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Oral Presentations



101/A

Detection of acute toxicity in water from Colombo and Anuradhapura Districts using zebrafish egg and its correlation to some water quality parameters

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Zebrafish (*Danio rerio*) are used to detect environmental toxicity. Developmental abnormalities can be observed through their transparent egg, and apical points (coagulated embryos, lack of somite formation, lack of heartbeat and non-detachment of the tail) are commonly observed. The objectives of the current study are to determine acute toxicity in dug well water from Anuradhapura and Colombo districts using zebrafish eggs and correlate the findings with minerals, some metals, and biological changes. Plates (24 wells) were maintained with internal control in three replicates. Positive and negative controls were also maintained. A single egg was placed in each well and observed for 24-96 hrs for apical points and sub-lethal toxicities. Water samples, 50 from Colombo and 67 from Anuradhapura, were randomly collected from each divisional secretariat. Zebrafish acute toxicity was detected using OECD guideline 236. The percentage of the cumulative apical point of the embryos, water turbidity, hardness, biological oxygen demand (BOD), dissolved oxygen (DO), pH, ammonia, nitrate, phosphate, Zn, and Cu in water from Anuradhapura were. $6.29 \pm 6.41\%$, 8.39 ± 11.57 NTU, 107.69 ± 14.20 mg/mL, 8.05 ± 2.87 mg/L, 4.36 ± 0.48 mg/L, 7.50 ± 0.28 , 0.00011 ± 0.00035 mg/L, 2.49 ± 1.86 mg/L, 0.8118 ± 0.797 mg/L, 0.011 ± 0.003 mg/L and 0.01 ± 0 mg/L, whilst in Colombo district they were $10.30 \pm 16.38\%$, 6.66 ± 8.14 NTU, 19.90 ± 6.04 mg/mL, 1.60 ± 1.29 , 4.65 ± 0.27 mg/L, 7.08 ± 0.13 , 0.00019 ± 0.00055 mg/L, 0.0195 ± 0.025 mg/L, 0.0019 ± 0.005 mg/L, 0.491 ± 1.32 mg/L, and 0.210 ± 0.537 mg/L, respectively. Significance was calculated by t-test. Significantly high water hardness, BOD, pH, DO, nitrate, and phosphate were observed in Anuradhapura ($p < 0.05$) whilst significantly higher Cu and Zn contents and 96 hrs cumulative apical point were observed in Colombo ($p < 0.05$). Nitrate levels were below the WHO-recommended values, but phosphate concentration was higher than the WHO-permissible levels in Anuradhapura and this may be due to the high usage of fertilizers. The high Cu and Zn content in the Colombo district may be the reason for acute toxicity in zebrafish eggs as this model is very sensitive to metals. The detected levels of Zn and Cu were below the WHO recommendation. Colombo water exhibits more acute toxicity in the zebrafish egg model than Anuradhapura. It may be a less sensitive model to anions such as nitrate, phosphate, and water hardness.

Keywords: NCP, Zebrafish, Minerals, water quality, Toxicities and Anuradhapura

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102/A

Health and environmental impacts of extensive unregulated agrochemical usage: An online public awareness survey

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Chronic exposure to agrochemicals is associated with cancer, respiratory, endocrine, reproductive, and neurological disorders. Unfortunately, due to lack of knowledge and weak legislation, agrochemicals are used extensively giving rise to serious economic, environmental, and health concerns. This cross-sectional survey was conducted from November to December 2021, using a self-administered online questionnaire to assess the knowledge and awareness of the public regarding the health and environmental impacts of agrochemical use and their perception of alternative methods. The questionnaire was shared using social media platforms, and responses were analysed descriptively using SPSS (version-20) statistical software; $p < 0.05$ was considered statistically significant. The study included 419 individuals (54.2% females and 44.9% males) with ages ranging from 18-75 years. Most individuals have completed their secondary education (42.5%), are employed full-time (54.9%), and are residents of the Western province (50.8%). Of the participants, 96.4% were aware of the harmful consequences of unregulated excessive agrochemical usage on the environment and human health. Awareness increased with the educational status of the participants ($p < 0.05$), but their knowledge of post-harvest agrochemical usage was inadequate. Toxicity to the environment (89.7%), consumers (84.5%), and farmers (77.3%), and destroying beneficial insects/animals (79.0%) were listed as key environmental concerns. The majority were aware of the impact on soil quality, microorganisms, pH, surface and groundwater, and aquatic life. Further, they attributed agrochemical misuse to inadequate knowledge among farmers (77.3%), expectation of high profit (74.9%) and inadequate legislation (62.1%). Most participants (93.8%) were aware of the health risks involved and possible routes of exposure. Chronic kidney diseases (85.7%), skin irritations (77.3%), and cancer (74.9%) were listed as key health concerns. Farmers not using personal protective equipment (87.4%) and cleaning equipment in open water sources (82.8%) were ranked as key risk factors. Recently, organic agriculture and integrated crop management practices have gained attention as alternatives to synthetic agrochemicals globally. Similarly, participants believe the use of organic fertilizers is advantageous for the environment (88.5%) and people (83.1%). However, most participants believe that a gradual transition to a mixed method with combination of organic farming and conventional farming is most suitable for Sri Lanka.

Keywords: Public perception, organic farming, agrochemical usage, health impact, online questionnaire

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103/A

A study to compare the dosage variation in five types of Ayurvedic pills used in Sri Lanka in four different commercial preparations

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Ayurveda practitioners prescribe different types of traditional pills, including *Vatī* (general pills) and *Guggulu* (pills containing resin from *Commiphora wightii* as the main ingredient). Hence, Sri Lankan Ayurveda pharmaceutical manufacturers manufacture various *Vatī* and *Guggulu* under different brands, but macroscopically, there are variations, even within the same batch of pills. Therefore, this research was carried out to compare the preparation dosage uniformity in selected Ayurveda pills available in the Sri Lankan pharmacy market. *Kaishora Guggulu*, *Chandraprabha Vatī*, *Yogaraja Guggulu*, *Gokshura Guggulu*, and *Sitharama Vatī* were used for the study. Fifty (50) randomly selected pills were weighed with an Analytical balance and their diameter measured with a Vernier calliper from each brand of selected Ayurvedic pills purchased. The mean weight was calculated and compared with the standard weight of each pill in the Ayurvedic Pharmacopoeia. The individual pill weight was compared with the average weight. The criteria "not more than two (02) individual tablet weights deviate from the average weight by more than the deviation stated in the Pharmacopoeia" was used for comparison. Additionally, the mean diameter of each brand was assessed. The statistical analysis was done using Microsoft Excel software. The weight of the pills from the selected brands showed a significant fluctuation compared to the standard weights. In addition, the study revealed that all selected pills exceeded the standard limit based on the acceptance criteria of deviated pill count in all brands except *Chandraprabha Vatī* in brand "C". In comparison with the other *Vatī* types, *Yogaraja Guggulu* and *Sitharama Vatī* showed marked differences in their diameters. Hence, this study provides evidence to have a national policy regarding the preparation of drugs in Ayurvedic medicine and thus will be an eye opener for policy makers.

Keywords: *Vatī*, *Guggulu*, Sri Lanka, commercial preparations

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104/A

Anti-inflammatory activity of Murungadi Lepaya: A traditional formulation used for joint diseases

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Curcuma zedoaria Roscoe, *Crateva adansoni* DC and *Moringa oleifera* Lam are used as external preparation in traditional medicine, including for inflammatory conditions of patients. This study aimed to evaluate the *in vitro* anti-inflammatory activity of *C. zedoaria*, *C. adansoni*, and *M. oleifera* individually and in the combined freeze-dried extracts of these plants. *Murungadi Lepaya*, a traditional formula, was prepared according to the Ayurvedic pharmacopeia of Sri Lanka. Aqueous extracts of fresh rhizome of *C. zedoaria*, fresh bark of *C. adansoni*, and fresh bark of *M. oleifera* were freeze-dried. Concentration series were prepared for *Murungadi Lepaya* and its ingredients respectively (5000 µg/ml to 39.0625 µg/ml by the double dilution method). *In vitro* anti-inflammatory activity of each sample was evaluated using the egg albumin denaturation assay. A combined freeze-dried sample was prepared using *C. zedoaria*, *C. adansoni*, and *M. oleifera* at a ratio of 1:1:4 which is the ratio used in *Murungadi Lepaya*. Anti-inflammatory activity was evaluated using a concentration series of the combined sample. All samples were triplicated. Absorbances were measured using 660 nm wavelength and the IC₅₀ value was calculated. Buffer solution was used as the blank solution and diclofenac sodium was used as the standard drug. Statistical analysis was performed using SPSS 25. *Murungadi Lepaya*, *C. zedoaria*, *C. adansoni*, *M. oleifera*, and the combined freeze-dried sample showed anti-inflammatory activity in the egg albumin denaturation assay with the IC₅₀ values; 359.4 µg/mL, 578.2 µg/mL, 256.0 µg/mL, 396.9 µg/mL, and 247.7 µg/mL, respectively. The IC₅₀ value of diclofenac sodium was 392.9 µg/mL. When considering the results of all samples it showed significant anti-inflammatory activity with egg albumin denaturation assay, ($p < 0.05$) based on ANOVA test results. The freeze-dried combined sample of rhizome of *C. zedoaria*, bark of *C. adansoni*, and bark of *M. oleifera* in combination exhibited a greater anti-inflammatory activity than the individual plant materials and the traditional formulation, *Murungadi Lepaya*. Hence, formulation of a topical dosage form such as an emulgel is recommended using the combined sample.

Keywords: Anti-inflammatory, *Crateva adansoni*, *Curcuma zedoaria*, egg albumin denaturation assay, *Moringa oleifera*

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***In vitro* anti-urolithic activity and phytochemical analysis of ethanolic extract of Varuna (*Crateva adansonii* DC.) stem bark**

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The recurrence rate of urolithiasis or urinary calculi is relatively high in modern society. Ayurveda authentic texts refer this disease condition as Mutra ashmari and mentioned many herbs with the anti-urolithic (mutra ashmaribhedana) activity for the treatment of urinary calculi. Among them the Varuna or Lunuwarana (*Crateva adansonii* DC) plant, which belongs to the family *Cappariaceae*, is considered as one of the best litholytic herbs. This study was designed to evaluate the *in vitro* anti-urolithic activity of an ethanolic extract of Varuna stem bark using a titrimetric method, to develop a standardization profile including organoleptic and physiochemical as well as biological parameters, and to screen phytochemical constituents. The ethanolic extract was prepared from 100 g of powdered Varuna stem bark using 99% absolute ethanol. Calcium oxalate crystals were prepared artificially by the homogenous precipitation method to assess anti-urolithic activity. *In vitro* dissolution models were prepared using semi-permeable egg membranes. Dissolution models containing calcium oxalate (5 mg) and different amounts of the ethanolic extract (15 mg, 25 mg, 35 mg) were suspended separately in conical flasks containing 100 mL of 0.1 M tris buffer solution. All of them were kept in the hot air oven for 7-8 hours pre-heated to 37°C for 2 hours. The dissolution percentage of calcium oxalate in each setup was evaluated by titrimetry with KMnO₄. The dissolution percentage increased when the concentration of the ethanolic extract increased. The highest dissolution percentage (71.34%) was shown by the sample with 35 mg of extract. Standardization parameters such as foreign matter content (2%), total ash (3.88%), acid-insoluble ash (1.32%), water-soluble ash (4.45%), alcohol-soluble extractive value (1.3%), water-soluble extractive value (10.5%), loss on drying (10.66%), swelling index (7 mL) and foaming index (<1000) were determined for the raw material. Alkaloids, tannins, flavonoids, steroids, glycosides, terpenoids, and proteins were positive while saponins and carbohydrates were negative in the extract. The thin layer chromatogram (MeOH : Chloroform 2:8, v/v) showed 2 R_f values (0.42, 0.73) for the extract. The results revealed that Varuna stem bark can be used as an effective ingredient in drug preparations to treat urinary calculi.

Keywords: Varuna stem bark, anti-urolithic, titrimetry, ethanolic extract, standardization

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Evaluation of acid-neutralising activity of *Asparagus racemosus* Wild. in tablet form

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The hyperacidity of gastric juice contributes to dyspepsia and gastro-oesophageal reflux disease, and plant medicines can be efficiently used as remedies to treat these types of illnesses. The present study aimed to formulate an oral antacid dosage form using the root of *Asparagus racemosus* Wild. which has demonstrated *in vitro* gastroprotective activities in previous studies. Aqueous crude extracts of *A. racemosus* roots were prepared by decoction. The extracts were freeze-dried and the powder was formulated into soluble oral tablets which were 1.0 g in weight. Lactose, maize starch, carboxymethylcellulose, magnesium stearate, talc and silicon dioxide were used as excipients. In the characterisation, physical appearance, weight variation, tablet hardness, disintegration time, and friability of the tablets were reported. The gastroprotective effects of these tablets were evaluated *in vitro* by assessing the acid-neutralising effect, neutralising capacity (by Fordtran's titration method), and duration of consistent neutralisation (by Vatie's artificial stomach model). A commercially available, sodium bicarbonate-based antacid formulation was used as the positive control, whereas distilled water was the negative control. The formulated light brownish antacid tablets were hygroscopic in nature. Weight variation of the tablets was within the reference range of the British Pharmacopoeia, 2016. Tablet thickness was 6.00 ± 0.00 mm and the diameter was 13.6 ± 0.0 mm. Hardness was 16.00 ± 0.005 N and friability was 1.02% (w/w). The disintegration time was 12 minutes 33 seconds. The tablets possessed significant ($p < 0.05$) antacid activity in the assays of acid-neutralising effect (3.12 ± 0.01 pH), neutralising capacity (0.65 ± 0.01 H⁺ mmol) and neutralisation duration (286.01 ± 2.43 s) compared to respective negative controls. The reference drug also demonstrated significant ($p < 0.05$) activity in respective assays (6.51 ± 0.01 pH, 1.18 ± 0.01 H⁺ mmol, and 462.38 ± 1.57 s) compared to the control. Hence, this study reveals that aqueous extracts of *A. racemosus* roots can be used effectively in the formulation of a soluble antacid tablet form with sufficient *in vitro* gastroprotective activity.

Keywords: Antacid, *Asparagus racemosus* Wild., Formulation, Gastroprotection

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201/B

Determination of functional and physiochemical properties of flower sap, toddy, and honey of three selected palm species in Sri Lanka

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In the present study, the total phenolic content (TPC), total flavonoid content (TFC), total antioxidant capacity (TAC), and physiochemical properties of coconut (*Cocos nucifera*), Kithul (*Caryota urens*), and palmyrah (*Borassus flabellifer*) flower sap, toddy, and honey were measured and compared. Flower sap and toddy of coconut were collected from Chilaw area; Kithul was collected from Matale area; and palmyrah was collected from Jaffna peninsula. Palm honey was made from relevant flower saps, which were collected from each palm species by heating with low flame. Immediately after collection of samples, centrifugation was performed to remove impurities before the analysis of functional and physiochemical properties of flower sap and toddy. TPC, TFC and TAC were determined using the Folin-Ciocalteu method, colorimetric method and ferric iron-reducing antioxidant power (FRAP) assay, respectively. The pH, colour parameters, total soluble solids (TSS) and viscosity of samples were measured using a pH meter, colorimeter, hand refractometer and viscometer, respectively. The moisture and ash were analysed using the methods reported by the Association of Official Analytical Chemists (AOAC). Statistical analysis was done using Analysis of Variance followed by the Turkey's Multiple Range Test using SAS software. Among the saps of the three selected palm flowers, the highest TPC (15.44 ± 0.13 mg GAE/L), TFC (41.13 ± 3.13 mg RE/L) and TAC (30.50 ± 1.12 mg TE/L) were recorded in *C. nucifera* flower sap. Among toddy samples collected from the three different palm species, the highest TPC (34.60 ± 0.34 mg GAE/L) and TAC (19.85 ± 0.91 mg TE/L) were recorded in *C. nucifera* toddy. In honey, the highest TPC (64.52 ± 4.68 mg GAE/100 g), TFC (41.13 ± 3.13 mg RE/100 g) and TAC (82.73 ± 10 mg TE/100 g) were also recorded in *C. nucifera* honey. The findings conclude that coconut, Kithul, and palmyrah honey, flower sap, and toddy all included significant amounts of bioactive compounds and antioxidant capacity.

Keywords: Flower sap, functional properties, honey, palm species, toddy

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Comparative analysis of yield, bioactive compounds, and antioxidant capacity of essential oil extracted from leaves of *Citrus reticulata* Blanco. of five different varieties

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Essential oil extracted from mandarin (*Citrus reticulata* Blanco.) is one of the key ingredients widely used in traditional systems of medicine, food, pharmaceutical and cosmetic industries. Currently, large-scale essential oil production is mainly based on fruits instead of leaves and essential oil production from fruits is restricted to a time frame due to seasonality. It is noteworthy that leaves are wasted during pruning that is practiced in mandarin cultivation. Therefore, this study aimed to quantify the essential oil yield that can be extracted from leaves of five different mandarin varieties (Indu, Heennaran, Madhu, Juicy and Rahangala) and to evaluate the functional properties of extracted essential oil. The essential oil was distilled using the hydro-distillation method. Quantification of total phenolic content (TPC), total flavonoid content (TFC) and total antioxidant capacity (TAC) was performed by using the modified Folin-Ciocalteu method, colorimetric method, and ferric reducing antioxidant power (FRAP) assay, respectively. The results revealed that all tested leaf essential oils of mandarin varieties contained significant amounts of essential oil content, as well as TPC, TFC and TAC. The highest TPC (69.80 ± 5.14 mg GAE/g DW), TFC (265.08 ± 7.95 mg RE/g DW), TAC (87.70 ± 4.02 mg TE/g DW) and essential oil content (1.89 ± 0.19 ml/100 g DW) were recorded in Indu variety. When compared with the maturity level of leaves, immature leaf essential oil extract contained higher TPC, TFC and TAC than mature leaf essential oil extract for all varieties except Heennaran variety. According to the results, essential oil accumulation within the oil glands of mature leaves was higher than that of immature leaves. Moreover, TAC was positively correlated with TPC ($R^2 = 0.8822$) and TFC ($R^2 = 0.4004$) of leaf essential oil extracts. The greater availability of bioactive compounds in the essential oil extracted from *C. reticulata* leaves highlighted that the essential oil of mandarin leaves can be used for product diversification in the pharmaceutical, food, and cosmetic industries.

Keywords: *Citrus reticulata* Blanco., essential oil, mandarin varieties, antioxidant

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Functional properties and proximate composition of immature fronds of different fern species as underutilized vegetables

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Wet zone of Sri Lanka is considered as a region with immense biodiversity and rich in plants, which are potential sources of natural antioxidants. Pteridophytes, commonly known as ferns have been used in traditional cuisines and indigenous medicine since ancient times. However, less attention has been given to exploring the biological and medicinal properties of edible fern species. Therefore, the present study attempted to evaluate total phenolic content (TPC), total flavonoid content (TFC), total antioxidant capacity (TAC), proximate composition, chlorophyll content and phytochemical screening of immature fronds of selected three edible fern species viz. *Acrostichum aureum* (*Karan koku*), *Blechnum orientale* (*Baru koku*), and *Diplazium esculentum* (*Miyana dalu*). Phytochemical extraction for the determination of TPC, TFC, and TAC was carried out using dry methanol. TPC, TFC and TAC were determined using, Folin-Ciocalteu method, colorimetric method, and ferric iron reducing antioxidant power (FRAP) assay, respectively. Proximate composition (moisture, crude ash and crude protein) was determined using methods of the Association of Official Analytical Chemists (AOAC). Parametric variables were analysed using analysis of variance (ANOVA) followed by the Tukey's Multiple Range Test using SAS version 9.5. According to the results, the highest TPC (13.04 ± 0.58 mg Gallic Acid Equivalents (GAE)/g Dry Weight (DW)), TFC (157.02 ± 3.66 mg Rutin Equivalents (RE)/g DW), and TAC (50.05 ± 2.97 mg Trolox Equivalents (TE)/g DW) were observed in *Baru koku* whereas, significantly the lowest TPC (1.98 ± 0.29 mg GAE/g DW), TFC (1.07 ± 0.38 mg RE/g DW), and TAC (1.93 ± 0.07 mg TE/g DW) were recorded in *Miyana dalu*. Significantly higher crude ash ($12.58 \pm 0.48\%$), crude protein ($52.23 \pm 0.44\%$), and total chlorophyll content (0.83 ± 0.01 mg/g Fresh Weight (FW)) were observed in *Miyana dalu*. Both *Karan koku* and *Baru koku* have all the tested phytochemicals (flavonoids, saponins, steroids glycosides and tannins). Finally, it could be concluded that immature fronds of selected edible fern species contain numerous natural phytochemicals, bioactive compounds, nutrients, and antioxidant activity. Hence, these fern species could be useful in value-added pharmaceutical productions and could be recommended to be incorporated into diet as potentially underutilized vegetable.

Keywords: Antioxidant capacity, edible ferns, phytochemicals, underutilized vegetables

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Development of a poly-herbal beverage incorporated with tranquilizing bioactive compounds using *Withania somnifera* (Ashwagandha), *Valeriana jatamansi* (Thuwarala), *Bacopa monnieri* (Lunuwila), and *Acorus calamus* (Wadakaha)

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The aim of this study was to develop a poly-herbal beverage with potential tranquilizing properties using Ashwagandha (*Withania somnifera*), Thuwarala (*Valeriana jatamansi*) Lunuwila (*Bacopa monnieri*), and Wadakaha (*Acorus calamus*) with acceptable sensory properties and to evaluate its proximate composition, physiochemical properties, and microbial acceptance. Soursop juice was utilized as the base to provide a nutritious and flavourful foundation for the herbal beverage. Eight formulations were established using the Taguchi method and they were subjected to sensory evaluation by 5-point hedonic scale to analyse the sensory attributes to select the best formulation for the product. The formulation of 750 ppm of Ashwagandha, 750 ppm of Lunuwila, 1000 ppm of Thuwarala and 250 ppm of Wadakaha was found to be significantly best at a 5% level of significance. To evaluate the impact of heat treatments on the product, three samples were prepared: control (without heat treatment), pasteurized, and retorted. The control sample represented the baseline, while the pasteurized and retorted samples underwent mild and high-temperature treatments, respectively. The proximate composition of pasteurized beverage samples including protein, fat, carbohydrate, fibre, ash, and Vitamin C was determined on the first day of the storage period. The variation of pH, titratable acidity, total soluble solids (TSS), and colour of the three beverage samples were checked on the 1st, 10th, 20th, 30th and 45th day of storage. Antioxidant activity (DPPH radical scavenging activity %) and total phenolic content of the three samples were determined on the first day of shelf life. There were significant differences between the three samples in DPPH radical scavenging activity % and total phenolic content with the increasing treatment temperature. All three samples were subjected to gas chromatography-mass spectrometry (GC-MS) analysis and the bioactive compound content of each sample was identified. There was a significant difference between the three samples in bioactive compound content with respect to the increment in treatment temperature.

Keywords: Antioxidant activity, GC-MS analysis, herbal beverage, proximate composition

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Development of sugar sprinkles with antioxidant properties by incorporating refused black tea extract as a natural food colorant

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This study was aimed to develop sprinkles coated with a natural colour derived from refused black tea (*Camellia sinensis*), providing health benefits and appealing sensory properties. In this study, eight sprinkle formulations were developed using Taguchi L8 Orthogonal array, and the ideal composition was selected by sensory analysis. The ethanolic extract of refused black tea was prepared and added as a coating in liquid form, where a 1% added sample was selected as the best tea-colour-coated sprinkle sample (TCCSS) *via* sensory analysis. The proximate composition analysis showed no significant difference in moisture, fat, protein, ash, crude fibre, and carbohydrate content between the TCCSS and sprinkles without tea colour coating (SWTCC). Physicochemical analysis revealed no significant difference in sucrose content and water activity between SWTCC and TCCSS. However, the texture, pH, lab values, hue angle, chroma, and whiteness index were significantly different in TCCSS compared to SWTCC. The pH value showed a significant decreasing trend after the addition of tea colour coating. The developed product contained minerals like sodium, magnesium, potassium, calcium, iron, and zinc. During the 4 weeks of shelf-life at 25 °C storage condition, no yeast and mold growth was observed, and the total colony count increased to 2.80×10^2 CFU/g. Accelerated shelf-life test was conducted at 25 °C/ 60% relative humidity to accelerate physicochemical changes, and fluctuation of peroxide value, acid value, texture, colour characteristics, and moisture content were observed weekly. Peroxide value, L*, and a* values of colour parameters differed significantly with storing time. No significant difference was observed in acid value, b* value, moisture content, or texture properties of the samples within 3 months of storing time. The total phenolic content (GAE) mg/g of the SWTCC, 0.63 ± 0.004 , was lower than TCCSS, 1.39 ± 0.27 . There was a significant difference in DPPH radical scavenging assay based on IC₅₀ value (mg/ml) between the SWTCC and TCCSS. Therefore, the TCCSS has more antioxidant properties than the SWTCC. Gas chromatography-mass spectrometry (GC-MS) analysis identified constituents responsible for antioxidant properties in TCCSS including methyl 1-dideuterio-2-propenyl ether; hydrazinecarboxylic acid, ethyl ester; hydroperoxide, 1-methylhexyl, and caffeine. It can be concluded that refused black tea could be successfully utilized to colour sprinkles.

