in the complete elevation gradient. A total number of 97 bird species were recorded including 86 resident, 21 endemic, 19 threatened, 7 montane, and 11 migratory. Adding evidence to the mid-domain effect, species richness, abundance, and diversity of birds indicated the hump-shaped variation along the elevation gradient. Both species richness and Shannon Wiener diversity have shown the highest values at 700 m MSL and the highest value in abundance at 580 m MSL. Above 0.8 higher, Shannon Wiener evenness value shows ecosystem stability at each elevation. Habitat complexity, tree height, and canopy cover, with several avian community parameters showed similar patterns of variation along the elevation gradient. Hence, the responses of avian communities along the elevation gradient are supported by vegetation and habitat topography. The leeward side of the forest patch at the highest elevation contributed to enhancing the faunal and floral community assemblages resulting in increment in species richness, habitat complexity, tree height, and canopy cover at the highest elevation.

Keywords: *Belihuloya, Habitat topography, Sri Lanka*

Biopriming of Rice Seeds with Plant-Growth-Promoting *Trichoderma citrinoviride* TRI103 Reduces Nitrogen Fertilizer Usage Under Greenhouse Conditions

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Abstract

The increased use of synthetic fertilizers in agriculture has been a financial burden for farmers while posing environmental and human health risks. This study aimed to explore the impact of seed biopriming with a novel isolate of plant growth promoting *Trichoderma citrinoviride* on growth and yield parameters of rice variety Bg 352 under 30% reduced level of recommended nitrogen fertilizer applications. Rice was cultivated under greenhouse conditions following the Completely Randomized Design with thirty replicates. The pure culture of the fungus was grown in Potato Dextrose Agar (PDA), and spore suspension (1×10^7 spores/ ml) was used for seed-biopriming. The ability of *Trichoderma citrinoviride* to produce Indole Acetic Acid (IAA) was assayed *in vitro* using the Swalkowski reagent. Plant growth characteristics (shoot and root dry weight, number of tillers per plant) and yield parameters (number of panicles, grain yield, number of full grains per panicle) were recorded. Data were analyzed statistically using ANOVA at 5% significance level. Plant and root development rose for seeds primed with *Trichoderma citrinoviride*. When biopriming seeds of with *Trichoderma citrinoviride*, a 30% nitrogen fertilizer reduction resulted in no significant difference when compared with control. The *in vitro* studies confirmed the IAA production of *Trichoderma citrinoviride*. As a result, it can be stated that biopriming rice seeds with novel *Trichoderma citrinoviride* may be employed in paddy production with lesser nitrogen application. However, the study should be carried out under field conditions.

Keywords: *Trichoderma citrinoviride*, 30% Nitrogen reduction, Biopriming

The Taxonomic History, Geographical Distribution and Status of Sri Lankan Jackal

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Abstract

The Eurasian Golden Jackal (*Canis aureus*) is found in Europe and Asia. It is the only wild dog species found in Sri Lanka. The taxonomic status of the Sri Lankan jackal, however, is ambiguous, and its distribution is poorly studied. Here we provide a critical overview of the taxonomic history and a detailed description of the geographical distribution of the jackal in Sri Lanka. The taxonomic history of the species was reviewed using the scientific literature and specimens in major collections. The name of the species based on morphology first appeared in Linnaeus (1758), followed by Kelaart (1852) as *Canis aureus*. Sri Lankan jackal was treated as an endemic subspecies to the island; *C. aureus lanka* in Ellerman & Morrison-Scott (1951) and in Philips (1984) or as a subspecies endemic to both Southern India and Sri Lanka; *C. aureus nariya* in Wroughton (1916). Later, Philips (1935) elevated the Sri Lankan jackal to a full species; *Canis lanka* Philips (1935). To map the density and geographical distribution of the jackal, a questionnaire-survey and sighting-reports were used across the country, covering major agro-climatic zones. The jackal inhabits throughout the island in low densities. In several regions in the dry zone, it has a denser population. It is rare above 1500 m of elevation. Questions based on recent population trends in the questionnaire suggested a recent decline in the jackal population across the country. It is emphasized here that the importance of a molecular phylogenetic study to verify taxonomic status and a systematic island-wide survey to assess the population size for this species.