Keywords: Antioxidant, GC-MS analysis, refused black tea, sugar sprinkles,

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Development of a button mushroom (*Agaricus bisporus*)-based savoury cream for fast food industry

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Development of a button mushroom-based savoury cream for the fast-food industry was carried out using white button mushroom (*Agaricus bisporus*) as the main ingredient and white pepper, garlic, red onions, corn flour, pasteurized cow milk, salt and palm oil as supplement materials along with soya lecithin and sodium metabisulphite as an emulsifying and preservation agents, respectively. Introducing a value addition based on button mushrooms with a minimum disturbance towards the nutritional profile and developing the product with commercial qualities were mainly intended by this project. Eight different combinations of raw material were tested, and the best formulation was selected by a thirty-member sensory panel using a 5-point hedonic scale followed by Taguchi experimental design. The data obtained from all tests was analysed by the Minitab-19 statistical software package and sensory data was analysed using the Friedman test and Mann-Whitney test. Formulation with the best sensory properties was subjected to determine physical, chemical, and functional properties while parallelly assessing the shelf-life using standard protocols of AOAC 2016. Results revealed that the best formulation contained $79.33 \pm 0.14\%$ moisture, $8.88 \pm 0.08\%$ total fat, $4.25 \pm 0.02\%$ total ash, $2.04 \pm 0.04\%$ crude protein, $2.57 \pm 0.31\%$ crude fibre, $27.00 \pm 0.28\%$ total carbohydrates, $23.03 \pm 0.00\%$ total solids, and $1.72 \pm 0.07\%$ salt. While the calorie value of the developed product was 533.9 kcal per serving, it could be stored for more than four months without affecting the sensory properties. According to the bio-active compound analysis, the IC_{50} value was 81.64 ± 0.83 mg/ml for antioxidant assay and 2.25 ± 0.03 mg GAE/g for total polyphenol content. The pH value of the product was 7.42 ± 0.05 . According to the colour measurement value of the button mushroom-based savoury cream, lightness (L^*) = 47.233 ± 0.493 , redness/greenness (a^*) = 6.333 ± 0.681 , blueness/yellowness (b^*) = 19.567 ± 0.666 , chroma (c^*) = 20.400 ± 0.361 , hue-angle (h°) = 72.100 ± 2.270 and the mineral profile was Na = 295.12 ± 2.27 , K = 56.88 ± 3.43 , Mg = 5.80 ± 0.14 , Ca = 3.55 ± 0.14 , Zn = 0.66 and Fe = 0.42 ± 0.1 in mg/kg units. Since this product can be introduced as a nutritious food innovation, other underutilized, country mushroom varieties can also be incorporated in developing more advanced value-additions to cater the demand.

Keywords: Fast food industry, mushrooms, value addition, savoury cream

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Analysis of nutritional composition, chemical and functional properties of *Salacia reticulata* (Kothala himbutu) aqueous extract incorporated drinking yoghurt

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Functional foods are developed all over the world incorporating a variety of components and diversified in terms of their positive impacts in preventing and treating illnesses. Dairy products can be employed as a unique carrier for delivering phytochemicals and other nutrients, which has proven successful in recent years. The aim of this study was to analyse the nutritional composition, chemical properties, functional properties and microbiological acceptance of *Salacia reticulata* extract incorporated drinking yoghurt. Drinking yoghurt samples were prepared using cow milk and 5% (w/w) of *S. reticulata* aqueous extract. Proximate composition of samples including moisture, protein, fat, total soluble solids, and ash was determined at the first days of storage. Titratable acidity, pH, yeast and mould count and coliform count of samples were determined for 30 days with every 5-day interval during the storage life. The radical scavenging activity of samples was determined using the DPPH method. According to proximate composition, the *S. reticulata* extract incorporated drinking yoghurt sample contains 0.5024 ± 0.00 % of ash, 81.38 ± 0.15 % of moisture, 13.77 ± 0.06 % of total soluble solids, 3.02 ± 0.03 % of crude protein, and 2.53 ± 0.06 % of fat. IC₅₀ values (mg/ml) obtained for *S. reticulata* extract, extract incorporated drinking yoghurt sample and control drinking yoghurt sample were 32.149 ± 0.097 , 89.399 ± 0.078 and 98.924 ± 0.026 , respectively. There was a significant difference in IC₅₀ values of extract incorporated drinking yoghurt sample and control drinking yoghurt sample (p value = 0.000 < 0.05). Total phenol content (TPC, mg GAE/g) of *S. reticulata* extract, extract incorporated drinking yoghurt sample, and control drinking yoghurt sample were 70.350 ± 0.257 , 2.248 ± 0.006 and 1.790 ± 0.015 , respectively. There was a significant difference in TPC of extract incorporated drinking yoghurt sample and control drinking yoghurt sample (p value = 0.000 < 0.05). According to the results, the incorporation of *S. reticulata* aqueous extract has a positive impact on increasing the functional properties of drinking yoghurt.

Key words: Aqueous extract, drinking yoghurt, *Salacia reticulata*, functional properties

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Development of a keto-diet support avocado muffin by incorporating avocado flour, pulp, and rice flour

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Raw avocado (*Persea americana*) flesh is a rich source of fat as well as other nutrients and is compatible with a keto diet. The purpose of this study is to develop a muffin that supports the keto diet by substituting rice flour, avocado pulp, and avocado flour in place of wheat flour, and to ascertain the physicochemical and sensory characteristics of the final product. As treatments, muffins were made with the following ratios of rice flour, avocado flour, and avocado pulp: T1-84:8:8, T2-75:8:17, T3-66:8:26, and T4-57:8:35. Because of its bitterness, avocado flour content was kept constant. The muffins were assessed for their sensory characteristics using 5-point hedonic scale. Total phenolic content (TPC), total flavonoid content (TFC), and total antioxidant capacity (TAC) of avocado flour, avocado pulp, and muffin were determined by the Folin-Ciocalteu method, colorimetric method, and DPPH assay, respectively. Based on sensory evaluation, T2 muffin formulation was selected as the best keto-diet support muffin. The selected muffin (T2) had significantly higher TPC (0.51 ± 0.01 mg GAE/g DW), moisture ($27.64 \pm 0.39\%$), crude protein ($8.99 \pm 0.27\%$), crude fat ($21.60 \pm 0.27\%$), and ash ($1.42 \pm 0.05\%$) than 100% wheat flour muffin or rice flour muffins used as controls. With the addition of avocado pulp and flour to the muffin recipe, the taste, texture, smell, sweetness, colour, and general acceptability were improved. It was concluded that formulated keto-diet support avocado muffin (T2) significantly ($p < 0.05$) increased total phenolic, moisture, protein, ash, and fat contents.

Keywords: Avocado flour, avocado pulp, keto-diet, rice flour

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A comparison of water absorption capacity during hot soaking and proximate composition of At-405 rice variety at different milling stages

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The objective of this study was to compare the water absorption capacity (during hot soaking) and proximate composition of the At-405 rice variety, which is a long slender rice variety in Sri Lanka at different milling stages including rough rice, brown rice, and polished rice. The purpose of this study was to identify the potential utilization of the parboiling process as a rice fortification method. The water absorption capacity at each milling stage was investigated at every 30 min period until 5 h by immersing the grain samples in hot water, at 70 °C for 5 h. Respective samples were drawn at 30 min intervals and weight gain due to water absorption was determined following a gravimetric method. There was a time-dependent increase in percentage water uptake at all three milling stages. Polished rice recorded significantly higher water absorption capacity compared to other milling stages ranging from 24.51 ± 0.90 to 111.41 ± 11.38 . The percentage water uptake of brown rice and rough rice ranged from 22.73 ± 0.23 to 49.41 ± 1.14 and from 15.07 ± 0.21 to 39.51 ± 0.87 , respectively. These results suggest that the removal of husk and bran layers facilitates moisture absorption. Proximate analysis revealed that the percentage contents of ash, crude fat, crude protein, crude fibre and total carbohydrate of brown rice of At-405 were 1.30 ± 0.03 , 2.52 ± 0.21 , 7.49 ± 0.34 , 0.64 ± 0.29 and 88.69 ± 0.55 , respectively in dry basis. The respective contents of polished rice were recorded as 0.42 ± 0.05 , 0.50 ± 0.06 , 6.60 ± 0.60 , 0.27 ± 0.15 , and 93.01 ± 0.58 . Significant difference in water absorption capacities were analysed using one-way ANOVA, Tukey's comparisons and proximate results were analysed by descriptive statistics using Minitab 17 statistical software. Based on the results, it can be concluded that the water absorption during hot soaking and the proximate compositions of the same variety can be influenced by the milling stage of rice grain. Hence, further studies can be recommended on the utilization of hot soaking steps as a fortification method to improve the nutritional quality of rice.

Keywords: Brown rice, hot soaking, polished rice, rough rice, water absorption

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The impact of grinding methods and pre-grinding parameters on the quality of *Cinnamomum zeylanicum* Blume (cinnamon) powder

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Cinnamon (*Cinnamomum zeylanicum* Blume) powder is widely used in the food and beverage industry for its warm and sweet flavour, making it a popular ingredient in various products. The grinding process employed in cinnamon powder production significantly impacts its overall quality. Standardized measures must be implemented to ensure consistency and good quality of the powder. This study compared two common grinding methods, the hammer mill and pin mill, to determine their effectiveness in producing high-quality cinnamon powder. The study examined the influence of pre-grinding moisture content and pre-grinding temperature of cinnamon featherings on particle size, oil content, and moisture content of cinnamon powder. Experimental investigations were conducted using cinnamon samples with different moisture contents (12%, 14%, and 16%) and pre-heating temperatures (35 °C, 40 °C, and 45 °C) prior to grinding. Results revealed that the pin mill grinder produced the highest-quality cinnamon powder at 14% pre-grinding moisture content and at 40 °C pre-grinding temperature, while the hammer mill grinder was optimal at 12% pre-grinding moisture content and at 45 °C pre-grinding temperature. Higher moisture content (16%) negatively affected powder quality. Pre-grind moisture conditions of 14% and 12% were suitable for quality cinnamon featherings. Gas chromatography-mass spectrometry (GC-MS) analysis showed distinct profiles, with the hammer mill sample having higher cinnamaldehyde content (89.9%) than the pin mill sample (80.93%). Additionally, scanning electron microscopy (SEM) analysis confirmed that pin mill grinding produced smaller strip-shaped particles (283 µm), while hammer mill grinding yielded smaller particles without strips (391 µm). The findings highlight the significance of selecting appropriate grinding techniques and pre-grind conditions to obtain high-quality cinnamon powder with the desired level of physicochemical parameters (volatile oil content of >0.5%, moisture content of <12.0%, acid insoluble ash content <1.0% and total ash content <8.0%) defined by the Sri Lanka Standards (SLS). By adhering to the recommended conditions, producers can ensure their cinnamon powder meets SLS quality standards, enhancing its desirability in the food and beverage industry.

Keywords: Cinnamon powder, hammer mill, pin mill, powder quality, pre-grinding parameters

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Assessing the effectiveness of eco-friendly extracts to control *Aleurodicus dispersee* (spiralling whitefly) in *Cocos nucifera* (coconut)

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Spiralling whitefly (*Aleurodicus dispersee*), which caused a recent outbreak of coconut cultivation in Sri Lanka, is an important destructive sap-sucking insect pest of coconut (*Cocos nucifera*) that severely decreases coconut production and causes palm damage. Utilization of eco-friendly strategies can be a successful substitution for chemical pesticides as unregulated consumption of chemical pesticides has led to negative impacts on the environment, human health, and non-target organisms. The present investigation was carried out at a coconut field in Palacholai, Sri Lanka to evaluate and compare the efficacy of different eco-friendly strategic applications over the neem oil with soapy water, which was recommended for whitefly infestation on coconut palm leaves. The experiment was laid out in a completely randomized design with seven treatments and three replications. The treatments were *Piper longum* fruit extract, *Acorus calamus* rhizome extract, *Justicia adhatoda* leaf extract, vermiwash, *Eucalyptus* leaf extract, neem oil + soap mixture, and untreated control. The foliar application was made at a 5:1 ratio with water. The number of leaves affected by whitefly attack from each palm was recorded and the percent reduction in infested leaves of coconut was calculated over the untreated control. The data were subjected to analysis of variance (ANOVA) using Minitab 19 statistical software. As per the results, *P. longum* fruit extract showed the highest percent reduction of infested leaves over untreated control at 1st, 2nd, and 3rd week after application (WAA). In addition to that, neem oil + soap mixture and vermiwash also significantly ($P < 0.05$) influenced the decline in the number of leaves damaged by whiteflies. However, there was no significant ($P > 0.05$) difference observed among *A. calamus* and *J. adhatoda* extracts. On the third week, after the last spraying of *P. longum* extract and neem oil + soap mixture, percent reductions in infected coconut leaves were noteworthy when compared to control which entailed 95.8% and 95.0% decrease over control, respectively followed by vermiwash (85.8%), *Eucalyptus* extract (56.3%), *J. adhatoda* extract (40.4%) and *A. calamus* extract (37.5%). Hence, this study suggests that foliar spraying of *P. longum* extract would be a more suitable ecologically feasible option to reduce the whitefly infestation in coconut palm leaves.

Keywords: Coconut, neem oil, *Piper longum*, soap mixture, spiralling whitefly

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Evaluating the potency of formulated pesticides from *Acorus calamus* Linnaeus, 1753 (sweet flag) to fend off cowpea grain deterioration by *Callosobruchus maculatus* Fabricius, 1775

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Cowpea (*Vigna unguiculata*) is one of the most prominent leguminous grains utilized in Sri Lanka, where *Callosobruchus maculatus* causes detrimental consequences during storage. The present study is concentrated on formulating *Acorus calamus* plant rhizome-based insecticides considering their tremendous secondary metabolites and defence mechanisms against *C. maculatus* attack to safeguard cowpea seeds. Consequently, the *A. calamus* rhizome component was utilized to formulate a liquid and a powdery pesticide. Cowpea seeds exposed to different pesticide formulations (80% of *A. calamus* liquid formulation, 90% of *A. calamus* liquid formulation, 100% of *A. calamus* liquid formulation and 100% of *A. calamus* powdery formulation) combined with untreated cowpea seeds were laid out in a completely randomized design (CRD) consisting of five treatments and four replications. The pesticide-treated and untreated cowpea seeds were stored in a laboratory (30 ± 2 °C and 70 ± 5 %) and under constant observation for 45 days. Data were analysed using the SAS 9.1 version and DMRT was utilized to separate means. This experimental setup was designed to investigate adult mortality when there was a "no choice" condition for choosing a cowpea seed protectant. The findings revealed that two days after the treatment, cowpea seeds treated with 100% *A. calamus* powdery pesticide had 97.5% mortality and no progeny development until 45 days. The cowpea seeds treated with 100% *A. calamus* powdery formulation, which confirmed its superiority, were selected after 45 days to perform a consumer preference test simultaneously with untreated cowpea grains. The data were analysed with SPSS software (version 26) and obtained the liking ratings "7=like very much" based on a 7-point hedonic scale as 26.7%, 23.3%, 43.3%, and 46.7% for the smell, colour, taste, and texture, respectively of cowpea seeds treated with 100% *A. calamus* powdery formulation. Ultimately, 100% of *A. calamus* powdery herbal pesticide-treated cowpea grains had an overall acceptance rating of 36.7%, which was greater than the untreated grains. The study proved that 100% *A. calamus* powdery pesticide was effective in protecting the cowpea grains from the *C. maculatus* infestation without affecting consumer preference.

Keywords: *Acorus calamus*, *Callosobruchus maculatus*, mortality, pesticide,

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Use of cassava flour as a possible replacement of wheat flour in selected commercial and conventional products

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Cassava (*Manihot esculenta*) is one of the major staple foods in the world. It is a versatile crop with great potential as a substitute for wheat flour in various food products. This study is aimed to evaluate the viability of using cassava flour, extracted from the MU51 cassava cultivar, in cookies, biscuits, roti, and parotta according to the completely randomized design (CRD) experimental model. The experimental results showed that the optimal sieve size for obtaining high flour yield while removing coarse particles was 300 μm , yielding approximately 31.16% flour. According to sensory evaluation results, cookies and biscuits prepared with 100% cassava flour, roti with 75% cassava flour and 25% wheat flour, and parotta with 25% cassava flour and 75% wheat flour were selected. Statistical analysis was conducted using MINITAB 17 statistical software. Instrumental texture analysis indicated that cookies and biscuits made with 100% wheat flour and 100% cassava flour exhibit similar hardness and fracturability characteristics. Colour attributes remained consistent among different flour compositions, indicating that cookies and biscuits made with 100% cassava flour can replace wheat flour. In addition, compared to wheat flour, cassava flour showed a reduced rate of starch hydrolysis. The cyanide content in cassava flour was within the safe limit of $2.43 \pm 0.17 \text{ mg kg}^{-1}$. The proximate analysis demonstrated that incorporating cassava flour improved the nutritional composition of cookies, biscuits, and roti, with higher crude fibre and total ash. The cassava flour-incorporated samples displayed comparable mineral levels of Zn and Fe, to the control wheat flour samples but higher levels of Mg and Ca. However, control samples had higher levels of Cu and Mn. Crude protein levels were higher in control wheat flour samples. Although cassava flour-incorporated samples showed lower antioxidant activity than the control samples, they still demonstrated acceptable activity. Therefore, as a result, this study demonstrates how cassava flour can be a healthy alternative to wheat flour in cookies, biscuits, and roti while still providing acceptable nutritional benefits.

Keywords: Biscuits, cassava flour, cookies, roti, wheat flour

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Evaluation of the residential gardens as suitable habitats for wildlife conservation: A case study in butterfly fauna associated with residential gardens in Gampaha divisional secretariat

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The advent of urbanization is one of the major contributing factors to environmental degradation, leading to habitat alteration and fragmentation. A notable decline in species richness of common pollinators has been reported in urban landscapes, mainly due to the restricted availability of floral resources. Due to their immense contribution to the existence of natural biota, the conservation value of residential landscapes is becoming increasingly apparent. Nevertheless, this value is influenced by the attitudes of the urban residents on wildlife conservation. Therefore, this study was conducted to assess the attitudes and perceptions of urban residents in the Gampaha Divisional Secretariat (DS) on wildlife, while examining the diversity of the butterfly population. A total of 50 urban households located within a 2 km radius of the city centre of the Gampaha DS was selected randomly. The socio-economic information and attitudes of the household heads on wildlife were gathered using a pretested interviewer-administered questionnaire. In addition, butterfly surveillance studies were conducted using the same household cluster referring to the Pollard Walking method. The majority of respondents (95%) were pleased to observe small fauna in their gardens, even with limited understanding (83%) of the concept of wildlife gardening. Further, a higher fraction of respondents (74%) strongly agreed with the fact that observing wildlife helps in connecting with nature and supports relaxation of the mind. According to the observations of the respondents, among the small wildlife categories which can be seen in residential gardens, butterflies are the 3rd frequently visited category after birds and squirrels. However, 40% of the respondents, were perceiving butterfly visitation frequency and species richness have declined over the years. Based on the butterfly surveillance data, butterflies belonging to Nymphalidae (35%), Pieridae (27%), Hesperidae (8%), Lycaenidae (15%) and Papilionidae (15%) families were identified. As a whole, the studied sites accounted for a species richness of 26, where Psyche (*Leptosa nina*) denoted the highest frequency of occurrence followed by Common Grass Yellow (*Eurema hacabe*) and Small Banded Swift (*Pelopidas mathias*). According to the results of the Chi-square test of association, the butterfly species richness was significantly associated with the overall maintenance of the garden ($p < 0.05$). The less maintained gardens recorded the highest richness. The present study denoted that urban residents already value the wildlife diversity in their residential gardens and the diversity therein is related to garden management aspects. Therefore, understanding the variability of the charismatic urban wildlife groups along with human-related factors that influence the presence of wildlife would be beneficial in developing urban biodiversity conservation plans.

Keywords: Landscaping, residential gardens, Sri Lanka, urban, wildlife gardening

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Evaluation of supercritical fluid extraction method against the conventional Soxhlet extraction method using *Pouteria campechiana* (Kaha Lawulu) fruits

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Pouteria campechiana is an underutilized fruit commodity that can be utilized in many industries where chemical extraction is a preliminary processing stage. Modern non-conventional green extraction technologies are considered more efficient and sustainable compared to conventional solvent extraction methods. In this study, *P. campechiana* fruit extract obtained from the non-conventional supercritical fluid extraction (SFE) method conducted at 42 °C and 30 MPa was evaluated against the extract obtained in the conventional Soxhlet extraction method (80% methanol solvent). Test parameters used for the evaluation were the yield percentage, antioxidant activity, total polyphenolic content, and the extracted phytochemicals identified by the gas chromatography-mass spectrometry (GC-MS) analysis. In terms of the antioxidant activity and total polyphenolic content, the supercritical fluid extraction method was superior where the results were $IC_{50} = 4677.30$ ppm and 32630.00 GAE/g DW, respectively. In the Soxhlet method, $IC_{50} = 6448.49$ ppm and 9612.50 GAE/g DW. Contradictorily, the highest crude extract yield percentage (34.44%) was obtained in the Soxhlet extraction method while a yield percentage of 0.39% was given by the SFE method. Also, the highest number of phytochemicals (61) was obtained in the Soxhlet extraction method. There was a noticeable difference between the extracted phytochemicals in the two extraction methods. Non-polar liquid CO₂ solvent in the SFE method extracted more non-polar phytochemicals while the Soxhlet method that utilized polar 80% methanol solvent extracted more polar phytochemicals. During the study, evidently, the best collective quantitative results were given by the SFE method. Depending on the chemical composition of the plant variety, plant part, operating conditions of the supercritical fluid extraction method, and the solvent used in the Soxhlet extraction method these findings could differ. Given the abundance of polar phytochemicals in *P. campechiana*, the SFE method can be improved by using polar organic modifiers. To determine the most suitable extraction method, both the qualitative and quantitative properties with regard to industrial scalability, human health, and environmental impact should be considered. Given the considerations, it can be concluded that the SFE method is optimal for *P. campechiana* out of the two analysed methods.

Keywords: *Pouteria campechiana* (Kaha Lawulu), Soxhlet extraction, supercritical fluid extraction

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Effectiveness of a biodegradable antimicrobial packaging film developed from food industrial wastes in preserving minimally processed *Psidium guajava* (guava) fruits

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The study was aimed to develop a biodegradable, antimicrobial packaging material as an alternative to commercial cling film (CF) to preserve minimally processed guava fruits (MPGF) while contributing to minimize dumping plastic waste and wastes generated from food-processing industries. The packaging material was developed by solution casting a mixture of chitosan (CH), cellulose (CL), guar gum (GG) and glycerol. CH and CL were extracted from black tiger prawn (*Penaeus monodon*) shells and sugar cane (*Saccharum officinarum*) bagasse, respectively. CH and CL exhibited a yield of $38.2 \pm 0.40\%$ and $41.4 \pm 0.56\%$, respectively. The films were developed by the two-factor factorial design; the two factors are varying mass % (0, 2, 4 and 6%) of CL (particle size $< 250 \mu\text{m}$), and varying ratios of CH: GG mixture (80:20, 70:30 and 60:40 v/v). The percentage biodegradability over a period of 2 weeks was 58 - 62% for CH-CL films and 5% for CF. Antibacterial properties of CH-CL films against Gram-negative *Escherichia coli* and Gram-positive *Staphylococcus aureus* were studied by disc agar method, and no growth of microbes was observed below the films. By considering a few important physical and mechanical parameters of films, the following formulations were selected as the best by the weighted average method: CH:GG:CL; 70:30:2% (film A), 60:40:2% (film B) and 60:40:4% (film C). Then the ability of these selected films to preserve the qualities of MPGF was studied under refrigerated conditions ($4 \pm 2 \text{ }^\circ\text{C}$) over a period of 6 days. Each test was carried out in triplicates. Among the three films, film A showed better ability to preserve MPGF as it recorded the highest value for titratable acidity ($0.48 \pm 0.02\%$ citric acid) and total phenol content ($3.68 \pm 0.238 \text{ mg GAE/g}$), lowest absorbance value of 0.02 ± 0.01 for browning index of fruits and a 4.31% decrease in hardness of fruits over the storage period which is fairly low compared to the 17.43% decrease in hardness recorded by the unwrapped sample. All films showed a good ability to minimize the physiological loss in weight of fruits ranging from 41 - 45%. In addition, the validity of these findings can be confirmed by carrying out a sensory evaluation. Thus, it can be concluded that with further modifications these films can be regarded as a good alternative to the non-biodegradable petroleum-based CF.

Keywords: Antimicrobial, biodegradable, bio-polymer packaging film, chitosan-cellulose composites, minimally processed guava fruits

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Effect of *in vitro* digestion on antioxidant activity of selected breakfast food

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Breakfast plays a major role in human nutrition and is considered the most important meal of the day. It is a nutrient-rich eating occasion relative to its contribution to daily energy and a strong contributor to vitamin and mineral intake. Bioactive compounds are substances that can enhance health by regulating metabolic processes. Currently, people are concerned about the consumption of food rich with bioactive compounds like antioxidants as they can improve their health, specially by preventing chronic diseases. This study was conducted to analyse the effect of *in vitro* enzyme digestion (oral, gastric and intestinal digestion with dialysis) on the antioxidant activity of selected breakfast foods such as rice, noodles, and string hoppers (with curries mixed) which are generally consumed by university students. The bioaccessibility of the antioxidants was also evaluated. Portions of homogenized mixtures of each breakfast meal were subjected to *in vitro* enzyme digestion. Antioxidant activity was measured using ABTS assay and DPPH assay, in each phase of *in vitro* enzyme digestion. For a selected breakfast food item, the antioxidant activity depends on the curries mixed. Both the ABTS radical scavenging activity ($IC_{50} = 84.04$ mg/ml) and DPPH radical scavenging activity ($IC_{50} = 20.21$ mg/ml) were high in the noodles breakfast meal compared to the other two samples. The obtained results from analysis (one-way ANOVA; MINITAB 18) indicated that the antioxidant activity of selected breakfast meals decreased when the samples were subjected to *in vitro* enzyme digestion and that there is a significant difference ($p \leq 0.05$) of antioxidant activity in raw, oral, gastric, intestinal and dialyzed fractions. During digestion, the antioxidant activity of all the products has decreased resulting in low bio-accessibility. Inside the gastrointestinal tract, food components undergo various changes that can affect the bio-accessibility of these components. Therefore, the presence of bioactive compound in a food does not necessarily reflect the amount that can be absorbed and metabolized by the human body.

Keywords: Antioxidant activity, bio-accessibility, breakfast, *in vitro* enzyme digestion

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Antifungal efficacy of *Gracilaria*, *Sargassum*, and *Ulva* extracts against selected fungal pathogens of *Solanum melongena* under *in vitro* conditions

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The Food and Agricultural Organization estimated that 40% of global crop production is lost annually due to pest damage and disease. Synthetic pesticides used to control plant diseases pose many health and environmental issues necessitating the development of environmental-friendly disease management alternatives. Marine macroalgae contain a broad spectrum of bioactive compounds with potential antimicrobial properties. Thus, the objective of this study was to evaluate the antifungal activity of *Ulva* sp., *Gracilaria* sp. and *Sargassum* sp. growing on the Thalpe reef, Galle in the Southern province of Sri Lanka. Sequential extraction of algae was carried out using 10 g of dried algal powder and 100 ml each of ethyl acetate and methanol by the Soxhlet apparatus. Resultant algal extracts were tested against *Diaporthe eugeniae*, *Pseudopezalotiopsis theae* and *Lasiodiplodia theobromae*, the causative agents of leaf necrosis, leaf chlorosis and leaf blight, respectively, on *Solanum melongena* plants. The poisoned food technique was used to determine the antifungal potential of the three algal species at four concentrations: 250 ppm, 500 ppm, 1000 ppm and 2000 ppm. Captan and dimethyl sulfoxide (DMSO) were used as positive and negative controls, respectively. Five replicates were conducted for each experiment and the percentage inhibition was calculated using the fungal colony diameter. The data were statistically analysed using a generalized linear model followed by Tukey's pairwise comparison ($p < 0.05$) in Minitab 22 software. Inhibitory percentages of algal extracts were significantly different from each other. The highest inhibition of *D. eugeniae* and *P. theae* was demonstrated by *Ulva*-ethyl acetate (2000 ppm) extract at 79.29% and 56.68%, respectively while the IC_{50} of *Ulva*-ethyl acetate extracts against the same fungi ranged from 177.99 - 6507.29 ppm and 863.24 - 5907.87 ppm, respectively. The highest percentage inhibition (43.09%) of *L. theobromae* was shown by *Ulva*-methanol extract (2000 ppm). *Ulva*-methanol extract demonstrated the lowest IC_{50} value at 3758.35 ppm concentration and the highest IC_{50} value was exhibited by *Sargassum*-methanol extract at 17866.26 ppm. Based on the results, it was concluded that the tested marine macroalgal extracts possess antifungal potential, which could be considered for future applications in agriculture and identifying novel fungicides from marine resources.

Keywords: Antifungal activity, IC_{50} inhibition, marine macroalgae, poisoned food technique, sequential extraction

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A comparative study on physicochemical properties, antioxidant activities and quality parameters of commercially available vinegar in the local market

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Vinegar is a natural condiment made from various starchy and sugary materials by alcohol fermentation followed by acetic fermentation. Vinegar can be produced using different raw materials and coconut vinegar is the major type produced in Sri Lanka. Several factors influence the quality of vinegar such as origin of coconut, environmental conditions, production methods, processing and storage conditions. Even though the trend of consuming vinegar in Sri Lanka is rising, the attention given to the quality of vinegar products in the market is considerably low. Also, there was no systematic comparative study on the quality of commercially available vinegar has been conducted in Sri Lanka so far with any characterization or comparison of them with vinegar standards. Therefore, the aim of this research was to analyse the physicochemical composition and antioxidant content of eleven commercial coconut vinegars from the open market. In this study, the major parameters were analysed using recommended protocols and identified the conformity with Sri Lanka Standards 168:1999 specifications. Commercial coconut vinegar produced on large and small scales exhibited great variability in quality parameters and also in antioxidant activities. Physicochemical properties of the samples showed a significant difference and ranged between minimum and maximum as follows: pH; (2.12 ± 0.02 - 2.58 ± 0.01), total acidity; (3.06 ± 0.02 g/100 mL - 5.55 ± 0.06 g/100 mL), residual alcohol; (0.33 ± 0.06 (V/V) % - 1.37 ± 0.05 (V/V) %), total solids; (0.1690 ± 0.02 - 11.0389 ± 0.07), total soluble solids; (1.00 ± 0.00 - 13.00 ± 0.00), permanganate oxidation value; (280.67 ± 4.16 - 3198.67 ± 2.31), alkaline oxidation value; (42.53 ± 0.61 - 323.33 ± 0.61) and iodine value; (112.00 ± 2.00 - 933.33 ± 2.31). The phenolic contents of samples ranged between 88.13 ± 7.78 mg GAE/L - 343.48 ± 10.53 mg GAE/L and the flavonoid content of samples were between 6.661 ± 0.95 mg QE/100 mL - 25.044 ± 0.95 mg QE/100 ml. The best ability to scavenge the DPPH radical was observed as an IC_{50} value of 20.63 ± 0.11 mg/ml. Correlation of the antioxidant activity with principal components showed that each individual compound moderately associated to all the antioxidant properties, suggesting that the expression of antioxidant activity in commercial coconut vinegar was mainly influenced by their total phenol content, followed by flavonoids present in the coconut vinegar.

Keywords: Alkaline oxidation value, antioxidant activity, coconut vinegar, permanganate oxidation value, physicochemical analysis

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Exploring the starch composition of underutilized flour varieties in Sri Lanka compared to refined wheat flour

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Differences in starch fractions including resistant starch, digestible starch, total starch, amylose percentage, and amylopectin percentage, contribute to variations in the physicochemical properties and functional behaviour of different flours. By comparing the starch fractions of underutilized flours with refined wheat flour, their potential applications in the food industry can be identified. This study aims to explore the nutritional and functional properties of underutilized flours in Sri Lanka through a thorough analysis of their starch fractions. Underutilized flours, namely Olu (*Nymphaea lotus*) seed, Madu (*Cycas circinalis*) seed, Palmyrah tuber (*Borassus flabellifer*), Kithul (*Caryota urens*), defatted coconut (*Cocos nucifera*), and Jackfruit seed (*Artocarpus heterophyllus*) flours, were selected for the analysis. Refined wheat flour was chosen as the control. Resistant starch, digestible starch, total starch, amylose, and amylopectin contents were analysed using Megazyme assay kits (Megazyme K-RSTAR 05/19 and K-AMYL 06/18) following the manufacturer's protocols. All analyses were performed in triplicate. Differences between means were compared by Tukey's test. Kithul ($61.54 \pm 0.40\%$), Madu ($52.28 \pm 0.24\%$), Jackfruit seed ($33.62 \pm 0.00\%$), Palmyra ($20.08 \pm 0.40\%$) and Olu ($6.16 \pm 0.08\%$) flours had significantly higher ($p \leq 0.05$) resistant starch contents in comparison to refined wheat flour ($4.22 \pm 0.28\%$). Defatted coconut flour ($2.22 \pm 0.13\%$) had a significantly lower ($p \leq 0.05$) resistant starch content than refined wheat flour. Kithul, Madu, Jackfruit seed, Palmyra and Olu flours offer promising potential for the development of functional food options which contribute to reducing postprandial glycemia and insulinemia. Among the underutilized flour types, only Kithul flour ($30.36 \pm 0.88\%$) had significantly higher ($p \leq 0.05$) amylose content when compared to refined wheat flour ($20.00 \pm 0.40\%$). The amylose content of Jackfruit seed flour ($19.09 \pm 0.09\%$) was not significantly different ($p \leq 0.05$) from refined wheat flour. Amylose contents of Palmyra ($16.49 \pm 0.38\%$), Olu ($6.86 \pm 0.39\%$), defatted coconut ($5.00 \pm 0.10\%$), and Madu flour ($4.91 \pm 0.09\%$) were significantly lower ($p \leq 0.05$) than refined wheat flour. Consequently, Kithul flour stands out as a favourable choice for enhancing the quality of food products due to its elevated amylose content.

Keywords: Amylose, flour, properties, starch, underutilized

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Optimization of surface sterilization and *in vitro* shoot proliferation protocols of shoot tip explants of *Aloe vera* (L.) Burm. f.

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The vegetative propagation of *Aloe vera* (L.) Burm. f. in nature *via* axillary shoots is too slow and insufficient to meet the industrial demand. Propagation *via* sexual means is also not feasible due to male sterility. Therefore, it is necessary to apply *in vitro* clonal propagation techniques for rapid and uniform production of this highly nutritive medicinal plant within a short time period. Two experiments were carried out to optimize surface sterilization by using different types of fungicides, Clorox and ethanol, to minimize contaminations, browning, and to promote *in vitro* shoot proliferation of shoot tip explants in the presence of 6-benzyl amino purine (BAP), Kinetin (KI), and 1-naphthalene acetic acid (NAA). As the experimental designs, completely randomized design (CRD) and two-factor factorial randomized complete block design (RCBD) were used. The number of survived cultures (noncontaminated and green colour) was recorded weekly during the first experiment and the number of shoots per explant, average shoot lengths per shoot and average number of leaves per shoot were recorded weekly during the second experiment. All the experiments were consisted of 20 replicates and data were analysed using Minitab software. Shoot-tip explants were collected from healthy mother plants maintained in a protected house under the periodical application of fungicides, water, and fertilizer. Culture vessels containing shoot tip explants were incubated at 25±2 °C temperature, under fluorescent light providing 5000-6000 Lux of light intensity and 08:16 hours of photoperiod. Further, the relative humidity was maintained at 65-70% inside the culture room. Results revealed that the shoot tip explant surface sterilized with 100% Clorox for 10 minutes exhibited the highest survival and responsiveness. The best shoot growth resulted in Murashige and Skoog medium with 2.0 mg/L BAP, 0.5 mg/L KI, and 0.25 mg/L NAA. Under the *in vitro* conditions, explants produced a mean of 8 shoots with a 2.4 cm mean shoot length and a 6.75 mean number of leaves per shoot in four weeks of subculturing intervals. This study presents an enhanced method for large-scale cultivation of genetically stable *A. vera*. Further refinement in rooting and acclimatization stages will improve the feasibility of this micropropagation protocol.

Keywords: 1-naphthalene acetic acid, 6-benzyl amino purine, *Aloe vera*, kinetin, micropropagation, shoot proliferation, surface sterilization

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222/B

Spice gardens in web-based experiential tourism: A study from Matale divisional secretariat, Sri Lanka

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Tourism is Sri Lanka's third largest foreign exchange source. COVID-19, the Ukraine-Russian war, and the Sri Lankan economic crisis impacted Sri Lankan tourism. Tourism digital transformation has positively impacted the travel and tourism sector, enabling businesses and travellers to connect globally. Platforms such as Airbnb have emerged, offering web-based tourism experiences. This platform allows individuals to share their experience and knowledge while generating income, all from the comfort of their homes. With its favourable climate and geography, Sri Lanka is a popular destination for spice tourism, ideal for most spice crops. It was observed that the Sri Lankan tourism industry was restricted to physical interactions, and rarely available on online platforms. Therefore, this study examined the potential of 'web-based experiential tourism' for spice gardens (SGs) in the Matale divisional secretariat. Primary data were collected (2023, January) from 23 SGs to review the potential Web-based experiential activities. According to its main findings, around 70% of SGs consist of more than a 1-acre land area. The staff can communicate in over 10 languages. The primary method of attracting tourists (over 80%) is through personal contacts and tour agents, while less than 13% utilize websites, social media, and reservation platforms. Notably, none of them have adopted the Airbnb digital platform to share spice garden experience. Simultaneously, 20 tour guides from the Matale district were interviewed to analyse the willingness of tourists to engage in available spice garden activities. Therefore, the 'Tourist Preference Index' (TPI) was developed. Results identified the following activities as the highest tourist preferences, listed in order: spice garden tour experience (7.1), spice processing experience (5.8), cooking experience (5.4), value-added spice processing experience (4.4), and spice harvesting experience (3.8). Secondary data were collected from Airbnb listings. Data were descriptively analysed to introduce the possibility of monetizing spice garden activities as web-based experiential tourism. Leveraging Airbnb to connect the high tourist demand with Sri Lanka's spice garden activities could boost the economy through foreign exchange. If these gardens provide excellent web-based experiences, it may encourage physical visits. This win-win situation allows tourists to enjoy unique experiences and helps garden owners expand their businesses.

Keywords: Airbnb, experiential tourism, spice gardens, tourist preference index, web-based experiential tourism

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223/ B

Evaluation of selected electrophysiological properties of *Dovyalis hebecarpa* (Ketambilla) under moisture and nutrient stimuli

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Plant electrophysiology is an emerging research area which provides a platform to understand how plants respond to stimuli. The electrophysiological data, along with comparisons of growth responses, can be used to predict and manage plant stress conditions better. Neither *in vivo* nor *in vitro* electrophysiology studies have been conducted in Sri Lanka for under-utilized fruit plants. *Dovyalis hebecarpa* (Ceylon gooseberry/ Ketambilla), which is an under-utilized fruit plant native to Sri Lanka, was investigated for its electrophysiological properties. The study was aimed to understand how the application of selected external stimuli; moisture, and nutrient supply affects electrophysiological properties, using three differently propagated plant types; budded, seedling, and cutting. The electrophysiology data was obtained using a non-destructive method, *via* inserting microelectrodes into the plant stem and measuring the signal at the working electrode with respect to a reference electrode. A potentiostat was used to record the signal. Data analysis involved calculating the signal-to-noise ratio (SNR) of potential versus time graphs. The results showed that the addition of moisture and nutrient stimuli had a notable effect on the working electrode potential. The highest value for SNR (dB), under the moisture stimulus, was obtained as 1.308 dB (SNR 20.318) from the plants propagated by cuttings, at a moisture level of 20 ml. The highest value for SNR (dB), under the nutrient stimulus, was reported as 0.0236 dB (SNR 1.055) from the plants propagated by cuttings at a nutrient level of 10 ml. A less significant response was shown by the budded and seedling plants upon the addition of moisture and nutrients. As per the results, Ketambilla cutting plants showed a comparatively higher response to moisture and nutrient stimuli than budded and seedling plants, which is anticipated due to the presence of a well-developed vascular system in cuttings. Understanding how Ketambilla plants respond to moisture and nutrient supply helps researchers for a better comprehension of the stress responses by the plants. Overall, the findings provide valuable insight into the dependence of plant electrophysiology upon studied stimuli, which can be used as a model to relate the changes in plant metabolism with the observed signal without molecular analysis.

Keywords: External stimuli, microelectrodes, plant electrophysiology, potential variations, signal-to-noise ratio

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224/B

Combined tolerance to anaerobic germination and submergence in Sri Lankan *Oryza sativa* L. (rice) germplasm indicates its compatibility to grow in prolonged floods to suppress weeds

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Rice is the only cereal that exhibits a degree of tolerance to anaerobic conditions during germination. Anaerobic germination-tolerance (AG-tolerance) is the ability of rice to germinate, grow, and survive under oxygen-limited conditions. This ability can be efficiently used to suppress weeds and reduce the harmful effects of weedicides. Sri Lankan rice germplasm of 193 varieties was efficiently screened to identify combined tolerance to anaerobic germination and survival at the seedling stage. This was conducted under laboratory-based simulated conditions in polystyrene boxes. The experiment had two phases: anaerobic germination, a submergence phase (0–14 DAS) with a 10 cm water column, and a recovery phase of 7 days (14–21 DAS) after draining the excess water. The data analysis was carried out using one-way ANOVA (Analysis of Variance) in IBM SPSS software (Version 20). The data analysis revealed that anaerobic germination percentage (GC), number of plant survival percentage (SN), and height of seedlings at the recovery phase (RSH) were significantly different in the germplasm. Based on the combined tolerance to AG and survival under submergence, we classified rice germplasm into six classes: highly tolerant (HR), tolerant (R), moderately tolerant (MR), moderately sensitive (MS), sensitive (S), and highly sensitive (HS) which were represented by approximately 20%, 31%, 37%, 4%, 6%, and 3% of varieties in the germplasm. More than 80% of the rice germplasm germinated successfully under anaerobic germination conditions. However, this capacity for AG was not proportionate to the survival under submergence in standing water. Nearly 60% of the rice varieties that were AG-tolerant had a growth performance similar to the control at the recovery phase. Rice varieties such as Godawee, Pachchaperumal, Mutpangan, Siru ModdanKaruppan, and IRIS 313-9917 with high combined AG tolerance at both the germination stage and seedling stage may serve as potential donors to develop improved rice cultivars. The presence of a combined higher tolerance to germinate under anaerobic conditions and maintain regulated growth under prolonged submergence in the seedling stage of Sri Lankan rice varieties indicate their coevolution with the cultural practices that adopt water management as a tool to suppress the weeds and use of weedicides.

Keywords: Combined tolerance, germination, recovery phase, weedicides

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301/C

Transfer based Bus Transport Networks: A Modified Concept on Feeder Bus Operations

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Feeder bus routes play a significant role in bus transport operations by providing access to urban areas and cities for passengers from suburban and rural areas. It is noted that some portions of feeder bus routes overlap with main bus routes. This overlapping reduces passenger loads on feeder bus routes. Reducing passenger loads leads to lower revenue for feeder bus operators. Another issue with the feeder bus routes is the need for increased fleet requirements. Both lower revenue and increased fleet requirements lead to operational inefficiency. Therefore, the existing feeder bus routes need modifications that maximize operational efficiency through increased revenue per kilometre and the reduced fleet requirements. The objective of this study is to propose a concept for a modified feeder bus route network that maximizes operational revenue in terms of increased revenue per kilometre with minimal fleet requirements. A thorough literature review was carried out by referring research articles and case studies on strategies to mitigate overlapping issues on bus routes. Discussions with stakeholders (passengers, bus operators, and regulators) were held to get a deeper understanding on the advantages and disadvantages of these strategies in terms of travel time, waiting time, travel cost for passengers, service frequency and revenue for bus operators, fleet size requirement, and timetable scheduling activities of regulators. The results of the study conceptualized that a transfer-based bus transport network could effectively address overlapping routes issues as practiced in other regions of the world. Transfer based bus transport networks referred to the running of feeder bus routes up to a terminus and returning with a view to minimizing overlapping while making shorter round trips. This could increase revenue per kilometre. Shorter round trips and reduced overlapping can also result in reduced fleet requirements. The results of the study outlined that operational efficiency could be achieved through increased revenue per kilometre at minimal fleet requirements. Identification of the proper termini for feeder bus routes and revising the bus schedules are vital for minimizing the transfer time, waiting time, and travel time for passengers. The existing bus fare structure causes increased travel costs. However, a well-planned transfer-based bus transport network can boost ridership, generate revenue, and create new routes. Focusing on a fairer fare structure is crucial for the smooth operations of this network.

Keywords: Public transport, overlapping, fleet requirement, frequency, fare structure.

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302/C

Variation of Particulate Matter in Different Seasonal Conditions in Colombo City

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Sri Lanka's rapid industrialization and urbanization since the late 1970s have led to a concerning rise in air pollution, driven by increasing energy consumption and automobile usage. It has emerged as a significant health issue affecting people, especially those residing in urban areas. This silent and invisible threat poses serious risks to public health. Urban centres like Colombo, Kandy and other districts have witnessed alarming levels of air pollution, surpassing both international guidelines and national standards for Particulate Matter 2.5 (PM_{2.5}). However, there is an urgent need for a robust action plan to address short-term high PM exposure in the Colombo area, contributing to effective air quality management. This research aims to investigate and assess the variations in particulate matter in Colombo city, forming the basis for a comprehensive database covering the entire island. Light scattering and beta attenuation particulate monitoring techniques are used along with an ambient fine dust sampler to measure PM concentrations in this study area. PM_{2.5} levels in Colombo during the period demonstrated clearly that high levels occur during the North-East monsoon season. Depending on the seasonal wind patterns, the trans-boundary pollution from neighbouring countries and the "Asian Brown Cloud" over Asian cities may have contributed to this tremendous rise during the North-East monsoon season. In comparison, this increase in pollutant levels is estimated to be 83% due to the impact of transboundary pollution. This period witnesses the exceedance of the 24-hour average national standard levels for PM_{2.5} air pollution on certain days, exposing city residents, especially vulnerable groups, to unhealthy short-term high PM levels. Managing urban air quality during this critical period requires heightened focus. The following actions can be implemented as a preparedness plan to overcome or to minimize exposure levels on critical days: limiting operation of thermal power plants around the Colombo urban area, vehicle entry to city, open burning, commercial activities and operations of their power generators. The proposed action plan involves limiting pollution emissions from local pollutant sources and emphasizes the active involvement of both the public and private sectors for successful implementation. By adhering to this plan, Sri Lanka can effectively tackle air pollution and safeguard public health, ensuring a sustainable and healthier future for its people.