Keywords: *Canis aureus*, *Sri Lanka*, *Wildlife management*

Morphological, Vocal, and Genetic Characterization of *Motacilla flava* – *tschutschensis* Allopecies Complex in Sri Lanka

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Abstract

Yellow wagtail complex was long considered a single species (*Motacilla flava*). Recent phylogenetic studies however, split this species into two; the Western Yellow Wagtail (*Motacilla flava*) and the Eastern Yellow Wagtail (*Motacilla tschutschensis*). Until 2020, there were no records of the Eastern Yellow Wagtail in Sri Lanka. Nonetheless, using several vocal, plumage, and a single genetic marker, a study in 2021 indicated that the Eastern Yellow Wagtail is wintering in Sri Lanka. In the present study, the yellow wagtail complex in Sri Lanka was critically evaluated using an assortment of phenotypic and genetic characteristics obtained from live-caught birds. The phylogenetic affinities of yellow wagtails wintering in Sri Lanka were constructed using Maximum likelihood inference and Bayesian inference using the mitochondrial ND2 gene region as the genetic marker. The morphological and vocal variations between Eastern (n = 15) and Western (n = 11) yellow wagtails were analyzed through the ANOVA test and the principal component analysis (PCA). The molecular phylogenetic trees and the number of peaks at the downstroke of the first flight call ($p = 0.00015$) of the yellow wagtail reveal that both Eastern and Western yellow wagtails are wintering in Sri Lanka. However, the morphological characteristics failed to separate the two species into two distinct clusters ($F_{n=26} = 3.9816$, $p = 0.0147$). Our study revealed the migratory occurrence of both the Western Yellow and the Eastern Yellow wagtails in Sri Lanka. The studied Eastern Yellow Wagtails clustered to the North Asian *tschutschensis* clade.

Keywords: *Molecular markers, ND2, Eastern yellow wagtail, Western yellow wagtail, Phylogeny, Integrative systematics*

Identification of Pathogenic Bacteria (*Escherichia coli*) in Drinking Water Sources and Detection of their Antibiotic Resistant Genes in Gampaha District, Sri Lanka

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Abstract

Water plays a critical role on Earth, and its significance is particularly evident in relation to human beings. The present study aimed to identification of *Escherichia coli* and detection of their antibiotic resistant genes in drinking water sources of five different regions Gampaha district, Sri Lanka. Five resources of randomly collect drinking water samples (n = 50) from every 10 samples from five different regions were used for analysis. The pathogenic microorganisms were isolated via membrane filtration technique (0.45 μm) and identified via conventional standard biochemical keys including Indole, Citrate, MRVP, TSI, Motility and Chromogenic culture and Gram stain. The DNA extraction was performed via column-based method. The disk diffusion method was performed to access the antibiotic sensitivity of the isolated *Escherichia coli* following CLSI guidelines via Ampicillin, Gentamicin and Tetracycline antibiotics (10 mg). From total sample 18% were positive with *Escherichia coli* in unprotected well, protected well and tap line samples. All nine samples exhibit resistance to Ampicillin (< 13 mm), sensitive to the Gentamicin (> 15 mm) and resistant to Tetracycline (< 11 mm). Molecular determination, 2% agarose gel image, confirmed the presence of *E. coli* DNA as evidenced by the presence 400 base pairs (bp) band size and UidA gene found in one sample confirmed the presence of different strains of isolated *E. coli*. The specific antibiotic resistant genes were analyzed and all three samples were negative for the *tet (a)*, *tet (C)*, *tet (m)* and bla_{TEM} antibiotic resistant genes which confirms that isolated *E. coli* were not resistant for the Tetracycline and Ampicillin due to mentioned genes.

Keywords: *Pathogenic microorganism, Bacterial contamination, Antibiotic resistance*

Application of the Peak-to-Valley Method for in-situ Gamma Spectroscopy Using NaI(Tl) Detector

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Abstract

The depth distribution in soil is required to quantify the radioactivity in environment using in-situ gamma spectroscopy. The conventional approach to determining depth distribution is the core sampling method, which requires samples from several depths in the soil and is a time-consuming process. In-situ gamma spectroscopy can be used as a rapid and efficient way to quantify radioactivity in large areas. The Peak-to-Valley (PTV) method which is based on the attenuation of gamma rays through matter, emerges as a novel approach, enabling the derivation of depth distribution information from in-situ gamma spectra without having core samples. The present study aimed to validate the PTV method using the NaI(Tl) detector and obtained a correlation between the PTV ratio and depth distribution. Water was used as the attenuation medium to create different depths and ¹³⁷Cs and ⁴⁰K sources were kept at different depths. The NaI(Tl) detector was used to measure spectra at each depth and calculated the PTV ratios. The results show a higher correlation of 2nd order between the PTV ratio and the depth for both ¹³⁷Cs and ⁴⁰K. It reveals that the PTV ratio of the in-situ gamma spectrum can be used to derive the depth distribution parameter. The relationship between the PTV ratio and the depth distribution parameter was obtained for several locations. This relationship is used for calibrating in-situ gamma detector which can be used in a similar environment to determine radioactivity.

Keywords: *Depth distribution, In-situ gamma spectroscopy, Peak-to-valley method*

Estimation of Phenolic Content, Flavonoid Content, and Antioxidant Activities of Selected Fruits in Sri Lanka

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Abstract

The aim of this study was to evaluate the Total Phenolic Content (TPC), Total Flavonoid Content (TFC), and *in vitro* antioxidant activity, of six underutilized fruits in Sri Lanka. The selected fruits are *Elaeocarpus angustifolius* L (Ceylon blue olive), *Elaeocarpus serratus* L (Veralu), *Manikara zapota* L (Sapadilla), *Ziziphus mauritiana* L (Masan), *Flacourtia indica* L (Ugurassa), and *Garcinia xanthochymus* L (Ratagoraka). The fruit extracts were prepared with 100% methanol, and crude extract (CE) of fruit was fractionated into hexane (HX), ethyl acetate (EA), and aqueous (AQ). TFC and TPC of each fraction were determined by aluminium chloride colourimetric and Folin-ciocalteu methods using 96 well microplates respectively. Antioxidant activities were determined using Ferric reducing power (FRAP), and Oxygen radical absorbance capacity (ORAC) assay methods. Among different fractions, the highest TPC and TFC were found in AQ of veralu (377.57 ± 65.65 mg GAE/ g of extract), CE of Masan (357.04 ± 9.63 mg GAE/ g of extract), EA of Ugurassa (173.47 ± 18.891 mg GAE/ g of extract), and EA of Ceylon blue olive (49.14 ± 1.60 mg QE / g of extract). The highest FRAP was found in AQ of Ugurassa (745.90 ± 23.06 mg TE/ g of extract), CE of Veralu (668.75 ± 7.7 mg TE/ g of extract), and EA of Ratagoraka (650.51 ± 6.88 mg TE/ g of extract). The highest ORAC was shown in AQ of Ratagoraka (113.72 ± 17.78 mg TE/ g of extract), CE of Veralu (31.38 ± 0.25 mg TE/ g of extract), and EA of Ratagoraka (143.24 ± 3.09 mg TE/ g of extract). In conclusion, Sapadilla, Ratagoraka, and Veralu possessed the highest antioxidant capacity compared to other fruit types. Thus, the CE fraction of Masan, the AQ fraction of Ugurassa, and the EA fractions of Ratagoraka will be good sources of antioxidants for the formulation of food supplements.

Keywords: *Antioxidant activity, Underutilised fruits, Food supplements*