Keywords: air quality, guidelines, particulate matter, standard levels, transboundary

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303/C

Optimization of coagulation and flocculation process of palm oil mill effluent using natural coagulant and flocculent

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Palm Oil Mill Effluent (POME) is a challenging waste product of crude palm oil extraction, known for its high content of Total Dissolved Solids, Total Suspended Solids, Chemical Oxygen Demand and Biochemical Oxygen Demand. Traditional methods involving physical pretreatment and conventional coagulants like alum or ferric chloride have raised environmental concerns. Natural coagulants like Empty Fruit Bunch Ash (EFBA) and Palm Oil Trunk Bio char have emerged as eco-friendly alternatives. This research focuses on optimizing coagulation and flocculation processes using EFBA and a constant dosage of OPT Bio char to enhance wastewater treatment plant performance. The study collected POME samples from different treatment points with varying pH levels and conducted jar tests to evaluate the coagulation and flocculation abilities of EFBA and OPT Bio char. The results provide valuable insights into their effectiveness in reducing COD under different pH conditions. The study found that EFBA is a promising coagulant, achieving COD reductions ranging from 43% to 53%. The optimal dosage was determined to be 1.5 g, highlighting its potential for optimizing POME treatment. OPT Bio char was held constant at 7.5 g as a flocculent, and consistently contributed significantly to COD reduction, establishing its reliability as a treatment agent. pH levels were shown to have a substantial impact on treatment efficiency, with samples collected after oil recovery (pH 5.01 – 5.50) exhibiting the highest COD reductions, averaging 73.40%. The study emphasizes the importance of integrating the oil recovery process into POME treatment, as it achieved an average COD reduction of 73.4%. In contrast, anaerobic digestion yielded the lowest reduction at 25.79%, highlighting the need for a comprehensive approach. These findings offer practical guidance for palm oil mills seeking sustainable POME treatment. EFBA and OPT Bio char demonstrate their effectiveness, with coagulant dosage optimization based on initial pH conditions. The integration of the oil recovery process significantly enhances COD reduction. This study contributes to the optimization of POME treatment processes, reducing environmental impact and potentially lowering treatment costs for the palm oil industry.

Keywords: Coagulant, EFB ash, Flocculent, OPT biochar, Palm Oil Mill Effluent

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304/C

Explore the implementation of BIM for building projects in Sri Lanka to improve project performance and yield better results at the design stage

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Building Information Modelling (BIM), which is seen as a revolution in the field, is altering the way architects and designers develop structures. It is a cloud-connected platform. BIM also has an impact on the conceptualization phase of the design process. The aim of this study is to implement BIM to enhance project performance and produce better outcomes in the design stage of building projects in Sri Lanka. A literature review, interviews, and case studies identified benefits, issues, and potential improvements in BIM. Previous research articles show that BIM has helped the concept design stage and made the conceptualization more integrated and collaborative. And it is much more effective at the beginning stages of construction or design, as the construction work can avoid issues at the beginning stages. Reduced design clashes, more accuracy, improved safety, easy access to information at all times, efficiency, and effective work can be seen as a result of BIM. BIM provides a visualization that enables faster buy-in approvals. BIM opens doors to more jobs since it requires more software and hardware and advancements in technology and needs human resources to build and maintain them. BIM establishment is challenging due to knowledge gaps, reluctance to change, collaboration challenges, and initial implementation costs, which are some of the barriers to implementing BIM. Interviewees and previous research studies suggest that educating young professionals and promoting the benefits of BIM to clients, contractors, and consultants can be very effective in BIM implementation.

Keywords: BIM, BIM Implementation, Sri Lanka, Design stage,

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305/C

Assessing the sustainability of a cascade system: A case study of Kimbulawala Lake and connected waters

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This research focuses on assessing the sustainability of the tank cascade system based on the Kimbulawala Lake and associated waters located in Sri Jayewardenepura Kotte, Sri Lanka. The integration of the Human Development Index (HDI) and sustainability measures offers a comprehensive perspective on development, aligning with the United Nations' Sustainable Development Goals (SDGs). Thus, this study explores the sustainability of tank cascade systems in the context of urban areas in the wet zone. Evaluating the cascade system's sustainability through the lens of the SDGs enables informed decision-making and future development plans. The research utilizes primary and secondary data sources, including stakeholder interviews and relevant literature, to assess the advancement of sustainability parameters within the ecosystem. It also comprehensively evaluates the system's alignment with all 17 SDGs and highlights the contributions to five key SDGs: Sustainable Cities and Communities, Decent Work and Economic Growth, Reduced Inequalities, Good Health and Well-being, and Clean Water and Sanitation. The findings underscore the interconnected nature of the SDGs and emphasize the importance of holistic approaches to achieve sustainable urban development. Based on the research findings, recommendations are made to enhance the sustainable management and development of the cascade system, including promoting sustainable tourism practices, prioritizing renewable energy sources, streamlining small-scale trade, implementing a mapping system, and enhancing security measures. By implementing these recommendations, the Kimbulawala Lake and associated waters that act as a tank cascade system can contribute to the achievement of multiple SDGs while fostering a thriving and sustainable local economy. Hence, this research provides insights about the sustainability of tank cascade-based ecosystems and offers guidance for informed decision-making and effective management strategies.

Keywords: Sustainability, tank cascade system, SDG, Kimbulawala lake

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306/C

Vertical settlement of Samanalawewa Dam: Results of 10 years of observations on its vertical control network

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Samanalawewa Reservoir is operating with a continuous water leakage of about 2.2 cumecs, and it is critical to continuously monitor the dam for the safety of the structure and people living downstream. The Ceylon Electricity Board (CEB) has been monitoring the vertical movements of the dam by running level lines over the permanent points on the dam. This study tried to identify the dam's vertical deformation pattern by establishing a levelling network independent from the existing control points and to identify the highly deformed area of the dam. Precise level lines were run over the existing monitoring points on the dam's upstream, crest, and downstream, so that the levelling network is not interconnected. Then an automated least square adjustment process was developed using MATLAB, in which the adjusted heights of each monitoring point were comparatively analysed with the height measurements observed by the CEB using ordinary levelling since 2010. Results indicated a maximum vertical deformation of 0.489 m on the crest compared to the initial height at the SMC 15 monument, located at the dam's centre. The least deformation of 0.138 m was recorded at SMC 7 towards the dam's left bank. From the historical annual time series data, a sudden increment of deformation of around 1 cm could be seen from 2013 to 2015, possibly due to the higher water levels of the reservoir. Further, the other centremost points on the dam have exhibited maximum vertical deformations of about 0.579 m upstream (SMS 15/1) and 0.256 m downstream (SMS 15/2). Most right bank points have demonstrated minimum vertical deformations of 0.152 m upstream (SMS 23/1) and 0.093 m downstream (SMS 23/2), and it should be noted that the leakage of the dam is located on the right bank corner of the dam. Compared to the initial levels in 1991, the upstream side of the dam is highly deformed by an amount of 0.579 m, while the crest and downstream are 0.489 m and 0.256 m, respectively. This indicated a clear typical deformation of an embankment dam due to long-term water pressure. Further, the overall deformation of the right bank is slightly higher than the left bank, so a detailed investigation should be carried out to confirm any relationship with the reservoir leak.

Keywords: Samanalawewa, vertical movements, long-term water pressure

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307/C

The historical modulations of Sri Lankan rainfall by *El Niño* and *La Niña* held between 2007 and 2023

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El Niño (EN) and *La Niña* (LN) are climatic mechanisms that have a significant impact on seasonal and inter-annual rainfall in tropical regions including Sri Lanka. Anomalously warm sea surface temperatures (SST) in the equatorial Eastern Pacific are referred to as the EN phase and anomalously colder SST is referred to as LN. Past research on Sri Lankan rainfall from 1869 to 2007 shows the following alternating seasonal influences: (a) the October-December (OND) rainfall increases during EN and drops during LN; (b) the January-March (JFM) rainfall drops during EN and increases during LN; and (c) the June-August (JJA) rainfall drops during EN and increases during LN episodes with relationship being stronger for July-August. Here, we evaluate these relationships for the recent 15 years using data for 16 well distributed stations from the Sri Lankan Department of Meteorology, and average SST anomalies in the NINO34 region (5°N–5°S, 120–180°W) to classify EN and LN episodes. First, we compute the monthly climatology of rainfall; thereafter, we compute the monthly anomaly from the climatology and then the anomalies during OND, JFM and JJA for recent EN and LN episodes. The impact of EN and LN on Sri Lankan rainfall in the last 15 years are as detailed below;

- During OND; EN episodes, rainfall was enhanced on average by 173 mm (+20%) and during LN it dropped by 159 mm (-19%).
- During JFM; EN rainfall dropped on average by 32 mm (-14%) and rose during LN by 73mm (+32%).
- During JJA; EN rainfall rose by 17 mm (+7%) enhancement and LN rainfall also rose by 20mm (+8%).

The impact of EN and LN on Sri Lankan rainfall was most significant in OND and JFM. The influence on JJA rainfall was weaker. However, if the July-August rainfall alone is considered then the influence is stronger. Overall while EN is a key factor in seasonal climatic variability, other factors such as the Indian Ocean Dipole can affect the seasonal variability. Weather events and climate change could also lead to departures. This analysis shows that, the historical patterns of climatic influence in EN has held largely over the recent 15 years.

Keywords: Sri Lanka, climate, rainfall, *El Niño*, *La Niña*

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Comparative study of alternative dispute resolution clauses in FIDIC conditions of contract and CIDA standard bidding document

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This research delves into the importance of incorporating Alternative Dispute Resolution (ADR) clauses into construction contracts, specifically comparing those found in the International Federation of Consulting Engineers (FIDIC) Conditions of Contract and the Construction Industry Development Authority (CIDA) Standard Bidding Document (SBD) used within the Sri Lankan Construction Industry. Objectives encompass recognizing the significance of ADR methods, evaluating disparities between the ADR clauses in both contracts, and assessing the evolution of ADR clauses in FIDIC contracts from 1999 to 2017. The literature review underscores the discouragement of litigation in the construction industry due to its financial and time-consuming nature, prompting the introduction of ADR methods for efficient dispute resolution. The methodology involves a literature review and desk study for comparing the ADR clauses in FIDIC Conditions of Contract and CIDA SBD. The investigation also scrutinizes the ADR clauses in the 1999 and 2017 editions of the FIDIC Red Books to identify improvements or developments. Results reveal a substantial difference between FIDIC and CIDA regarding the requirement of a Dispute Adjudication Board (DAB) in FIDIC, whereas CIDA mentions an Adjudicator without reference to a DAB. FIDIC establishes a fixed date for DAB formation, while CIDA allows a 14-day window for Adjudicator appointment. However, adjudication conditions are largely similar in both contracts. When amicable settlements are unattainable through adjudication, both contracts recommend arbitration. FIDIC adheres to International Chamber of Commerce rules, whereas CIDA follows the Sri Lankan Arbitration Act No. 11 of 1995. FIDIC encompasses provisions emphasizing the finality and binding nature of DAB decisions, promoting amicable settlement before arbitration. Conversely, CIDA lacks these provisions and considers the Adjudicator's decision final and binding if disputes are not referred to adjudication. The 2017 edition of the FIDIC Red Book introduces an 'Avoidance of Disputes' clause, allowing informal discussions through the Dispute Avoidance and Adjudication Board (DAAB) to resolve conflicts. Another significant development is the ability to sever disputed parts of the DAAB decision, limiting arbitration to only those sections. This amendment reduces the scope of disputes resolved through arbitration, resulting in cost and time savings. The study suggests that CIDA should contemplate adopting provisions similar to FIDIC's 'Avoidance of Disputes' clause and dispute escalation schemes to enhance the efficiency of dispute resolution in Sri Lankan construction contracts.

Keywords: FIDIC, SBD, ADR, contracts, construction

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309/C

An investigation of the physicochemical characteristics of intermittent streams in the dry zone, Sri Lanka

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Intermittent streams consist of more than half the length of the world's water networks and flow in phases in response to environmental conditions. They are common headwater streams that influence downstream perennial streams. However, they are widely ignored as important freshwater sources and valuable ecosystems. Studies conducted on their physicochemistry emphasizing the long-term variation with seasonal changes are scarce, especially for tropical climates. In this regard, a two-year study was done in Habarana (in the dry zone) of Sri Lanka to study the temporal variations of the physicochemical characteristics of water and sediment of three intermittent streams close to the Minneriya forest reserve. The variations were similar within streams for many variables (electrical conductivity, pH, dissolved oxygen, nitrate, ammonia, and phosphate) for water quality even when the hydrological flow stages were different, with significant differences between months (at a temporal scale). An interesting observation was that water physicochemistry was spatially variable even within the reaches of the stream, perhaps due to the fluctuating flows and diverse local environmental conditions within the reaches. This indicates that streams in similar geo-climatic conditions can show similarities in overall water quality. On the other hand, sediment quality (electrical conductivity, organic content, and phosphate) did not show similarities within streams; some similarity was observed in pH and nitrate. The differences between months were also not significant for these parameters. Sediment quality showed both heterogeneity and homogeneity and could indicate a major influence on water quality regulation. This study closes a gap in knowledge regarding intermittent streams in tropical climates and suggests that sediment monitoring must be given priority, as much as, or even more so, than water quality monitoring in these streams.

Keywords: Physicochemistry, water network, tropical climate, Habarana

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310/C

Application of remote sensing data in flood mapping- a case study in the Nilwala River basin

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Floods rank among the most prevalent natural disasters worldwide. The knowledge gained from past flood occurrences plays a pivotal role in reducing damage in future events. Therefore, accurate flood inundation mapping is crucial for developing effective disaster management strategies. However, the utilization of remote sensing data analysis for major flood events has been a highlighted research gap for major rivers in Sri Lanka. To address this disparity, this study aims to utilize remote sensing techniques in flood mapping. The objective is to acquire a flood map for a particular region and then extract the submerged area based on the resulting map. The study selected a severe flood event that happened in May 2017 in the Nilwala River basin, situated in southern Sri Lanka, to examine. During the flood period, a satellite image is required to identify the flood-affected region. A Sentinel-2 image has been identified through maximum likelihood classification which has been operated by ArcGIS. Finally, the image classification illustrates the extent of the impact clearly. The findings indicated that 46 km² of water covered the total area; 48 km² of the vegetation cover and 15 km² of the urban areas were found as the final results. In conclusion, the assessment of flood events through remote sensing data analysis holds significant potential in mitigating the adverse effects of floods and enhancing disaster preparedness in Sri Lanka. Leveraging modern technologies, like the Sentinel-2 image, provides invaluable data for effective flood inundation mapping and disaster management strategies, ultimately contributing to the safety and well-being of affected communities.

Keywords: Floods, satellite images, remote sensing analysis, maximum likelihood classification

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311/C

Analytical assessment of issues and solutions, and proposal for a physical model at a critical meandering location in Deduru Oya

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Investigation of mitigatory methods to the aggressive river meandering of Deduru Oya at the Manuwangama Kalu Palama bridge, Sri Lanka via analytical methods, and development of a feasible physical model were the objectives of this study. The methodology included collection of field data as well as secondary data. This was followed by calculating discharges for various river cross section scenarios using analytical methods (e.g., Lotter's, and Horton-Einstein methods) available for compound sections. The compound sections had compound cross sections (i.e., low and high flow sections) as well as varying channel roughness. The scenarios considered were (1) the existing channel; (2) excavation of the low flow area (5% increase in the bankfull cross section) and (3) strengthening the concave bank with a gabion wall together with the excavation of the low flow area. The bankfull discharge of the existing channel 70 m³/s, increased by 14% in scenario 2, however, during a typical low flow, water seemed to be stagnating in the modified high flow flood plain. The introduction of a gabion wall resulted in an increase in the bankfull depth by about a meter and would flood over the banks. To overcome this the low flow area needed to be excavated such that bankfull cross section is increased by 3%. The distorted physical model was developed adhering to the Froude similarity. The scaled down model with vertical and horizontal scales of 100:25 and 50:1 was found to be feasible for laboratory experiments. Further studies are recommended using the proposed physical model.

Keywords: Deduru oya, channel, bankfull, distorted physical model

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312/C

Assessment framework for disaster management in passenger terminals

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Assets deteriorate with time. On the other hand, improper operation and maintenance and improper risk management also contribute to the failures in optimized asset management. However, asset management encounters challenges when it gets incorporated with disaster management, since disasters might trigger hostile consequences on assets in many factors perhaps depending on their nature. Hence, the deficiencies in sound disaster management practices result in the deterioration of the asset management within an organization, project, or infrastructure development. Even though both asset management and disaster management take a prominent place in most countries, asset management is a new knowledge area, yet disaster management is relatively far ahead of it in the Sri Lankan context. It is evident that most of the efforts had been taken related to mega infrastructure projects as well as to the donor funded projects in local context. But not any considerable research work had been carried out related to the application of disaster management practices on assets in passenger terminals. On the other hand, there is not any tangible document including the disaster contingency plans related to the passenger terminals that can be executed. But it is necessary to identify the risks associated with the disasters vulnerable to terminals to convert them into actionable steps to reduce likelihood of possible occurrences on assets. Therefore, a better functionality needs to be maintained in meeting the passenger requirements to satisfy them with reliable facility usage. Hence, the study introduces a conceptual framework for disaster management by introducing the disaster risk score of assets and simple approach of asset damage calculation for pre and post disaster assessments respectively.

Keywords: Assets, management, disaster, passenger terminal

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313/C

Efficacy of green building rating systems to protect biodiversity of Sri Lanka

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Green building rating systems (GBRS) are acquiring a growing popularity in international and local construction industries due to the increasing adverse impacts of buildings on the natural environment. GBRS are considered as important tools for minimizing threats to the natural environment using fewer natural resources for building construction and operation, without sacrificing the user comforts. Therefore, GBRS are vital to be used in a country like Sri Lanka, as it is a place rich in biodiversity and being one of the 36 biodiversity hotspots in the world. Although the GBRS are internationally recognized as effective tools for environmental protection, their real efficacy specifically on biodiversity protection is not explored yet. Thus, a mixed method research project was carried out to evaluate the efficacy of biodiversity protection through GBRS. Initially the LEED, GREENSLR, and BLUE GREEN SL rating systems were explored to find the biodiversity protective criteria in their evaluation schemes. Due to a gap in the available literature about how to clearly figure out biodiversity protective criteria and points in GBRS, the post-2020 Global Biodiversity Framework (P-2020 GBDFT) was used as a reference material to identify biodiversity protective criteria in accordance with GBRS criteria, and two high-rated green buildings were selected as case studies to explore their contribution to GBRS. The study found that all GBRS considered have 65% - 76% points for optional biodiversity protective criteria and 0 - 66% points for compulsory biodiversity protective prerequisite criteria. Furthermore, all the selected case studies have omitted 7 to 11 biodiversity protective criteria contain 08% to 25% points, and still have managed to achieve Gold to Platinum ratings using other criteria. According to the present study, it is revealed that all the selected GBRS are inefficient in biodiversity protection as it is not a must to obtain a high green rating though there is an impact on biodiversity. Therefore, the study recommends improving GBRS by adding separate biodiversity protective aspects, to highlight the biodiversity protective features, and to increase biodiversity protective prerequisites in GBRS.

Keywords: Biodiversity, green building rating systems, LEED, GREENSLR, BLUE GREEN SL

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Harmony of elements: Investigating the impact of macronutrient levels on water quality in the North Colombo coastal region of Sri Lanka

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Coastal regions worldwide face growing challenges due to the impacts of excessive nutrient loading, which can lead to algal blooms and eutrophication. The algae decomposition can further impact pH and increase electrical conductivity (EC). The North Colombo coast of Sri Lanka is an urban ecosystem stressed by untreated wastewater discharge, macronutrients from the Kelani River, and urban surface runoff. This study aimed to assess the status of nitrogen (N) and phosphorus (P) abundance and its influence on water quality, particularly in the stretch from the Kelani River estuary to the Colombo port. To investigate the spatial distribution of nutrients, a total of 35 stations were selected along the north Colombo coast. Samples were collected during the non-monsoonal period of 2023 within a depth of 0.5 m, to assess Total Dissolved Nitrogen (TDN), nitrate, Total Dissolved Phosphorus (TDP), and phosphate levels. Concurrently, measurements of DO, EC, and temperature were also recorded for the collected samples. Standard colorimetric methods were employed to analyse nutrient concentrations. Although historical data were limited, the measured values were compared with available historical data to gain insights into the long-term trends. The results revealed that the North Colombo coastal region operates as a nitrogen-limited ecosystem. The maximum concentrations of TDN, nitrate, TDP, and phosphate were recorded as 0.74, 0.09, 0.79, and 0.70 mg/L, respectively. All measured values were within the Sri Lankan ambient water quality standards, indicating acceptable conditions at the time of data collection. However, concerning trends emerged when comparing the data with historical records, showing an increasing trend in macronutrient concentrations. This highlights the need for effective monitoring and management efforts to ensure the long-term sustainability of the coastal ecosystem and to prevent potential water quality degradation in the North Colombo region. In conclusion, this case study provides valuable insights into the current state of nutrient levels and water quality in the North Colombo coastal region, and the findings serve as an essential foundation for policymakers, scientists, and local stakeholders to develop effective strategies for preserving the coastal environment in Sri Lanka.

Keywords: Nutrient, nitrogen, phosphorus, urban coastal ecosystem, wastewater

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315/C

Spatiotemporal investigation of plan geometry of Deduru Oya to identify causes of aggressive river meandering.

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Due to its significance in the hazards associated with bank erosion, the migration of meandering rivers through their floodplains has gained societal and scientific interest, especially when meandering happens at a rate more than the normal. This study investigated the spatiotemporal variation of meandering of the downstream reaches of the Deduru Oya. Satellite images from 2003 to 2023 were carefully investigated to derive the changes in the displacement of the meander and channel sinuosity. Noticeable changes to the trends of the above parameters were noted in and around 2014, the year when the Deduru Oya reservoir was commissioned. Also, the rate of changes of these parameters increased in the flowing direction. The functions developed between river discharge and sediment load also showed somewhat weaker relationships than what was expected, indicating a disharmony between the flow and sediment load. The study showed that Deduru Oya dam could be a reason for aggressive river meandering. However, this has to be validated by studying the impact of sand mining (legal as well as illegal) taking place along the river, and also other river regulation activities that took place along the river.

Keywords: Deduru oya, spatiotemporal, hazards, sand mining

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Exploring the role of ephemeral streams in mountainous regions on landslides and understanding the level of regulation

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Landslides and ephemeral streams are natural processes that significantly influence landscape formation and hydrological systems. Ephemeral streams, characterized by intermittent flow during or following rainfall events, play crucial roles in natural flood control mechanisms, nutrient cycling, and other biogeochemical processes. While past studies have explored the influence of ephemeral stream dynamics on landslide occurrence, a comprehensive understanding of the specific conditions and interactions leading to landslide initiation in the presence of ephemeral streams remains limited. This research project aimed to fill this gap by conducting field studies and experiments focused on understanding the mechanisms by which ephemeral streams influence slope stability and identifying the hydrological and geological factors involved. Field studies were conducted in two ephemeral streams and a perennial stream in the Rathnapura district which are in Madola and Malwala, during both wet and dry seasons. Sediment and undisturbed soil samples were collected at the surface and approximately 1 m depth in both ephemeral streams and adjoining terrestrial areas. Plant stability was assessed using the pulling method with a system containing a belt and a spring balance, and tree ages were estimated using the DKH (Diameter at Knee Height) method. Soil compaction was measured using crowbar penetration, sediment samples were analysed for soil organic content and particle size distribution, and undisturbed soil samples were checked for shear strength to understand the wet-dry cycle effect on ephemeral streams compared to the perennial streams. Due to the shallow bedrock and cemented sediment nature of the active channel, the results revealed low crowbar penetration. Higher penetration depths were found in terrestrial areas, particularly in areas with favourable sedimentation conditions. The force required to uproot plants in terrestrial areas was significantly higher, indicating the advantage of firmly bound plants for stability. As evidenced by the damage to a bypath during the rainy season, the research emphasized the importance of identifying ephemeral streams for infrastructure planning and design. Also, the study adds to the understanding of the role of ephemeral streams in mountainous regions in landslides and emphasizes the importance of further research to regulate and manage these critical environments for sustainable development and hazard mitigation.

Keywords: Landslide, ephemeral streams, perennial streams, Rathnapura

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317/C

Improving road safety of bicycles through vibration-based energy generation

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The world is currently prioritizing sustainable energy concepts, recognizing the significance of electric power in modern living and technological advancement. Amidst a recent fuel crisis in Sri Lanka, bicycles have gained popularity as transportation vehicles and globally renowned sporting equipment, contributing significantly to eco-friendly mobility in urban and suburban areas. In this research context, it focuses on harnessing piezoelectric energy from bicycle vibrations to enhance eco-friendly mobility and bicycle safety in Sri Lanka. The study begins by experimentally measuring pedal force under various conditions and employs an IoT setup for real-time data collection. A specially engineered pedal is designed to convert foot and road vibrations into electricity, with an emphasis on minimizing rider discomfort. The methodology integrates finite element analysis, 3D printing, and COMSOL Multiphysics simulations to develop and validate the energy harvesting system. Results from simulations and physical prototype testing show the potential of piezoelectric transducers on bicycle pedals to generate electricity. Under constant loading, voltage variation of up to 2V is observed. Real-world conditions, involving cyclic pedal loading and road vibrations, result in variable load simulations, with an initial peak of 3.8 V and an average voltage of 1.175 V at 60 rpm. Experimental data from the prototype demonstrates voltage variation between 0.845 V and 3.63 V, aligning with the cyclic pedal movement. While prototype voltages are slightly lower than simulations, they remain within the expected range, affirming feasibility. In summary, the research confirms the feasibility of generating voltage using piezoelectric transducers on bicycle pedals, potentially contributing to sustainable transportation solutions. This technology could be integrated with existing power sources to maintain continuous bicycle illumination, utilizing vibrations and pedal force generated during typical road cycling conditions. Furthermore, it addresses environmental concerns related to disposable batteries, promoting the use of rechargeable batteries and offering a sustainable alternative to traditional bicycle lighting systems. In conclusion, this study highlights the potential of piezoelectric energy harvesting technology to enhance bicycle functionality, increase safety, and reduce environmental impact. It serves as a promising step toward eco-friendly transportation solutions, aligning with the global shift towards sustainable energy sources and addressing the pressing issue of energy conservation and environmental pollution.

Keywords: Sustainable, electric power, bicycles, vibration

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318/C

Development of an improved biomass stove for urban households

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Biomass fuel is the primary cooking source for a significant number of households in Sri Lanka. Various biomass stove designs, claimed to have improved performance, are available in both the market and the literature, However, a prevailing issue with these stoves is the emission of smoke, which has been linked to various health problems stemming from household air pollution. Despite health concerns, the reliance on biomass for cooking has been increasing due to the economic crisis and rising LPG costs in Sri Lanka. In light of this backdrop, the objective of this study was to examine different biomass stoves documented in the literature and developed a novel biomass stove design. This new stove incorporates features to address key concerns such as smoke emission, biomass feeding, efficiency, user-friendliness, and thermal efficiency. The stove's inner layer is composed of mild steel, with clay used for insulation, and the outer layer also made of mild steel. Additional components include an exhaust chimney, blower fan, combustion chamber door, and blower fan controlling unit. To facilitate ash removal, a mesh and ash tray were integrated into the design. During experiments conducted using water, the results showed that the stove took 16 minutes to boil 500 g of water while consuming 0.5 kg of wood. The mesh effectively filtered the ash, collecting approximately 5 g of it in the tray. Visual observations indicated minimal smoke, with most of it being efficiently released through the chimney. However, at higher fan speeds, a small amount of smoke was noticed to escape through the pot seat area. The study also determined the stove's thermal efficiency to be 55% under steady conditions. Improved efficiency is attributed to the prevention of heat loss by appropriately selecting dimensions and insulation materials. These findings highlight the potential of the newly designed biomass stove to offer an improved and healthier cooking option for households in Sri Lanka.

Keywords: Biomass, urban, stove, household, LPG

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401/D

Analysis of putative xylanase enzyme in *Mycobacterium tuberculosis*

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Tuberculosis is one of the most common diseases in the world and is highly resistant to several antibiotics. The MarR gene family in the *Mycobacterium tuberculosis* genome contributes to drug resistance and virulence mechanisms. Previously, our work revealed that Rv 3095 gene encodes a transcriptional regulator that directly controls the expression of a putative xylanase. Furthermore, the regulator is also involved in virulence gene modulation. Hence, we hypothesize this xylanase may have an active role in the bacterium. This study was conducted to check the activity and expressivity of the Rv 3096 gene under *in vitro* conditions. The genomic DNA isolation of *Mycobacterium tuberculosis* was done using the C tab - NaCl DNA isolation method, which yielded a good concentration of DNA with high purity. Rv 3096 gene was amplified using PCR and cloned into a TA plasmid cloning vector. The recombinant plasmid was transformed and expressed using *Escherichia coli* BL-21 strain. Protein expression was induced with Isopropyl β -D-1-thiogalactopyranoside and after expression was confirmed by SDS PAGE, culture supernatant was used for the assays. The xylan-agar well diffusion assay was carried out to check the extracellular expressivity of the putative xylanase enzyme against non-transformed *E. coli*. *Trichoderma spp.* was used as a positive control. After the incubation period, the plate was stained with Congo Red dye, and a circular decolorized zone was observed around the well, which indicates the activity of the xylanase enzyme. These results show that the Rv 3096 gene can produce an active extracellular xylanase enzyme in *M. tuberculosis* that warrants further studies on its cellular role in pathogenicity.

Keywords: Rv 3095 gene, Rv 3096 gene, MarR gene family, putative xylanase enzyme, Xylan – Agar well diffusion assay

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402/D

Isolation of abiotic stress regulated OsBBX13 promoter from Rice (*Oryza sativa*)

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Rice is the staple food for more than two third of the world's population as well as in Sri Lanka. A wide range of biotic and abiotic stress conditions have a significant impact on rice productivity. Different molecular biological approaches have been used by researchers to increase the production of rice under stress conditions. A large number of genes and proteins in rice genome contributes significantly to improve tolerance to salt and drought stresses. OsBBX13 gene that belongs to the B-box gene family, has been identified as an abiotic stress-responsive gene (unpublished data). However, there has not been conducted a complete study of the OsBBX13 promoter region to understand its contribution to abiotic stress regulation. The objective of this study was to isolate the rice OsBBX13 gene promoter region to clone and characterize its mechanism in abiotic stress regulatory pathway. As the first step, OsBBX13 gene sequence was obtained from the MSU rice genome annotation project database (RGAP). Then the 1000bp nucleotide sequence upstream to transcription start site of the OsBBX13 was obtained and using Bioinformatic tool PLACE and plantCARE software, cis-regulatory elements present on the OsBBX13 promoter were analysed. The results confirmed the presence of many stress-responsive elements on OsBBX13 promoter region from -1 to -1000. Those elements include GT-1 motif, ACGT sequence, ABRE like sequence, MYC recognition site, bZIP transcription factors, MYB binding site, and HSE (heat shock element). Hence, 1000bp region was selected as the promoter of OsBBX13 gene. To isolate the promoter, genomic DNA was isolated from 5-day old rice leaves of Bg-250 rice variety using the CTAB method. The OsBBX13 gene promoter was amplified successfully using the rice genomic DNA and the optimized primers. Amplified promoter region was cloned into pUC19 plasmid. Then the ligated pUC19 with promoter region was transformed into *E. coli* DH5 α , which is a versatile strain with higher transformation efficiency. The research is planned to be continued by confirmation of recombinants using hot start colony PCR and restriction enzyme digestion analysis, characterization of promoter, and cloning the promoter region to the pCAMBIA 1391Z binary vector.

Keywords: OsBBX13 promoter, salt and drought stress, cis-regulatory elements, Bg-250 rice variety

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403/D

Characterization of growth-related cyanotoxin production in selected cyanobacteria

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Cyanobacterial toxins pose significant health risks to humans and animals. Understanding the relationship between cyanobacterial growth and cyanotoxin production is the most suitable approach for mitigating their proliferation in freshwater reservoirs. This study aims to investigate the differences in microcystin (MC) production among selected cyanobacterial species during their growth stages. Five cyanobacterial isolates, (*Microcystis* sp., *Fischerella* sp., *Nostoc* sp., *Pseudoanabaena* sp., and *Leptolyngbya* sp.) were cultivated as batch cultures in BG11 media. The initial cell concentration was maintained at 1×10^8 cells ml⁻¹. Chlorophyll-a extraction was performed and pigment concentrations were determined by measuring absorbance at 470 nm, 665 nm, and 720 nm using a UV-vis spectrophotometer within 8 days after culturing, continuously for 2 months. The brine shrimp bioassay was conducted, and mortality percentages were calculated using extracts from cyanobacterial pellets and supernatants. Microcystin content was analysed using high-performance liquid chromatography (HPLC) with a reference MC standard (SIGMA ALDRICH 33578) for both cyanobacterial pellets and supernatants. Preliminary cytotoxicity assays revealed that *Pseudoanabaena* sp. had the highest toxicity (45%) in the supernatant, while *Fischerella* sp. and *Nostoc* sp. showed a similar high toxicity (85%) in the pellets. Analysis of growth curves showed three distinct phases: lag, exponential, and stationary. The average final cyanobacterial cell concentration exhibited an approximately 4% decrease compared to the initial cell concentration. Cyanotoxin production exhibited significant difference between the lag and exponential phases ($p < 0.05$), but no significant variation was observed during the stationary phase ($p = 0.08$). *Pseudoanabaena* sp. (2.541 ± 0.57 mg l⁻¹) and *Fischerella* sp. (1.5152 ± 0.14 mg l⁻¹) exhibited the highest toxin concentrations during the stationary phase. *Microcystis* sp. displayed a negative correlation ($p < 0.05$, $r = -0.7135$) between cyanotoxin production and growth, while the selected filamentous-type cyanobacteria showed a positive correlation ($p > 0.05$, $r = 0.3324$). In this study, filamentous-type cyanobacteria exhibited higher microcystin toxicity compared to unicellular *Microcystis* sp. Cyanotoxin production is significantly different between the lag and exponential growth phases. The intracellular toxin concentration was higher than the extracellular concentration in the selected cyanobacterial isolates. However, in natural environments, the toxin production of these organisms can vary due to different microenvironmental and molecular factors.

Keywords: Cyanobacteria, colonial, filamentous, growth stages, microcystin

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Anti-fungal effect of endophytic fungi isolated from *Plumeria rubra* leaves against pathogenic fungi *Fusarium* isolated from diseased leaves of *Epiphyllum oxypetalum*

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Endophytes are symbiotically living microbes, mainly fungi. Not only do they live inside the host but also possess various benefits conferred through production of diffusible volatile components known as secondary metabolites. Secondary metabolites have various properties such as anticancer, antibacterial, antifungal and many more. The primary objective of this context was to investigate the inhibitory properties possessed by endophytic fungi isolated from *Plumeria rubra* leaves and their diffusible materials against potential plant pathogens isolated from *Epiphyllum oxypetalum* leaves. Endophytic fungi were isolated from processed leaf samples of *Plumeria rubra*. *Epiphyllum oxypetalum* leaves showing brown colour irregular patches with yellowing around the patches were selected as diseased leaves to isolate pathogenic fungi. Biochemical and microscopic observations (urease test, oxidase test, catalase test) were conducted on potential pathogenic fungal isolates to select the most suitable isolates for further investigations. Dual culture and volatile component assays were conducted for two endophytes against two potential pathogens and all tests were carried out in triplicates. Control tests were conducted for both assays by inoculating the pathogenic fungal plugs with agar plugs. The growth rates of fungi for both assays were conducted by drawing intercept lines between the mycelial plugs and the fungal plugs of test organism (plant pathogen) and measuring the growth along the intercept to evaluate the inhibitory effect of endophytic diffusible materials against the plant pathogen. Obtained results were analysed using one-way ANOVA, R-studio version 4.2.3. Analysis of obtained results for dual culture depicted that PL1C-pathogen A, pathogen B show inhibition by 46.7%, 20% and PL2C-pathogen A, pathogen B show inhibition by 86.7% and 40%, respectively. Whereas in volatile component assay, PL1C- pathogen A, pathogen B show inhibition by 42.9%, 75% and PL2C-pathogen A, pathogen B show inhibition by 28.6%, 62.5%, respectively. PL2C has the ability to significantly ($P < 0.05$) inhibit plant pathogens. PL2C endophyte has a significantly high degree of inhibition against the plant pathogens isolated. Following further validation, there is a potential in production of effective and inexpensive anti-fungal agents using endophytes, which could prevent fungal infections in economically important plants.

Keywords: Endophytic fungi, dual culture, volatile component assay, *Plumeria rubra*, diffusible compounds

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405/D

Effect of cadmium, chromium, and lead on mortality and kidney functions of zebrafish (*Danio rerio*) embryo

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Heavy metals such as cadmium (Cd), chromium (Cr), and lead (Pb) are ubiquitous toxicants. These are known to cause nephrotoxicity at high exposure levels. However, there is limited evidence on whether these heavy metals contribute to the development of chronic kidney disease (CKD) in human at relatively low environmental exposure levels. The zebrafish (*Danio rerio*) embryotoxicity model is a powerful model in ecotoxicology due to its robustness and high genetic similarity to mammals. Thus, the present study intends to reevaluate the effect of Cd, Cr, and Pb at relevant environmental concentrations on zebrafish embryo mortality and kidney functions. The Sri Lankan standard levels of Cd (II), Cr (VI), and Pb (II) at five concentrations were selected to perform the zebrafish embryotoxicity assay adhering to the OECD guidelines 236. The lethal concentrations and endpoints were determined at 24, 48, 72, and 96- hour post-fertilization (hpf). The effect of the lethal concentration of each heavy metal on kidney functions was determined by measuring the levels of urea and creatinine in embryo suspension employing commercially available assay kits. Mean values of three independent experiments were statistically analysed using the SPSS statistics 20. According to the results, highest mortality was observed in 96 hpf for all three heavy metals. The highest toxicity was reported for Cd (II) (LC50: $37.151 \pm 3.3 \mu\text{g ml}^{-1}$), followed by Pb (LC50: $84.098 \pm 2.5 \mu\text{g ml}^{-1}$). Urea concentration of embryo treated with Cd (II), Cr (VI), and Pb (II) at concentrations 0.024 mg l^{-1} , 0.4 mg l^{-1} , and 0.08 mg l^{-1} was significantly increased up to $14.912 \pm 5.21 \text{ mg d l}^{-1}$ $p=0.02$, $15.789 \pm 4.558 \text{ mg d l}^{-1}$ $p=0.01$, and $4.611 \pm 0.127 \text{ mg d l}^{-1}$ $p=0.04$ compared to the control ($2.34 \pm 0.127 \text{ mg d l}^{-1}$) at 96 hpf ($p<0.05$). Though the creatinine levels of the embryo were increased by Cd (II) and Cr (VI) treatments, a significant increase was observed only in Pb (II) treatment at 72 hpf ($0.972 \pm 0.394 \text{ mg d l}^{-1}$ $p=0.03$) and 96 hpf ($0.722 \pm 0.255 \text{ mg d l}^{-1}$ $p=0.02$) hpf compared to the control ($0.2 \pm 0.12 \text{ mg dl}^{-1}$). Thus, the current study revealed, that even at standard concentrations, Cd, Cr, and Pb can cause nephrotoxicity. It is assumed that embryonic stages could be more susceptible to nephrotoxicity caused by heavy metals. Further, studies are warranted to identify the developmental defects of nephrogenesis.

Keywords: Cadmium, chromium, embryotoxicity, nephrotoxicity, zebrafish

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406/D

Effect of altering circadian rhythms during post-harvest storage on the shelf-life of *Basella alba* (Spinach) leaves

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The longevity of leafy vegetables reduces during post-harvest storage due to rapid senescence. Metabolic and biological processes of leafy vegetables occur even after harvest by entraining their internal circadian clocks with external environmental stimuli. The study aimed to investigate the effect of different circadian rhythms on improving the shelf-life of *Basella alba* (Spinach) leaves during postharvest storage. The effect of circadian rhythms altered by using white LED (3.5 W) on the shelf-life of spinach leaves was studied by visual observation and estimating the cell membrane integrity. The colour change of the leaves was compared using a colour key based on numerical rating scale and the electrolyte leakage (EL) was measured using the conductivity during the storage of 1-6 days under different light (25 $\mu\text{mol s}^{-1} \text{m}^2$)/dark regimes, *i.e.*, 24 h light (LL), 16 h light/8 h dark (16L/8D), 12 h light/12 h dark (12L/12D), 10 h light/14 h dark (10L/14D), constant 24 h dark (DD) at 20 °C and constant 24 h dark at 4 °C (RDD). Three replicates were conducted for each treatment. Constant light (LL) and 16L/8D treatment caused a change in the initial green colour into light green colour after 6 days of storage. 10L/14D and RDD treatments facilitated maintaining green colour throughout the storage period. A small variation of green colour was observed throughout the storage period in leaves stored under 12L/12D. Spinach leaves stored under DD showed rapid loss of green colour by 6 days of storage. Percentage mean EL of spinach leaves indicated that the leaves stored under RDD treatment had the lowest EL% (14.16 ± 0.51) while DD treatment recorded the maximum EL% (23.98 ± 0.31). Mean EL values of spinach leaves decreased significantly by 21.87%, 30.01%, 28.52% in LL, 10L/14D, and 16L/8D treatments, respectively compared to the leaves stored in DD. The leaves stored under 12L/12D decreased EL by 3.08% relative to LL. Visual quality of leafy vegetables changed rapidly in constant light and constant dark treatments compared to different light/dark treatments. The results suggest that post-harvest storage for 6 days at 16L/8D retain the colour and texture of spinach leaves better than other studied treatments.

Keywords: Green leaves, light, spinach, storage, texture

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407/D

Effect of water stress on the morphological, physiological, and biochemical parameters of Quinoa (*Chenopodium quinoa* Willd.) variety Amarillo Marangani

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Quinoa (*Chenopodium quinoa* Willd.) is a pseudocereal grown for its edible seeds in Andean region as a staple crop. The adaptability of plant to unfavourable environmental conditions, low production cost, and nutritional potential have led to an increased interest in quinoa cultivation on a global scale. However, quinoa has not received appropriate recognition as a high scope crop in Sri Lanka. The aim of the present study is to investigate the effect of water stress on the morphological and biochemical parameters of quinoa variety Amarillo Marangani. Three water stress conditions; 95% FC (FC: Field capacity) (sufficient water), 65% FC (water stress), and 35% FC (severe water stress) were imposed (five plants per treatment). Tree height, stem diameter, number of leaves/ branches as morphological parameters and total chlorophyll concentration, proline content, relative water content (RWC%) as biochemical and physiological parameters were measured over 15 weeks of water stress period. As expected, the best growth was observed at 95% FC and gradual reduction in growth was observed at 65% FC to 35% FC. Mean heights of plants after 15 weeks of growth were 38.97cm \pm 9.15, 38.07cm \pm 8.87 and 27.17cm \pm 7.81 at 95% FC, 65% FC and 35% FC, respectively and mean stem diameters were 3.30 mm \pm 0.30, 3.03 mm \pm 0.26 and 2.17 mm \pm 0.36 at 95% FC, 65% FC and 35% FC, respectively. Under 35% FC, the highest average proline content (3.28 \pm 0.48 μ mol /g) was observed compared to the proline levels at 95% FC and 65% FC. Plants grown at 35% FC, showed a significantly high mean (8.8 \pm 1.32 mg/g) total chlorophyll concentration where 7.01 \pm 0.68 mg/g and 7.19 \pm 0.19 mg/g were found at 95% FC and 65% FC, respectively. The highest mean RWC% value (84.33% \pm 3.91) was found at 95% FC, where 83.10% \pm 1.83 and 77.12% \pm 5.56 were found at 65% FC and 35% FC, respectively. The main findings demonstrate that young plants can withstand water stress of 35% FC without critical growth retardation. High proline concentration suggests better stress tolerance ability of the plants at severe water stressed environments.

Keywords: Chlorophyll, growth, proline, quinoa, water stress

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408/D

Evaluation of co-digestion for domestic biogas production under tropical climate conditions

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Biogas is an environmentally friendly renewable energy source produced by breakdown of organic matter such as food scraps and animal waste by microorganisms in the absence of oxygen. Biogas consists mainly of methane and carbon dioxide. Methane has a high heat energy, and many countries use biogas for their energy requirements such as to produce heat, in industries, and as an advance fuel for vehicles. Since biogas is an important source of renewable energy, it is a solution for the current energy crisis, solid waste management, and climate change as well. To adapt biogas technology for Sri Lankan domestic usage, it is necessary to identify the optimum operating conditions for biogas generation. Feedstock plays an important role in biogas production. Kitchen waste and lawn grass are two widely available feed stocks in Sri Lanka at domestic level. Cow dung is also commonly available to be used as inoculums for biogas generation process. The main objective of present research is to evaluate the biogas generation potential of different co-digestion mixtures of Kitchen Waste (KW), Lawn Grass (LG) and Cow Dung (CD). This study investigated the co-digestion of KW and LG on the biogas yield using six reactors of R1 (100% KW, 0% LG, & CD), R2 (0% KW, 100% LG & CD), and R3 (50% KW, 50% LG & CD) in duplicates in stage 1 and using three reactors in stage 2 for thirty (30) days at room temperature, $35\text{ }^{\circ}\text{C} \pm 2$. In phase 1, CD was used as the inoculum and inoculum brought from a reactive biogas plant was added as well and increased the substrates weight in phase 2. The peak values observed in biogas yield in the R1, R2, and R3 in stage 2 were 10,740 ml, 7,918 ml, and 14,850 ml, respectively. Mixture of KW and LG produced the highest quantity of biogas while LG produced the lowest quantity of biogas, and biogas production of KW was in-between the other two reactors. Therefore, co-digestion of substrates has enhanced the biogas production. The effect of other ratios of KW and LG in co-digestion and the effect of thermal treatment are recommended for future work.

Keywords: Biogas, co-digestion, kitchen waste, lawn grass, cow dung

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409/D

A comparative study on the effect of bisphenol-A and bisphenol-S on human erythrocyte membrane stability and blood clotting

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Bisphenol A (BPA) is a highly used industrial chemical, which acts as xenoestrogen leading to numerous health consequences in living organisms. Therefore, bisphenol S (BPS) was introduced as a safe alternative to BPA. However, the safety of BPS has become questionable with its endocrine disruptive ability and the presence in human circulation. Therefore, comparative and comprehensive analysis on the health effects of both bisphenols is required in evaluating the relative safety of BPS. Accordingly, this study was aimed at comparative analysis of BPA and BPS exposure in human blood using *in vitro* assays. Erythrocytes were separated from fresh venous blood of 10 healthy reproductive-age females following an informed voluntary consent. For haemolysis assay and morphological identifications, erythrocytes were isolated, 5% haematocrit was prepared, and incubated with both bisphenols (50 µg/ml, 100 µg/ml, and 200 µg/ml) and the control treatment at 37 °C for 24 hours. For total blood clotting time, 20 minute-whole blood clotting test was carried out with both bisphenols at comparable concentrations. Percentage of haemolysis and erythrocyte deformations were significantly high with all bisphenol treatments than that of negative control ($p < 0.05$). Echinocytes and stomatocytes were the major bisphenol-induced erythrocyte deformations. Both bisphenols demonstrated dose-dependent increase in erythrocyte haemolysis and deformations: however, the effect of BPS was significantly lower than BPA for all comparable concentrations ($p < 0.05$). Both BPA and BPS showed no significant difference in blood clotting time in the tested range of concentrations and time. Both bisphenols significantly affected the viability and morphology of erythrocytes by disturbing the cellular structure through disturbed membrane stability and integrity. The effect of BPS on erythrocyte membrane stability was less than BPA yet statistically significant from control treatment in the tested range of concentrations and time. Therefore, based on the current study, BPS cannot be recommended as a safe alternative to BPA. However, more comprehensive physiological studies are recommended to evaluate the relative safety of each type of bisphenol in human blood.

Keywords: Bisphenol-A, Bisphenol-S, erythrocytes, membrane stability, blood clotting

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410/D

Development of a screening method to differentiate Sri Lankan virgin coconut oil, palm oil, and homemade coconut oil using ATR-FTIR technique

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In this study, Fourier Transform Infrared (FT-IR) spectroscopy coupled with Attenuated Total Reflectance (ATR) and multivariate chemometric modelling were deployed to discriminate palm olein, virgin coconut oil (VCO), and homemade coconut oil. Spectral data from 60 samples were visually observed to identify the signature region for certain oil types. Following bands, 1097 cm⁻¹, 1117 cm⁻¹, 1654 cm⁻¹, and 3005 cm⁻¹ were identified as four specific bands that differentiate VCO and palm olein. The spectra of homemade coconut oil and VCO appeared to be identical. Spectral data were pre-processed with the purpose of noise reduction, baseline correction and normalization. Three different preprocessing strategies (standard normal variate, multiple scatter correction, and first derivative) were used to identify the best method for enhancing the separation or clustering of the samples based on their spectral patterns and characteristics. Principle component analysis (PCA) was deployed on the whole spectrum (450 cm⁻¹ to 5500 cm⁻¹) region in order to classify the best pre-processing method. It revealed that there is no significant improvement among the different preprocessing methods. Orthogonal partial least squares-discriminant analysis (OPLS-DA) was developed subsequently and resulted in coefficient of determination (R²) and cross-validated coefficient of determination (Q²) values of 0.979 and 0.934, respectively. The resulting Fisher's probability value of 2.2 x 10⁻⁵ indicated the predictive ability of the model. The applicability of the discriminant analysis was examined by performing a validation test wherein the 15 samples of VCO and palm olein were classified 100% accurately. The results of this study revealed the applicability of using FT-IR spectroscopy in combination with multivariate analysis for identifying the VCO, palm olein and homemade coconut oil samples. This finding is only applicable for differentiating the VCO, palm olein, and homemade coconut oil. However, it can be further developed to quantify the palm olein adulteration in coconut oil.

Keywords: ATR-FTIR, palm olein, virgin coconut oil, differentiation, adulteration

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411/D

Development and analysis of nutritional properties of gluten free cookies incorporated with Water Lily Rice (“Oolu Haal”, *Nymphaea Sp.*)

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“Oolu Haal” is an underutilized food commodity in Sri Lanka with many health benefits. Individuals who experience gluten intolerance have the ability to consume cookies made from rice flour. “Oolu Haal”, the seeds of *Nymphaea sp.* have been used from the ancient time and in Siddha medicine as a treatment for diabetes mellitus. This study has been carried out to develop a cookie incorporating “Oolu Haal”, with the objective of comparing the nutritional properties of the developed cookie with the cookies made with 100% rice flour (control). Friedman and Wilcoxon signed rank tests in SPSS software were used to evaluate a sensorial data. The sample with most acceptance (aroma, texture, taste, overall acceptability) for all sensory properties was selected as optimal cookie composition. The control and new cookie were analysed for their proximate composition (moisture, protein, fat, carbohydrate, ash, and crude fibre), antioxidant activity (DPPH), total phenolic content, mineral profile following the standard procedures of AOAC. The formula of the developed cookie is composed of rice flour 43.88%, Oolu flour 18.8%, butter 31.34%, baking powder 0.31%, and sugar 5.64%. The control sample was prepared by adding 62.68% rice flour, butter 31.34%, baking powder 0.31%, and sugar 5.64%. Product moisture content was recorded as $2.97\% \pm 0.13$, protein content $5.58\% \pm 0.14$, ash $0.68\% \pm 0.20$, fat $26.69\% \pm 0.81$, fibre $5.73\% \pm 0.24$, and carbohydrate $10.47\% \pm 0.10$. As per the two-sample t-test, fat, fibre, protein, and carbohydrate contents of new cookie were significantly higher than the control (p value = 0.001, 0.000, 0.000, 0.024, respectively). Furthermore, total polyphenol content was significantly increased in new cookie ($1.094 \text{ GAE mg g}^{-1} \pm 0.039$) than control sample ($0.263 \text{ GAE mg g}^{-1} \pm 0.023$). Moreover, the DPPH IC_{50} value of the new cookie was $17.62 \text{ mg g}^{-1} \pm 0.52$ which was significantly higher than the control sample recorded as $0.417 \text{ mg g}^{-1} \pm 2.44$ (p value 0.000). The Mg, Na, K contents of the newly developed cookie were 39.54, 456.26, 54.16 mg l⁻¹, respectively. The shelf-life of the new cookie was 4 weeks under the triple laminated packing conditions. According to the yeast and mold test and Total Plate Count test, less than 30 CFU were observed after 4 weeks. Collectively, the newly developed cookies have more nutritional properties compared to cookies made with 100% rice flour.

Keywords: Cookies, gluten free, nutrition, *Nymphaea sp.*

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412/D

Molecular xenomonitoring of brugian filariasis in two filariasis endemic areas

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Lymphatic filariasis (LF) is a parasitic disease caused by nematodes from family Filariodidea that affects 882 million people in 47 countries worldwide. Brugian filariasis (BF) was eradicated from Sri Lanka in 1967 and after multiple rounds of mass drug administration, the World Health Organization declared Sri Lanka to be LF-free in 2006. However, routine surveillance has detected re-emergence of LF in Sri Lanka along the filariasis belt; specifically, in the Western and North-western provinces. There is no cure for LF and therefore, prevention is important in controlling the spread of the disease. This study investigated the geographical and seasonal variations of vector mosquitoes of brugian parasites in two filariasis-endemic regions of Sri Lanka, where the most recent filariasis positive incidents were reported from. Samples were collected from one site each from Puttalam (P1) and Kalutara (K1) during the monsoon (August-P1, December-K1) and inter-monsoon (April-P1, March-K1) seasons. The collected mosquitoes were morphologically categorized, dissected, and examined for the presence of the parasites within the head and thorax regions and confirmed *via* polymerase chain reaction targeting a region-specific for brugian parasites. A total of 281 and 71 mosquitoes were collected from P1 and 135 and 208 from K1 during the monsoon and inter-monsoon seasons, respectively. The mosquito population consisted of *Mansonia*, *Culex*, *Armigerous*, *Anopheles*, and *Aedes* in both sites. At P1, the most prevalent mosquito species were *Culex* spp. (67.26%) and *Mansonia* spp. (64.79%) during monsoon and inter-monsoon seasons respectively, whereas it was *Culex* spp. (55.56%) (43.27%) in both seasons at K1. The infective rate (IR) and vector index (VI) suggest *Mansonia* spp. (IR=0.378, VI=31.027) to be the dominant vectors with high infectiousness and abundance during both seasons at P1 while at K1 *Mansonia* spp. (IR= 0.18, VI=13.32) and *Armigerous* spp. (IR=0.01724, VI=1.03448) are dominant vectors in the inter-monsoon and the monsoon seasons, respectively. Data suggest that the species composition of mosquito populations and infectiousness change seasonally and geographically, and studies are being carried out to investigate this further. Data from this study suggest species-specific vector control strategies must be implemented to eliminate the possibility of the re-emergence of brugian filariasis in Sri Lanka.

Keywords: Brugian filariasis, re-emergence, infectiousness, seasonal, geographical

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413/D

Variation of water quality and brush park fish diversity: A study in Negombo Estuary

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In the Negombo estuary, the brush park fishery is confined to two small zones along its Eastern Katunayake side and the Western Dungalpitiya side, with approximately 50 brush parks each. In this research, we investigated what factors, whether seasonal or water-quality related, contributed to the brush park fishery being confined into these two zones. Three (03) randomly selected brush parks were sampled from each zone during the rainy season (November to December 2022), and the fishes in each brush park were identified to the maximum possible taxonomic category and enumerated separately. Further, the water quality parameters within those selected brush parks were measured using standard field and laboratory procedures. This procedure was repeated for another set of 03 brush parks in each zone during the dry season (February to April 2023). The fish diversity in each brush park was calculated using the Shannon-Weaver (H') and Pielou's evenness (J') indices. Fish abundance data and water quality data between the two zones and between the two seasons were analysed parametrically and nonparametrically as appropriate. Altogether, 18 taxa belonging to 16 finfish and shellfish families were recorded. Of the water quality parameters measured, the salinity, electrical conductivity, dissolved phosphates, and Ch-a increased significantly at both zones during the dry season. These water quality changes induced many marine species, including *Siganus* sp. and *Acanthopagous berda* to migrate into the two zones, resulting in *Siganus* sp. contributing about 42% and *Acanthopagous berda* contributing about 33% of the fish catch at Dungalpitiya and Katunayake, respectively. When the salinity, in particular, dropped near zero in both zones during the rainy season, these marine species migrated back. The same salinity drop induced the freshwater *Macrobrachium rosenbergii* to migrate into the two zones in large numbers during the rainy season, contributing about 61% and 30% of the fish catch at Katunayake and Dungalpitiya, respectively. It was apparent that *M. rosenbergii* dominates the brush park fish catch during the rainy season, while the marine *Siganus* sp. and *A. berda* dominate it during the dry season. The brush park fish diversity was higher in both zones during the dry season than in the wet season. For example, the SR, N, H' , and J' at Katunayake during the dry season were 15, 425, 1.651, and 0.6098, while 7, 87, 0.5189, and 1.01 during the wet season. Results also suggest that the seasonal and zonal changes of salinity, dissolved phosphates, and Ch-a govern the brush park fish diversity in the Negombo estuary.

Keywords: Brush park, *Macrobrachium*, Negombo estuary, seasonal, water quality

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414/D

Herpetofaunal diversity and endemism in a fragmented forest patch: A study in the Dombagaskanda Forest Reserve

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Fragmented forest patches provide refuge for distressed animal forms including amphibians and reptiles (herpetofauna) but an array of adverse anthropogenic impacts often threatens them. Surrounded by human settlements, the Dombagaskanda Forest Reserve (DFR) is one such small, threatened, fragmented forest patch (area 192 ha) in the wet zone of the country. In this research, we studied the variation of the herpetofaunal diversity along a seasonal and spatial scale in the DFR and evaluated their endemism and conservation status against the National Red List 2012 of Sri Lanka. The research design included surveying herpetofauna within (*viz.* forest zone and monastery zone) and around the DFR (*viz.* outer buffer zone) during the wet season (November to December 2022) and dry season (January to March 2023) using a quadrat sampling strategy. The herpetofauna diversity in these three zones was calculated using the species richness (SR), Shannon-Weaver index (H'), and Pielou's evenness index (J'). The canopy cover, air and soil temperature, humidity, and tree diameter in the quadrat sampling areas were also measured. A total of 125 individuals belonging to 14 reptilian and 11 amphibian species were identified. They showed a distinct spatial variation where their total abundance and diversity within the monastery zone were greater ($N=40$, $SR=14$, $H'=2.507$, $J'=0.9501$) than in the forest zone ($N=26$, $SR=13$, $H'=2.418$, $J'=0.9427$) and the peripheral buffer zone ($N=21$, $SR=9$, $H'=1.934$, $J'=0.8801$). They also showed a seasonal variation where their total abundance and diversity were higher during the dry season than in the wet season. Five (05) reptile and 08 amphibian species were endemic to Sri Lanka, representing 42% reptilian and 73% amphibian endemism. The endemism percentage (%) of herpetofauna within the DFR is 56.5%, which is 13 times higher than that in the outer buffer zone (4.6%). Of the 05 endemic reptile species, 02 are endangered, whereas of the 08 endemic amphibian species, 04 are endangered. Despite its small size, results suggest that the DFR is a rich biodiversity repository with a high herpetofaunal endemism, of which most are endangered. Results also insist on the grave need to protect and conserve small, fragmented forest patches, similar to DFR, from further human threats.

Keywords: Conservation, Dombagaskanda, endemism, fragmented forest, herpetofauna

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415/D

Morphological and vocal characterization of Western and Eastern Yellow Wagtail allospecies complex (*Motacilla flava*–*tschutschensis*) in Sri Lanka

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The yellow wagtail complex, previously considered a single species (*Motacilla flava*), has recently been divided into two: the Western Yellow Wagtail (*Motacilla flava*) and the Eastern Yellow Wagtail (*Motacilla tschutschensis*). Previous studies conducted elsewhere have shown noticeable differences in hind claw length and the first flight call between these two species. This study aims to characterize the yellow wagtail complex in Sri Lanka for the first time using key morphological and vocal traits. We used the mitochondrial ND2-based molecular phylogeny developed by us to separate these two species. The morphometric analysis involved combining data on key morphometric variables obtained from yellow wagtails captured in the field (Eastern= 10, Western= 3) using mist nets with data from previously identified eastern and western yellow wagtails. The data from the firstflight call recorded in the field (n=13) along with data from the Xeno-canto database were used for the vocal. A multivariate analysis of variance (MANOVA) test conducted using the R statistical platform was used to determine differences in morphological and vocal traits between the two species. Principal components analysis (PCA) was also performed on the morphometric and vocal data in the R platform. According to the MANOVA test ($F_{n=26}=3.9816$, $P= 0.0147$), there was no significant difference in morphological traits between the two species as defined by molecular phylogeny. However, a separate ANOVA analysis revealed that hind claw length exhibited significant variation ($P=0.018$). The PCA biplot showed no clear separation, although hind claw length tends to increase towards the Eastern Yellow Wagtail group. Similarly, the MANOVA test ($F_{n=22}=3.4087$, $P= 0.024$) showed no significant difference in vocal traits between the two species. A separate ANOVA analysis revealed that the number of peaks at the down stroke of the first flight call exhibited significant variation ($P=0.0001$). The number of peaks at the down stroke increased towards the Eastern Yellow Wagtail group. Based on these findings, we proposed the length of the hind claw and the number of peaks at the down stroke of the first flight call are the best phenotypic characters that can be used to separate the two taxa in the field.

Keywords: Eastern Yellow wagtail, MANOVA, Morphological traits, Vocal traits, Western Yellow Wagtail

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416/D

Parasite load and host immune response in avian communities along the elevational gradient

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Parasites consume host resources, leading to a decrease in the overall health and fitness of the host. Consequently, parasites act as a selective pressure and play a significant role in shaping the evolution of hosts. Elevational gradients offer an ideal research setting for investigating the distribution of parasites, vectors, hosts, and host immune responses across different environmental conditions. However, a systemic investigation of the parasitic profile and host immune responses in avian hosts along an elevational gradient in the region is lacking. To address this research gap, an investigation was conducted in the Issengard Biosphere Reserve located in Belihuloya, Sri Lanka, which has a steep elevational gradient spanning 1 km, with elevations ranging from 480 m at Samanalawewa Reservoir to 1420 m at Haagala peak. The study is focused on examining the presence of parasites, parasite intensity, and host response in avian communities along this elevational gradient at every 100 m interval. A total of 49 birds representing 18 species from 13 families, including endemic, resident, and migratory birds, were obtained along the elevational gradient. Out of the 49 birds analysed, a total of 13 individuals (26.53%) belonging to 6 species were found to be infected with blood parasites. Among these birds, 6 individuals (12.24%) from 3 species were found to have microfilaria larvae, while 7 individuals (14.28%) from 4 species were found to have *Haemoproteus* sp. infections. The intensity of microfilaria decreased with increasing elevation. On the other hand, the intensity of *Haemoproteus* sp. infections increased with elevation. Microfilaria found in Brown-capped Babbler may be the first discovery of the microfilaria found in Brown-capped Babblers in Sri Lanka. Upon examining the host immune response, data showed that body temperature significantly increased with elevation ($P=0.002$), and the total white blood cell (WBC) count showed a substantial negative correlation with elevation ($P=0.05$). The red blood cell (RBC) elongation ratio significantly increased along with elevation ($P=0.042$). Notably, there was a positive correlation between the RBC elongation ratio and the intensity of *Haemoproteus* sp. infections ($P=0.003$). In conclusion, the results provided valuable insights into parasite-host interactions and their response to changing elevation in avian communities.

Keywords: Elevational gradients, blood parasites, host immune response, microfilaria, *Haemoproteus*

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417/D

Microplastic contamination in Morawala intertidal rocky shore in Negombo, Sri Lanka: Possible threats towards molluscs during Southwest and Northeast monsoon seasons

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Floating litter (FL) is a silent threat towards the global marine ecosystems, which needs to be addressed immediately. Microplastics (MPs) are the major FL with size less than 5 mm. Its accumulation in the major marine gyres and associated ecosystems has already been imposed with some unseen adverse environmental effects. Not even the biota of the pelagic zone, the inhabitants of the intertidal zone including rocky shores (RS) and sandy shores (SS) will also get contaminated with MPs when it is inundated with the sea water twice during the day. The present study has been conducted in the 500 m stretch of Morawala RS in Negombo Sri Lanka to investigate the MP contamination levels in RS associated environmental samples (sea water and beach sand). Moreover, the RS was surveyed for its vertical zonation molluscan diversity since they act as sentinel species of the ecosystem health. The RS was sampled during the Southwest (SWM) and Northeast (NEM) monsoon seasons during both the high tide and the low tide time. Nearly 50 L of water was filtered and bulk sand samples (1 kg) in triplicates were collected at each of the locations to test for MPs (sample n=3 per visit). Samples were subjected for sieving, wet peroxidase oxidation, density separation, and fractionation. Finally, MPs were visually detected and quantified as per standard procedures. The results exhibit a high significant surface water MP concentration (49,067 items/m³) with the onset of NEM ($p < 0.05$) while (6133 items/m³ and 4613 items/m³) during the SWM. MP levels in sand varied between the monsoons (7.85 items/kg, 9.94 items/kg and 13.33 items/kg) with no significant seasonal difference ($p > 0.05$). The surface water MPs concentration was higher than the percentage abundance of the MPs presents in beach sand. Further, molluscan species richness of the RS is 20 recording *Nodilittorina quadricincta*, *Saccostrea* sp., *Crassostrea* sp., and *Brachiodontes* sp. as the common species. The molluscan diversity index is slightly high during NEM. Digested specimens showed entangled threads of MPs in the radula interfering grazing. Further investigations are warranted as the MPs are considered as vectors of persistent organic pollutants if these grazers are ingesting the MPs itself and deplete their bodies with continuous influx of seawater.

Keywords: Microplastic, Molluscs, intertidal, Negombo, Sri Lanka

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418/D

Study of gastrointestinal parasitic infections in isolated, semi-wild population of critically endangered hog deer (*Axis porcinus*) in Honduwa island sanctuary in the wet zone of Sri Lanka

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Hog deer (*Axis porcinus*) is considered as a critically endangered species in Sri Lanka. Thus, as an *ex-situ* conservation program implemented by Wildlife Conservation Society of Galle (WCSG) in 2013 to conserve the critically endangered Hog deer in Sri Lanka, there were 30 individuals of isolated semi-wild hog deer population in the Honduwa island sanctuary. This study was conducted to analyse the prevalence and infection intensity of gastrointestinal (GI) parasites in this hog deer population. A total of 18 animals were examined for GI parasites of protozoans, nematodes, trematodes, and cestodes. Out of which, 14 were infected with at least one GI parasite. Fresh faecal samples were collected immediately after defecation and were stored at 4 °C before analysis. The analysis was conducted using four methods: iodine and saline smears, sedimentation technique, Sheather's sucrose floatation method, and the McMaster test. Parasitic eggs, cysts, and larvae were morphologically identified. McMaster counting technique was carried out to obtain egg counts across five age categories of the population to determine the intensity of parasitic infections. Protozoan infection was more common than helminth infection. The highest prevalent GI parasites in hog deer were protozoans (88.8%) followed by nematodes (66.6%), cestodes (55.5%), and lowest prevalent GI parasites were trematodes (44.4%). The quantitative analysis revealed that the highest protozoan infection was observed in sub-adult males (0.5 cysts per gram). The highest trematode (0.667 eggs per gram) and nematode (1.667 eggs per gram) infections were observed in adult males and the highest cestode infection was observed in adult females (0.833 eggs per gram). Importantly, despite the high prevalence, infection intensity suggests these may be incidental infections, potentially becoming pathogenic under stress conditions. In conclusion, managing these parasitic infections in the Hog deer population requires regular examinations, early treatments, and holistic practices encompassing nutrition, sanitation, and deworming.

Keywords: Hog deer, parasitic infection, gastrointestinal parasites, critically endangered, semi-wild population

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419/D

Nestling development in *Dinopium* Flamebacks of Sri Lanka: A study using endoscope nest cameras

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The growth and development of nestlings have been extensively studied in avian ecology; however, there is a scarcity of detailed investigations on primary excavators such as woodpeckers. *Dinopium* Flamebacks, a group of woodpeckers found in tropical Asia, received limited attention regarding their nestling development. Our objective was to investigate the nestling development of *Dinopium* Flamebacks using an endoscope wire pinhole camera. The study was conducted from June 2022 to February 2023 in three distinct study areas in Eppawala, Kaduwela, and Talaimannar, each covering 2 km². Active nests were located by closely observing adult birds and monitoring their cavity activities. Video recordings of nestlings were obtained during feeding trips of adult birds, ensuring minimal disturbance. Recordings were analysed to study nestling growth and colour development. In total, 12 nestlings from six active nests were monitored, with one nest closely observed daily from hatching to fledging, serving as a reference for interpreting the developmental stages of others. Initially, hatchlings exhibited no feathers, closed eyes, egg-tooth and prominent rectal flanges. As days progressed, their limbs grew stronger, enabling them to push itself off the nest bottom using their tarsi, allowing them to reach higher while begging. Starting from day 3, feather tracts began to emerge, the colour of the egg tooth started to shade, and vocal activity also increased. From days 7 to 11, nestlings displayed fully open eyes, development of pin feathers, and distinct crest and crown coloration. Feather development continued, and around days 12 to 13, red/orange colour barbs emerged. By days 16 to 17, the bill, tarsus, and feet turned grey. From day 18 onward, the young birds climbed the nest wall and appeared at the entrance in response to the presence of adults. Finally, by days 24 to 26, nestlings left the nest, initially making short flights and gradually exploring their surroundings independently. The study also revealed that the nestlings relied on parental care and support for approximately 24-26 days after hatching before leaving their nests. This study emphasizes the significance of investigating nestling development using endoscope cameras, enhancing our knowledge of the nestling development phase of *Dinopium* Flamebacks' breeding phenology.

Keywords: *Dinopium*, Flame backs, nestling development, breeding, Sri Lanka

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The effect of genetic introgression in shaping phenotypic diversity in *Dicrurus drongos*

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Genetic introgression is described as the incorporation of alleles of one species into the genome of a second species through hybridization and backcrossing. The resulting hybrids could acquire a mixture of alleles and phenotypes of their parents to different degrees. Introgression occurs when closely related species come into secondary contact. It is capable of significantly modifying a population's phenotype, affecting its physical and behavioural traits as well as its evolutionary course. *Dicrurus drongos* are a group of passerine birds found throughout tropical Asia. Among them, Sri Lanka drongo (*Dicrurus lophorinus*) is restricted to the wet zone, and the Greater racket-tailed drongo (*Dicrurus paradiseus*) is found in the dry zone of Sri Lanka. Belihuloya, Sri Lanka, is identified as a transitional habitat located between the dry and wet zones, where these two species of drongos come into contact. The objective of this study was to determine the clinal variation of genotype and phenotypic traits of *Dicrurus paradiseus* allospecies cluster from wet zone to the dry zone of Sri Lanka. To investigate this phenomenon, field sampling was carried out along a transect across the identified contact zone and into the allopatric zones which are located on either side of the contact zone in Belihuloya. The study identified 6 partially informative single nucleotide polymorphisms (SNPs) found in two molecular markers (ND2 and Cytb) and 14 morphometric parameters including 4 ornamental traits and 10 non-ornamental traits. The CFit-7 program was used for the cline construction for genetic data. CFit-7 results suggest a clinal variation in ND2 and Cytb genomic markers. The cline is narrow, measuring 19.52 km in width and its centre is located 29.24 km east of Belihuloya. The cline variation of the phenotypic traits was visualized by fitting cubic splines in the program R. Among all the morphometric traits, only the total tail length of drongos shows a clinal variation at the same area where the genetic data shows a clinal variation. These results suggest that the total tail length can be considered a good predictor of the genetic variation of this group of birds.

Keywords: Introgression, *Dicrurus*, hybridization, phenotype, Belihuloya

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421/D

**Microplastics occurrence in the gut content of Bluestripe herrings
Herklotsichthys quadrimaculatus (Rüppell, 1837) along the Southern coastal
waters of Sri Lanka**

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Microplastics (MPs) are a major threat and pollutant in the marine environment, affecting wide range of marine species. Studying the MPs in marine species is important to evaluate the level of pollution and the risk of food contamination in marine waters. The aim of the present study was to investigate MPs contamination of the gut content of Bluestripe herring (*Herklotsichthys quadrimaculatus*) along the southern coastal waters of Sri Lanka. Five fresh samples were collected from each site (Weligama, Tangalle, Kottogoda), and the necessary measurements were taken. Digestive tracts were digested in 30 ml of 10% KOH solution at 60 °C. A density separation method (1.2 g/ml NaCl) was used to separate MPs from digested solution and filtered using Whatman GF/C filter papers (1 µm pore size). Filter papers were stained using Nile Red and examine under a stereomicroscope (x45 magnification) using blue light (430-470 nm). Blank samples were used to standardize all the laboratory procedures. The total mean abundance of MPs/individual in the three sites were significantly different (One-way ANOVA: $F = 5.55$, $MS = 57.87$, $p = 0.020$, $p < 0.05$). The total mean abundance of MPs (mean \pm standard deviation, MPs/individual) at Weligama, Kottogoda, and Tangalle were (9.40 ± 3.05 MPs/individual), (5.80 ± 4.60 MPs/individual), and (2.600 ± 0.894 MPs/individual), respectively. Samples collected at Weligama had the highest MPs while the lowest was recorded at Tangalle. The abundance of MPs neither showed a significant relationship (Regression analysis: $p > 0.05$) with the total body weight nor with the gut weight. Fragments, fibres, and films were the types of MPs detected in the gut content, with the highest being fragments (44.94%), and the most common colour was blue (52.54%) in all three sites. The results of this study emphasize that MPs are a specific problem in the marine environment with some sources and that this pollution affects marine organisms regardless of their size by ingestion that is either intentional or unintentional.

Keywords: Microplastics, Sri Lanka, *Herklotsichthys quadrimaculatus*, Nile red staining

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Spatial distribution of vectors carrying brugian parasites in a transmission active locus in the Puttalam District, Sri Lanka

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Lymphatic filariasis (LF) is a debilitating disease which infects 882 million people worldwide. Of the two types of LF, brugian filariasis (BF) was eliminated from Sri Lanka by 1967. However, post-elimination surveillance suggests re-emergence of brugian filariasis. With no cure for BF, controlling transmission *via* effective vector control strategies is the most effective method of curbing the disease. Here, we investigated the spatial distribution of potential vectors in a transmission active locus to assess the risk of transmission of the disease from an infected individual. The most recent case of BF (index site) in the Puttalam district at the time of the study was selected as the study site since BF cases are most frequently reported from the Puttalam district. Mosquitoes were collected from four locations: the index site, 150 m, 450 m, and 650 m away from the index site to encompass the mean flight range of *Mansonia* spp., the known vectors of BF. Mosquitoes were morphologically identified and the heads and thoraces were dissected to detect infected mosquitoes. The parasite positive mosquitoes were confirmed *via* PCR. Mosquito abundance and species composition differed between sites, with the highest number of mosquitoes being reported at the index site (281). The total number of mosquitoes caught at 150 m site, 450 m site, and 650 m site were 224, 32, and 33, respectively. The infective rate (IR) was 0.1593 at the index site, and 0.1084 at the 150 m site. Infective mosquitoes were absent at 450 m and 650 m sites. The dominant vector species at the index and 150 m sites were *Mansonia uniformis* (IR=0.3333) and *Culex gelidus*, (IR=0.2500) respectively. Additionally, *Culex tritaeniorynchus*, *Mansonia annulifera* and *Mansonia indiana* were detected as potential vector species at the index and 150 m sites of which, based on the Vector Index (VI), *Cx. tritaeniorynchus* (VI=14.00) and *Ma. uniformis* (VI=14.83) were the most abundant species at each site, respectively. Observation of the surroundings of the sites revealed breeding sites of *Culex* and *Manosnia* mosquitoes. These results suggest that vector mosquito species vary between sites based on the availability of breeding sites; hence, targeted control measures should be implemented.

Keywords: Parasitology, brugian filariasis, mosquito-borne disease, vector Distribution

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501/E1

Investigating outburst characteristics of YZ Cancri dwarf nova through TESS photometry

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In this study, we present a detailed analysis of Transiting Exoplanet Survey Satellite (TESS) photometry data for Yz Cancri, a dwarf nova system. A dwarf nova consists of a white dwarf, an accretion disk around the white dwarf, and a companion star. Dwarf novae exhibit periodic eruptions which occur due to the accretion of matter onto the accretion disk from its companion. Our investigation of Yz Cancri reveals three distinct types of eruptions: normal bursts, superbursts, and superhumps which were observed during the superburst phase. Normal bursts are characterized by sudden increases in brightness followed by a gradual decline to the quiescent state. Superbursts, on the other hand, are rare and intense eruptions with significantly higher luminosity. Superhumps are periodic brightness variations that occur during the superburst phase, providing valuable insights into the dynamics of the system. To analyse the photometric behaviour of Yz Cancri, we utilize the TESS light curve data obtained between 12th October 2021 and 27th January 2022. Through careful examination of the light curve, we accurately determine the orbital period of Yz Cancri to be 0.0869 ± 0.0121 days, which corresponds to the time taken for one complete orbit within the binary system. Furthermore, our analysis reveals the periodicity of superhumps as 0.0910 ± 0.0121 days. These periodic brightness variations of superhumps provide valuable clues about the physical processes occurring within the system during the superburst phase. Examining the recurrence time of normal bursts, we find it to be approximately 10.61 ± 2.50 days. This information sheds light on the cyclic nature of the eruptions in Yz Cancri and provides for further studying the system's long-term behaviour. Additionally, we measured a significant magnitude difference of 2.60 ± 1.06 between the superburst and quiescent states where its average magnitude is 14.17 ± 1.04 . Overall, our findings contribute to a comprehensive understanding of Yz Cancri's photometric behaviour and provide valuable insights into the distinct eruption types exhibited by this dwarf novae system.

Keywords: SU Uma dwarf novae, Normal and Super Bursts, Superhumps,

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Study of the effect of chemical composition on the standard compressive strength of ordinary Portland cement with the same mixed design

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Ordinary Portland Cement (OPC) is one of the most widely used types of cement in construction. Its compressive strength is a crucial parameter that determines its ability to withstand loads and provide structural stability. The compressive strength of cement is typically measured in terms of the maximum load it can bear before it fails under compression. Mixed design refers to the specific proportions of the constituent materials used to create the cement mix, including cement, aggregates, water, and any additional admixtures or additives. The mixed design and chemical composition play a significant role in determining the properties including the strength of the cement. The compressive strength of Ordinary Portland Cement is an important parameter in determining the durability and stability of structures. This study aimed to investigate the effects of chemical composition on the variation of the standard compressive strength with the same mixed design at 28 days. Ordinary Portland cement samples were prepared according to the standards for the strength class of 42.5 for the same mixed design with a cement, water, and sand ratio of 1:2:6 respectively. The analysis of six chemical compositions revealed that the chemical composition of Ordinary Portland Cement exerts a substantial influence on its compressive strength. In the analysis, it was ensured that all other parameters were kept constant while examining the significant effect of the chemical composition of Ordinary Portland Cement on its compressive strength. According to the results, calcium oxide (CaO), silicon dioxide (SiO₂), and aluminium oxide (Al₂O₃) were in maximum suitable ranges of 63.5% to 65.0%, 4.5% to 4.9%, and 20.75% to 21.50%, respectively, increasing the compressive strength with time, and magnesium oxide (MgO), chlorine (Cl), and sulphur trioxide (SO₃) were in minimum suitable ranges of 2.6% to 2.45%, 1.3% to 1.0%, and 0.05% to 0.03%, respectively, decreasing the compressive strength with time. The study found that an increase in CaO, SiO₂, and Al₂O₃ content leads to an increase in compressive strength, while MgO, Cl, and SO₃ have a limited range for improving compressive strength with time. This information can be useful in selecting the appropriate Ordinary Portland Cement for specific applications.

Keywords: Ordinary Portland cement, compressive strength, chemical composition, mixed design, strength class

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Design and fabrication of 360-degree rotatable eyepiece unit for Newtonian reflectors as an ergonomic improvement of astronomical instrumentation

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The ability to reach the eyepiece of the telescope conveniently is of utmost importance during astronomical observations. It significantly improves the observational capacity for a variety of users. The eyepiece placement in different astronomical telescopes changes according to its own optical assembly. It is undoubted that the Classic Newtonian telescope in equatorial mount is the ideal for longer duration celestial observations. But this arrangement has a significant disadvantage too. As the eyepiece is located at the upper end of main tube, it moves away when tracking celestial objects, and the observer finds it difficult to see through it. This problem is further aggravated with larger telescopes as the diameter is increased. As a resolution for this, a less complex, low cost and light weight unique mechanical design, a rotatable secondary mirror cell, was designed to bring back the eyepiece near to observer's eye. The secondary mirror cell is made rotatable using an electric motor-powered belt driven mechanism. This assemblage was introduced to an equatorial mounted Newtonian reflector having a 300 mm diameter f8 primary mirror, which was also completely fabricated locally. In test observations, the developed mechanism could achieve 360-degree rotation around the primary optical axis without distorting the image and without changing the viewing position. By incorporating a rotatable eyepiece, observers could easily align the eyepiece with their line of sight regardless of telescope's orientation. Also, the results suggested that incorporation of the rotatable eyepiece into a telescope offers several other user benefits. The enhanced observational versatility due to its ergonomic design contributed to a more comfortable and efficient observing experience. Furthermore, it helped to eliminate the neck and back strain of users, which might occur with odd postures maintained during prolonged observations. The ability to position the eyepiece to a convenient position reduced observational limitations caused by biophysical variations of different users. The findings of this project work highlighted that this advantageous invention with high Benefit-Cost Ratio (BCR) adds a greater value to astronomical telescopes than the existing similar modifications. Therefore, it indicates significant advancement in observational astronomy and offers a novel approach to telescope design and usability, with a greatly enhanced user experience, making astronomy more accessible, comfortable, and enjoyable for both professional and amateurs.

Keywords: Rotatable eyepiece, ergonomic design, astronomy instrumentation, reflectors

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Investigation of the reverse piezo response of tropocollagen using molecular dynamics simulations.

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Collagen is the main structural protein in the human body and the major constituent of the extracellular matrix of tissues such as cartilage and tendon. It is well known that collagen exhibits piezoelectricity; however, its microscopic origin and manifestation at different hierarchical levels of collagen is not fully understood. The main objective of the present study was to investigate the reverse piezoelectric effect of the fundamental building block of collagen fibrils known as tropocollagen, using molecular dynamics (MD) simulations. MD simulations provide a computational tool to investigate the atomic-level behaviour of biological systems under different thermodynamic conditions. The tropocollagen model consisting of three amino acid chains wound into a triple helix was obtained from the PDB databank (PDB ID: 1BKV). The axis of the tropocollagen was aligned parallel to the z-axis and the corresponding topology and parameter files were created. The structure was energy minimized and equilibrated at 278 K temperature. The production MD run was performed at 278 K while applying a constant electric field along the z-axis. The deformation of the tropocollagen fragment with time was measured for a period of 100 ps with a timestep of 0.1 ps. Maintaining the temperature as low as 278 K was important to exclude the deformations due to thermal fluctuations from the deformations due to the electric field. When the electric field intensity was varied from 0.514 V pm^{-1} to 1.028 V pm^{-1} , we observed that the tropocollagen started deforming only after the field was increased to a threshold value of $0.78779 \pm 0.00005 \text{ V pm}^{-1}$. In the range of electric field intensity of 0.7877 V pm^{-1} to 1.0284 V pm^{-1} , the backbone of the tropocollagen fragment gradually bent into a circular shape; the bending was initiated from the middle region of the tropocollagen where imino-poor residues are abundant. The time taken for the complete deformation was 65 ps for the threshold electric field and decreased with the increasing intensity of the electric field. When the field intensity was increased in a range from 0.771 V pm^{-1} to 1.028 V pm^{-1} , the angle of the backbone of the tropocollagen fragment with the z-axis (bending angle) increased from 0° to 115° . Our findings provide a basic understanding of the reverse piezoelectric response of an isolated tropocollagen fragment. This could lead to a more comprehensive study on the piezoelectric response of collagen at different hierarchical levels and hence the piezo response of collagen-based biomaterials.

Keywords: Tropocollagen, Collagen reverse piezoelectricity, Molecular dynamics.

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XRD and SEM characterization and performance analysis of rGO/carbon black incorporated positive electrode in lead acid battery

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Lead acid batteries have long been recognized as a versatile and cost-effective energy storage solution for various applications, including automotive, renewable energy integration, and telecommunications. However, the performance of lead acid batteries can be hindered by issues such as sulfation during discharging and positive electrode grid corrosion. This research aims to investigate the impact of specific additives on the positive electrode of lead acid batteries, with a focus on carbon-based additives such as rGO and carbon black (CB). However, the present research mainly focuses on the comprehensive characterization of rGO and CB-incorporated positive electrodes using scanning electron microscopy (SEM) and X-ray diffraction (XRD). SEM analysis revealed the presence of lead oxide and lead dioxide particles in the positive electrode clearly but rGO and CB particles were not observed due to lower content. However, XRD analysis revealed the present of rGO and CB clearly.

Keywords: Lead acid battery, positive electrode, rGO, Carbon black, Charge-discharge performance, SEM and XRD

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506/E1

Measurement of airborne indoor radioactivity from alpha emitting isotopes in Colombo municipal council schools

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For the first time in Sri Lanka, a preliminary study was done to investigate the indoor radon and thoron daughter product levels in schools in the municipal council area of Colombo, using alpha spectroscopy. Radon and thoron decay products present in the air quickly attach to the aerosols and enter and deposit inside the lung wall through inhalation. These decay products have a very short half-life, quickly decay by emitting high energy alpha radiation inside the lungs before coming out and increase the risk of cancer. Children are generally more vulnerable to its effects than adults because their cells are dividing more rapidly. Measurements were based on the collection of radon daughter products present in airborne dust onto a glass microfiber filter paper, which was attached to the air inlet of the sampling vacuum pump, and subsequent measurement in an alpha spectrometer equipped with a surface barrier detector. Fourteen samples were collected from schools during school time in selected sampling locations, and two samples were collected from police stations to compare the results with those in public areas. Alpha spectra for each collected sample were taken. In alpha spectroscopy, spectral de-convolution has always been a problem since individual low energy side alpha peaks frequently partially or completely overlap on the tailing of other high energy alpha peaks because of the low attainable energy resolution. Therefore, an improved peak shape formula was used for the de-convolution of alpha spectra. ^{214}Po , ^{212}Bi , and ^{212}Po decay products were observed from the obtained spectra, and the activity concentrations of these daughter products were calculated. It was observed that indoor ^{214}Po activity concentration varies from $(3 \pm 1 \text{ Bq/m}^3)$ to $(14 \pm 3 \text{ Bq/m}^3)$ with an average value of $(5 \pm 1 \text{ Bq/m}^3)$. The maximum indoor ^{214}Po activity concentration was observed in Colombo 09, and the minimum ^{214}Po activity concentrations were observed in Colombo 13 and Colombo 14. The ^{212}Bi activity concentration varies from $(0.09 \pm 0.02 \text{ Bq/m}^3)$ to $(0.8 \pm 0.2 \text{ Bq/m}^3)$ with an average value of $(0.23 \pm 0.04 \text{ Bq/m}^3)$. The ^{212}Po activity concentration varies from $(0.08 \pm 0.02 \text{ Bq/m}^3)$ to $(0.8 \pm 0.2 \text{ Bq/m}^3)$ with an average of $(0.24 \pm 0.05 \text{ Bq/m}^3)$. The maximum indoor ^{212}Bi and ^{212}Po activity concentrations were observed in Colombo 09, and the minimum ^{212}Bi and ^{212}Po activity concentrations were observed in Colombo 07 and Colombo 08. There was no significant difference between the activity concentration values obtained from the police stations and schools. Compared to India, the recorded activity concentrations of radon and thoron daughter products are very low.

Keywords: Alpha spectroscopy, radon, thoron, radon progeny

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Impact of sea water intrusion on the groundwater in Hikkaduwa area

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Seawater intrusion into the groundwater aquifers is an identical challenge in coastal and near coastal areas in the world. This research study is focused on the contamination of groundwater by saltwater. The Hikkaduwa coastal area was selected as the study area in southern Sri Lanka. Twenty-nine samples were collected from dug wells, lagoons, estuary, river, and sea. Samples were chemically tested at the Sri Lanka Atomic Energy Board's Isotope Hydrology Laboratories. The degree of contamination of seawater in groundwater around the Hikkaduwa area was measured using chemical parameters such as electrical conductivity (EC), pH, dissolved oxygen (DO), resistivity, salinity, hardness, and major ion concentration (cations and anions). The results of the analysis revealed the ranges of values of EC, TDS, salinity, resistivity, pH, DO, and hardness as 72.5 – 50800 ($\mu\text{S}/\text{cm}$), 34.3 – 31700 (mg/L), 0.03 – 33 (‰), 0.0199 – 13.9300 ($\text{k}\Omega/\text{cm}$), 4.67 – 8.03, 3.93 – 7.53 (mg/L), and 5.6 – 662.4 ppm as CaCO_3 , respectively. The ranges of concentration of major ions Na^+ , K^+ , Mg^{2+} , Ca^{2+} , F^- , Cl^- , NO_3^- , and SO_4^{2-} are 4.36 – 13838.00, 1.40 – 880.50, 1.10 – 1999.25, 5.33 – 2082.50, 0.04 – 1.25, 4.34 – 20818.75, 0.06 – 70.50, and 0.27 – 68.00 (mg/L), respectively. According to various research studies and world standards, to determine the seawater intrusion to the groundwater aquifers, the threshold values can generally be used as: pH (< 7.5), (EC) (> 1,000 $\mu\text{S}/\text{cm}$), (DO) (> 4 mg/l), salinity (> 2 ppt), resistivity (< 5,000 ohm-cm), TDS (> 1500 mg/L), hardness (> 250 mg/L as CaCO_3), chloride ion (Cl^-) (> 250 mg/L), sodium ion (Na^+) (> 200 mg/L, $\text{Ca}^{2+}/\text{Mg}^{2+}$ ratio (> 1), NO_3^- : the maximum permissible value is 45 mg/L as NO_3^- , SO_4^{2-} : the maximum permissible value is 400 mg/L as SO_4^{2-} . According to the results compared with threshold values, it was concluded that there is seawater intrusion to the groundwater in near coastal and lagoon areas. Apart from that it was found that some groundwater sources are not suitable for drinking purposes within the range of 0-560 m from either sea or lagoon margins. Avoiding groundwater extraction from aquifers minimizes saltwater intrusion into freshwater aquifers.

Keywords: Sea water intrusion, groundwater, drinking water, chemical parameters, ion chromatography.

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Light curve analysis of Kepler-observed eclipsing binary star systems: KIC3858884, KIC8504570, and KIC6629588

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This investigation analysed three Kepler targets, KIC3858884, KIC8504570, and KIC6629588, which are eclipsing binaries containing Delta Scuti stars, allowing the analysis of both extrinsic and intrinsic characteristics. The main objective was to probe the g-modes of these and understand essential interior stellar parameters such as overshooting, mixing length, and chemical composition. The light curves of the star systems were analysed using Kepler's photometric data. Binary signatures in these light curves were eliminated by disentangling eclipses from pulsations using the PYWD2015 binary light curve modelling tool. The process of eliminating binary characteristics involved selecting the most accurate binary parameters through iterative differential corrections, aiming to minimize the differences between observed light curve data and the modelled binary light curve. The residual data were subjected to Discrete Fourier Transform, allowing them to be decomposed into their constituent frequency components. Only frequencies with a signal-to-noise ratio (S/N) ≥ 4 were considered for analysis. Prior to probing the g-modes, dominant radial and non-radial pressure modes and their combinations and harmonics were removed. The g-modes for each star system were identified within the frequency range of 0.3 to 3.0 cycles per day. This study confirmed seven g-modes for KIC 8504570, fourteen g-modes for KIC 3858884, and nine g-modes for KIC 6629588. After identifying the g-modes of these star systems, evolutionary tracks representing the life cycle of each star were modelled using MESA code. The best-fitted track for each star in the binary star systems was selected as the one spending most of its lifetime within the observed temperature and luminosity region. According to the best-fitted evolutionary tracks, the primary star and the secondary star of KIC 8504570 possess stellar masses of $1.65 \pm 0.05 M_{\odot}$ and $0.95 \pm 0.05 M_{\odot}$ respectively. For KIC 3858884, findings indicate stellar masses of $1.95 \pm 0.05 M_{\odot}$ and $1.90 \pm 0.05 M_{\odot}$ for its binary components. In the case of KIC 6629588, the analysis points to stellar masses of $1.60 \pm 0.05 M_{\odot}$ for the primary star and 0.45 ± 0.05 for the secondary star. The evolutionary tracks indicate that the primary stars of KIC 8504570 and KIC 6629588, both binary components of KIC 3858884, are Delta Scuti stars, as they reside within the instability region on the H-R diagram. The secondary stars of KIC 8504570 and KIC 6629588 are non-variable and do not contribute to brightness variations through pulsations. The study has the potential to further computational simulations of the g-modes exhibited by these stars and explore their interior properties.

Keywords: g-modes, eclipsing binaries, Delta Scuti stars, evolutionary tracks

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Machine learning application for binary and pulsation star classification

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In recent times, there have been many space missions exploring space. Some of these missions, like Kepler, K2, and TESS, focus on finding planets outside our solar system. But scientists are also interested in studying stars that change in brightness, called variable stars. These missions collected a lot of data, and researchers are using computer programs to analyse it. They use a special kind of computational technique called machine learning, which can quickly and accurately handle large amounts of data. The main goal of this research is to identify three groups of variable stars in the Kepler mission's data. These groups are pure pulsation stars, pure eclipsing binary stars, and eclipsing binary stars with pulsation components. To carry out our study, we downloaded 850 light curves from the MAST (Mikulski Archive for Space Telescopes) database and simulated 180 additional light curves using software that models binary stars. Here, light curves had to be simulated because there wasn't enough dataset for the class of pure binary stars. To classify the stars correctly, a machine learning algorithm called Random Forest was used. The reason for that was that it provided the highest accuracy among other algorithms used here (KNN, CNN, SVM and NB). The first classifier aimed to tell apart eclipsing binary stars and pulsation stars. The second one focused on categorizing four types of pulsation stars, viz., Delta Scuti, Gamma Doradus, RR Lyrae, and Solar-like Oscillation stars. Lastly, the third classifier was built to identify pure eclipsing binary stars and eclipsing binary stars with pulsation component systems. In this research 17 features were used and those were divided into two main categories, which are statistical features and Fourier analysis-based features. Here, 20% of the dataset was used to evaluate the first and second classifiers and 30% of the dataset was used to evaluate the third classifier. The first two classifiers showed an accuracy rate of 93%, which means they could distinguish between different types of pulsation stars and eclipsing binary stars very well. The third classifier achieved an accuracy rate of 89%, which is still quite good given the complexity of its task. This research is significant as it helps us classify the binary and pulsation stars in very large archives of Kepler and TESS. The classifier is available at the <https://variable-star-classification-model.onrender.com/>

Keywords: TESS data, machine learning, binary stars, pulsation stars

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Nanosilver-embedded polycaprolactone and gelatine electrospun scaffolds: understanding their distribution effect on antibacterial activity and cell viability

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Electrospun scaffolds for human skin tissue engineering have diversified over the past two decades with greater attention to the use of Polycaprolactone (PCL) and Gelatine (Gel) as polymers. Herein, we describe the fabrication of PCL/Gel electrospun scaffolds with two methods of incorporation of chitosan-mediated silver nanoparticles (C-AgNPs) to study their antibacterial activity and cell viability. Initially, the C-AgNPs solution was prepared using a modified method that used chitosan to reduce silver nitrate. A neat polymer blend containing 25% (w/v) PCL and 2.5% (w/v) Gel was prepared by dissolving in a 1:1 solvent mixture of chloroform and 90% (v/v) acetic acid solution. An amount of 0.5% (w/v) solid C-AgNPs was dispersed into the above neat polymer blend and was successfully electrospun to prepare PCL/Gel/C-AgNPs(dis) scaffold. Another scaffold was prepared by surface coating C-AgNPs to the neat PCL/Gel electrospun scaffold to obtain PCL/Gel/C-AgNPs(coat) scaffold. The synthesized C-AgNPs and all electrospun scaffolds were characterized using scanning electron microscopy (SEM), X-ray diffraction (XRD), and FT-IR spectroscopy. The PCL/Gel scaffold showed 34.6% water uptake and 30.8% weight loss after 7 days, indicating significant biodegradability. The PCL/Gel/C-AgNPs(coat) scaffold showed antibacterial activity of (7±1 mm) against *Staphylococcus aureus* and (9±1 mm) against *Escherichia coli* bacterial strains with agar disk diffusion assay, whereas PCL/Gel/C-AgNPs(dis) did not (0±0 mm), indicating efficient antibacterial activity of Ag⁺ when surface coated. This observation was further verified using Energy dispersive X-ray (EDX) analysis where a greater silver composition (weight (%) =1.98) was observed in the PCL/Gel/C-AgNPs(coat) scaffold, which however, showed a significant decrease with thermal and washing treatments of the scaffold. Cell viability of 86.2% was observed for PCL/Gel/C-AgNPs(dis) according to a 24-hour MTT assay with dermal fibroblast cells. However, a cell viability of 60.9% was observed for PCL/Gel/C-AgNPs(coat) indicating that surface-coated C-AgNPs may have potentially hindered fibroblast cell attachment. Thus, the results of the present study will be beneficial to understand how the method of AgNP incorporation into PCL/Gel scaffold differently affects antibacterial activity and cell viability.

Keywords: Polycaprolactone, silver nanoparticle, electrospun scaffold, tissue engineering, antibacterial activity

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Preparation and characterization of electrospun membrane embedded with visible light active cobalt doped ZnO nanohybrids for food packaging

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A food packaging material of cobalt doped ZnO (Co-ZnO) nanohybrids embedded in cellulose acetate (CA) nanofiber (NF) was prepared after optimizing the photocatalytic efficiency of Co-ZnO to enhance the shelf life of fruits from antimicrobial effect and to slow down the excess ripening process due to degradation of organic compounds such as ethylene using the radicals generated by Co-ZnO. ZnO particles were fine-tuned by doping Co to bring it to the visible range since it is activated mainly under UV range. Undoped ZnO nanoparticles (NPs) and cobalt doped ZnO nanorods with Co : Zn atomic ratios of 5%, 10%, 15%, and 20% were synthesized, using the co-precipitation method. The powder X-ray diffraction patterns (PXRD) revealed that NPs were crystallized in a hexagonal wurtzite structure. The successful incorporation of Co ion into ZnO lattice was determined by peak shifts in PXRD patterns, changes in binding energy in X-ray photoelectron spectroscopy, and energy dispersive X-ray spectroscopy. The morphology of the synthesized NPs was observed to be altered from spherical to rod shape upon doping Co according to the scanning electron microscopic images. The band gap energies were observed to be red-shifted from 3.26- 3.01 eV upon doping with Co and it has reached into the visible range. The photocatalytic performance was evaluated, using the degradation of methylene blue dye molecules under visible light. The best photocatalytic activity was shown by 15 at% Co-ZnO under visible light and the degradation was 40.2% for a one-hour period. Electrospinning technique was used to incorporate 15 at% Co-ZnO into CA polymer matrix. The successful incorporation of the Co-ZnO into the polymer matrix was determined by PXRD patterns and the peak shifts in the Fourier-transform infrared spectroscopy. The prepared NF mat with CA+ Co-ZnO was used to study the shelf-life enhancement of a model crop, strawberry, along with control mats. The shelf life of the model crop was found to be increased up to 18 days in the optimized Co-ZnO nanofiber mat than in the control mats and further supported by resulting a lower reduction of weight loss, sustaining firmness, and titratable acidity showing a less increment in pH.

Keywords: Photocatalysis, Co-ZnO, doping, electrospun nanofibers, active packaging,

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Development of an extended-release insect repellent bio-composite by encapsulation of *Acronychia pedunculata* essential oil into Cloisite 20A against *Sitophilus oryzae* (L.) (Coleoptera: Curculionidae)

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Insect pests pose a persistent threat to stored food products, leading to substantial losses in their quality and quantity. However, most control measures heavily rely on synthetic pesticides often resulting in human exposure and detrimental environmental issues. Therefore, botanical pesticides have emerged as an alternative to synthetic pesticides due to their advantages in addressing those issues. Thus, the present study aimed to develop an extended-release insect-repellent bio-composite by encapsulating *Acronychia pedunculata* essential oil (APEO) into the adsorbent, cloisite 20A against the rice weevil, *Sitophilus oryzae*. Test insect cultures of adult *Sitophilus oryzae*, consisting of mixed-sex cohorts, were maintained under ambient thermo-hygrometric conditions. Hydro-distillation was used to extract APEO from the leaves of *Acronychia pedunculata*. Thirteen major compounds, wherein ocimene (33.8%) being the predominant constituent, were identified through gas chromatography-mass spectrometry analysis of APEO. The 95% repellent concentration (RC₉₅) value, which was recorded as 3.62 µl/cm², was determined through the area preference bioassay using five concentrations of APEO. After that, APEO content equivalent to RC₉₅ was incorporated into the adsorbent matrix to prepare the APEO-adsorbed bio-composite. The 100% repellency was observed at the highest concentration after a 6-h exposure period. Statistical analysis revealed that concentration and exposure time significantly influenced repellency. The cumulative release of APEO from the bio-composite was assessed using thermogravimetric analysis, which resulted in a cumulative weight loss of 88.61% by the end of the study period of 30 days. The successful incorporation of APEO into the sorbent matrix and its extended release over the 30 days of the study period was confirmed through Fourier transform infrared spectroscopy analysis. Scanning electron microscopy analysis performed for the matrix demonstrated a significant change in its morphology from leaf-like to a thick, swollen nature upon adsorption of APEO. Cup-bioassay was triplicated for 30 days in view of evaluating the prolonged repellency, which resulted in a percentage repellency of 100%, 90–70%, and 70–50% after each 10-day exposure period within a 30-day study period, which correlated with the cumulative release of APEO. Thus, the essential oil-based bio-composite effectively controls stored grain pest infestations, serving as an eco-friendly alternative for a prolonged period.

Keywords: *Acronychia pedunculata*, cloisite 20A, *Sitophilus oryzae*, extended-release

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Synthesis of hollow hydroxyapatite (HHAp) and its composites for enhanced photocatalytic performance

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The effectiveness of neat titanium-based nanomaterials, as photocatalysts, often in conjunction with other materials have been highlighted in previous studies. Further, those studies have shown that TiO₂ incorporated hydroxyapatite (HAp) is used as an effective photocatalyst in the degradation of antibiotics and organic dyes in water. However, the ability of other titanium species in conjunction with HAp has not been recorded. In this study, we synthesized hollow hydroxyapatite (HHAp) using a template method and its nanocomposites at a 1:1 ratio using a *non-in-situ* method to investigate their efficacy in photocatalytic degradation. Specifically, a well-known procedure was employed to synthesize the titanium-based nanomaterial metatitanic acid (MTA) by the digestion of raw ilmenite. These nanomaterials were subsequently incorporated into the pores of HHAp through Schlenk techniques. Comprehensive characterization of both the prepared nanocomposite and neat nanomaterial was carried out using techniques including X-ray diffraction, Fourier-transform infrared spectroscopy, scanning electron microscopy, and energy-dispersive X-ray spectroscopy. Photocatalytic degradation experiments were conducted utilizing the cationic dye methylene blue (MB) with an initial concentration of 10 ppm. Results demonstrated that the degradation rate constant (k) of HHAp-MTA (0.0541 min^{-1}) was enhanced to that of neat MTA (0.0526 min^{-1}) at pH 7. Moreover, HHAp-MTA exhibited higher dye degradation rates at neutral pH (pH 7) compared to degradation at pH 4 and 11. The rate of dye degradation was determined using the Langmuir-Hinshelwood model for pseudo-first-order reactions. Thus, the fabrication of MTA into the pores of HHAp enhanced the photocatalytic activity confirming that the pores can act as active sites to catalyse reactions.

Keywords: Hollow hydroxyapatite, metatitanic acid, Schlenk techniques, photocatalysts, methylene blue.

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Preparation and investigation of slow-releasing NPK fertilizer films using protein extracts from fish-waste

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Commercial agriculture has become one of the most important industries due to the rising world population. Development of slow-releasing fertilizers (SRF) has received growing attention because SRFs reduce the amount and the frequency that a fertilizer needs to be applied. Use of bio-waste in the SRF production increases the sustainability and affordability of the product. In this study, the preparation of slow-releasing NPK fertilizer using fish protein-chitosan polymers and their properties were investigated. Protein was isolated by the alkaline extraction and isoelectric precipitation of fish waste. A polymer film was prepared using extracted protein, chitosan, poly-ethylene glycol (PEG), and commercial NPK fertilizer using solvent casting method. Ratio of protein/ chitosan/ PEG/ Fertilizer was 1: 0.5: 0.2: X for the film fabrication where X = 0, 0.5, 1, 2, and 3 to obtain different SRF. Films were characterized using thermo-gravimetric analysis (TGA), Fourier transform infrared spectroscopy and scanning electron microscopy (SEM). Fertilizer films were tested for the biodegradability according to the ASTM D 5988-12 standard. Slow-release properties were analysed by applying the fertilizer film to soil pots and the soil samples were analysed weekly using Kjeldahl method, molybdovanadophosphate method, and atomic absorption spectroscopy, respectively for N, P, and K content. A plant growth study was carried out to observe the effect on growth height of brinjal (*Solanum melongena*) plants with fertilizer films. Fabricated SRF films had thicknesses ranging from 0.60-0.80 mm. TGA revealed that the thermal decomposition of films begins at 220 °C. SEM micrographs demonstrated that the porous nature of the film surface increases with the fertilizer ratio. SRF films showed a 38.1-49.9% greater biodegradability at the end of the 35th day of study compared to the positive control (cellulose). Slow-releasing studies demonstrated that the films slow down the release of P and K compared to the control (commercial fertilizer) but not the N mostly due to the additional release of N by the degradation of film. Plant growth study had not shown any significant difference with the height change with SRF films compared to the commercial fertilizer during the period of study (35 days). These observations suggest that the fabricated SRF with fish protein extracts demonstrates slow-releasing properties.

Keywords: Slow-release, fertilizer, fish protein, chitosan, poly-ethylene glycol

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Purification and characterization of Sri Lankan vein graphite obtained by acid leaching method

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Sri Lanka is well known for high-quality vein graphite, which can be exported with value addition at a higher price than the raw form. Hence, it is necessary to add value to the raw form of Sri Lankan vein graphite to remain competitive in the global market. Therefore, the objective of the present study was to purify graphite above 99% purity level using Sri Lankan vein graphite by an eco-friendly and chemical method. Generally, the main impurities found in different Sri Lankan graphite resources are S, SiO₂, Al₂O₃, Fe₂O₃, CaO, MgO, MnO, K₂O, Na₂O, P₂O₅, TiO₂, and trace elements. Among them, SiO₂, Fe, Mg, and Ca are abundant in the Sri Lankan vein graphite. Floatation followed by an optimized acid leaching method using sulfuric acid was used in this study to remove most of these impurities from graphite and the industry can utilize it for value addition to graphite. The ash test was used to determine the final purity of graphite. The raw and treated graphite were subjected to the characterization using X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), and scanning electron microscopy (SEM) to verify any structural changes resulting from the treatment. XRD analysis showed that the crystal structure of graphite had not significantly changed upon treatment. FTIR spectroscopy analysis also revealed that there is no addition of functional groups to graphite structure upon treatment. SEM images demonstrated a flaky appearance of graphite without any clear changes in morphology even after the treatment with acids. The results illustrated that the floatation method and the combination of the flotation technique followed by acid leaching significantly improve the graphite purification up to well above 98% and 99% carbon, respectively without significant structural damage in graphite.

Keywords: Sri Lankan vein graphite, floatation, acid leaching, XRD, FTIR and SEM analysis

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XRD, FTIR and SEM characterization of graphite oxide synthesized using Sri Lankan vein graphite

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Graphene is a thin layer carbon material, which has become one of the most intensively studied materials based on its extraordinary properties and found applications in various fields. Graphene can be prepared by chemical and thermal reduction of graphite oxides (GO) while GO can be synthesized from natural graphite using a popular method known as Hummer's method and its modified protocols. Among the countries with natural graphite resources, Sri Lanka is well renowned for its highly crystalline vein graphite with high natural purity, in the 95–99% carbon range, which is being exported mainly in raw form. Value added products such as graphene and graphite oxide would bring more than 1000 times foreign revenue compared to raw graphite. The present study mainly focuses on X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), and scanning electron microscopy (SEM) characterization of graphite oxide synthesized from Sri Lankan vein graphite of natural purity 99.5%. Modified Hummer's method with in-house developed modification using optimized chemical composition was followed. Mass scale production of graphite oxide from Sri Lankan vein graphite were also experimented at optimized condition minimizing chemical, energy and time wastage. The presence and shift of XRD peaks related to graphite and graphite oxide verified the formation of graphite oxide through the complete oxidation of graphite. FTIR spectrum of synthesized graphite oxide exhibited characteristic peaks of graphite oxide while SEM showed the typical morphological features of graphite oxide. The investigation concludes that even mass scale production of quality graphite oxide is possible from Sri Lankan pure vein graphite, which can subsequently be used to produce precious graphene and derivatives as value addition to graphite.

Keywords: Graphite oxide, graphene, XRD, FTIR, SEM

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Effect of solvent parameters on electrochemical exfoliation of graphene

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The electrochemical exfoliation approach for graphene synthesis becomes a greater option for industrial implementation due to its variety of advantages compared to other synthesis methods. However, restacking of the synthesized graphene is the major limitation of this approach. One of the effective strategies to overcome this limitation is the optimization of solvent properties that affect electrochemical exfoliation. Therefore, this study aimed to synthesize 'few-layer' graphene using a novel electrochemical exfoliation approach to overcome the restacking of graphene layers. The novelty of this study is the optimization of solvents for electrochemical exfoliation by considering solvent parameters, Hansen and Hildebrand solubility parameters, enthalpy of mixing, and electrostatic and steric parameters, collectively. The optimized electrochemical exfoliation approach was applied for different solvents, water, 5 % N, N-dimethylformamide (DMF), 5 % Isopropyl alcohol (IPA), 5 % Dimethyl sulfoxide (DMSO), and the synthesized graphene is characterized structurally and electrochemically. Ultraviolet-visible spectroscopic data confirmed the characteristic peak for graphene around 268-274 nm. Water, 5 % DMF, 5 % IPA, and 5 % DMSO showed a reduction in absorbance on day 02 compared to day 01, by 59.7 %, 27.5 %, 12.5 %, and 23.1 %, respectively, indicating the extent of restacking. The X-ray diffraction, Fourier transform infrared, and Raman spectra of the synthesized graphene match well with the standard data indicating the synthesis of few-layer graphene. Moreover, the scanning electron microscopic images confirmed that the mean lateral size of the graphene is in the nano-range. Cyclic voltammetry data illustrated that peak currents for graphene/Nafion-modified glassy carbon (GC) electrodes are 46.3, 45.2, 38.6, and 30.4 μA for graphene-DMF, graphene-DMSO, graphene-IPA, and graphene-water, respectively. Moreover, the graphene-DMF-modified GC electrode contains the lowest peak-to-peak separation ($\overline{\Delta E_p} = 92.8 \text{ mV}$), and the largest electroactive surface area ($A = 0.03 \text{ cm}^2$) which is 66.7 times larger than the Nafion-modified GC electrode. Electrochemical impedance spectroscopy confirms the high ion diffusion behaviour of graphene-DMF-modified GC electrodes compared to other electrodes. The characterization data showed that solvents with compatible Hansen and Hildebrand parameters, such as DMF, minimize restacking and improve the stability, and electrochemical performance of graphene.

Keywords: Graphene, electrochemical exfoliation, restacking, solvents

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Antifungal, antioxidant, and anti-inflammatory potentials of an authenticated Ayurveda herbal formula

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The development of antimicrobial resistance has endangered lives and hampered the developments in modern healthcare. Hence, the problem of antimicrobial resistance must be addressed with innovative solutions. The discovery of natural novel antimicrobial, antioxidant, and anti-inflammatory drugs have become a better approach worldwide due to safety concerns. Due to the restricted applicability of the present antifungal, antioxidant, and anti-inflammatory medications, there is a growing need to search for new remedies from medicinal plants. The Ayurveda herbal formula 'Yakshakshyadi Kasaya' (YK) has been used for many years, but the activity has not been scientifically proved. YK is a decoction that has been used for centuries to treat oedema and worm illnesses. The present research was carried out to determine the *in vitro* antifungal, antioxidant, and anti-inflammatory activity of the Ayurveda herbal formula YK. The antifungal activity of this Ayurveda herbal formula was tested against *Aspergillus* sp., *Rhizopus* sp., *Fusarium* sp. and *Candida* sp. Poisoned food technique and agar well diffusion method were used for filamentous fungi and non-filamentous fungi, respectively to determine the zone of inhibition and the percentage inhibition of mycelia growth. According to the results, YK did not exhibit any activity against any fungal species tested. The antioxidant activity of the Ayurveda herbal extract was tested *in vitro* using DPPH free radical scavenging assay and the anti-inflammatory activity was tested *in vitro* using egg albumin protein denaturation method (heat induced) and IC₅₀ values were determined. Although the herbal formula did not show antifungal activity, it showed promising antioxidant activity in a dose-dependent relationship with an IC₅₀ value of $40.538 \times 10^{-3} \pm 0.021$ mg/ml compared to the standard L-ascorbic acid with an IC₅₀ value of $8.781 \times 10^{-3} \pm 0.005$ mg/ml. Also, anti-inflammatory activity of YK showed an IC₅₀ value of 0.527 ± 0.161 mg/ml in a concentration dependent manner, which is higher than the standard Diclofenac sodium with an IC₅₀ value of 1.361 ± 0.268 mg/ml. Although, YK did not show any antifungal activity, it showed high levels of antioxidant and anti-inflammatory activities.

Keywords: Antifungal, antioxidant, anti-inflammatory, Ayurveda herbal formula

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Determination of antifungal properties of endophytic fungi isolated from *Wendlandia bicuspidata*

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Diseases caused by various microorganisms have increased dramatically in recent years, and drug-resistant strains have become a serious concern. Currently, many researchers have focused on developing novel drugs from endophytic fungi, a promising natural source rich in bioactive compounds. This research was conducted to determine the antifungal properties of endophytic fungi isolated from the leaves of the *Wendlandia bicuspidata* plant. Based on the colony colour and microscopic characteristics, twelve different fungal strains were identified. The poison food method, dual culture assay, and well diffusion assay were carried out to determine the antifungal properties of the isolated endophytic fungi. According to the poison food method, crude ethyl acetate extract of WBE5 fungus showed the highest level of antifungal activity against *Rhizopus sp.* with 19.9% activity, and crude ethyl acetate extract of WBE10 fungus showed the highest level of antifungal activity against *Aspergillus sp.* and *Fusarium sp.* with 8.7% activity and 13.8% activity, respectively. The results obtained from the dual culture assay showed that the WBE5 fungus caused 63.0% mycelial growth inhibition for *Rhizopus sp.* on the fifth day. The WBE10 fungus caused 45.2% and 52.6% mycelial growth inhibition on the fifth day for *Aspergillus sp.* and *Fusarium sp.*, respectively. Results from these two assays can be correlated by comparing antifungal activity in the poison food method with visual observation of inhibition zones in the dual culture assay. The well diffusion assay was carried out to determine the antifungal properties against *Candida sp.* and the results indicated that only the ethyl acetate crude extract of the WBE5 fungus showed a strong inhibitory effect against *Candida sp.* (20 ± 0.57 mm). Majority of the ethyl acetate crude extracts showed higher antifungal activity and indicated that these antifungal compounds could be moderately polar in nature. These results confirmed that some of the endophytic fungi present in *Wendlandia bicuspidata* leaves provide a potential source of novel bioactive compounds that can be developed as antifungal agents in the drug discovery process.

Keywords: Antifungal, crude extracts, endophytic fungi, *Wendlandia bicuspidata*

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Development of a hydrophobic antibacterial cotton substrate using bio-based fatty acids

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The Limitations of existing non-renewable, multifunctional modifications of cotton substrates have motivated the exploration of renewable materials. The current study investigated the possibility of preparing hydrophobic and antibacterial cotton fabrics with a plant-based fatty acid composition. Lauric acid-based fatty acids (FAs) were extracted from coconut oil using a simple saponification method. A reactive accelerator must be used for the reaction between cotton and FAs. Therefore, the main precursor, thionyl chloride, and the conventional lab-scale reflux method were used to synthesize fatty acyl chlorides (FAC) to obtain chemicals with greater reactivity. The by-product of the reaction with the hydroxyl groups of the cotton substrate was removed using pyridine. Here, the effect of the concentration of FAC added to a constant cotton fabric weight was studied. The successful synthesis of FAs, FAC, and modification of cotton fabrics were determined using Fourier transform infrared (FTIR) and Attenuated total reflectance-Fourier transform infrared (ATR-FTIR) techniques. Characteristic 1709 cm^{-1} and 1800 cm^{-1} FTIR peaks confirmed the presence of FAs and acyl chloride, respectively. The covalent attachment between the modified cotton fabric and FAs was investigated using the FTIR peak at 1740 cm^{-1} , which is characteristic of the ester bond carbonyl linkage. Based on the obtained results, the water contact angle (WCA) was measured to assess hydrophobicity, and a remarkable adhesive-type hydrophobicity ranging from $133.68\pm 1.34^\circ$ to $145.92\pm 0.32^\circ$ was observed for 125 ppm to 375 ppm concentrations respectively, which is closer to the superhydrophobic surface. Furthermore, a bacterial test against *Escherichia coli* (*E. coli*) was performed using the disk diffusion method. A 14.8 ± 0.28 mm of high zone of inhibition (ZOI) was observed at 125 ppm in the presence of covalently and non-covalently bound FAs. The presence of non-covalently bound FAs was confirmed by thin layer chromatography (TLC). The physical appearance of the modified cotton was further investigated to optimize the cotton substrate, which gave the majority of positive results.

Keywords: Cotton modification, contact angle, hydrophobicity, antibacterial activity, thin layer chromatography

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A study on physicochemical and antioxidant properties of different brands of 'Nimba Arishta' in Sri Lanka

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Ayurvedic arishta is self-fermented polyherbal formulation and Nimba arishta is a widely used ayurvedic drug. According to ayurvedic pharmacopoeia, there are two formulae for making Nimba arishta. The absence of specific recipe or ingredient information on the label of commercially available Nimba arishta, creates a false perception of uniformity among these products within the market. The present study was aimed to evaluate variations in different formulations using six different commercially available brands of Nimba arishta (A, B, C, D, E, and F). They were thoroughly evaluated for their organoleptic characteristics, physicochemical parameters, and antioxidant activity. A sensory evaluation on taste and odour attributes was also performed. The physicochemical parameters evaluated were pH, specific gravity, brix, refractive index, total ash, acid insoluble ash, water-soluble ash, reducing sugar content, sucrose content, alcohol content, total dissolved solid content, total phenolic content, and total flavonoid contents. *In vitro* antioxidant activity was performed by DPPH assay. The results of the study were found within following ranges: pH 3.01(D)–3.64(A), refractive index 1.3725 (A)–1.4019(C), specific gravity 1.0684(A)–1.0864(F), brix 25.06(A)–41.00(C), ethanol content (V/V %) 7.65(C)–10.4(A), total dissolved solids (g/mL) 0.1993(A)–0.4107(C), reducing sugar content (g /100g sample) 15.75(A)–34.24(C), apparent sucrose content (g/100g sample) 0.69(B)–7.69(E), total ash content (w/w%) 0.0971(D)–0.1070(A), water soluble ash content (w/w%)(0.004(B)–0.0899(F), acid insoluble ash content (w/w%) 0.0131(D)–F-0.0571(F), total phenolic content (tannic acid equivalents in mg/g of sample) 1.7275(A)–9.727(F), total flavonoid content (quercetin equivalents in mg/g of sample) 1.2410(A)–3.2151(B), and DPPH radical scavenging activity (IC₅₀) (µg/mL) 35.76(F)–48.04(A). These results indicate that variations in formulae including differences in ingredients, source of herbs or plants, and their quantities, may account for the significant difference observed among different brands. Data obtained in the present study emphasize the need for standardized arishtas in order to enhance the effectiveness and acceptance of these ayurvedic medicines.

Keywords: Nimba arishta, standardization, ayurvedic, physicochemical, antioxidant

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***In-vitro* anti-inflammatory activity of aqueous extracts of *Dialium ovoideum thwaites* leaves**

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Dialium ovoideum thwaites (gal siyambala), an endemic plant to Sri Lanka, is used in traditional and folk medicine to treat many diseases. The objective of the present study was to examine the *in-vitro* anti-inflammatory activity of mature and young leaf extracts of *D. thwaites*. Aqueous extracts were prepared by mixing the dry powder of mature and young leaves (50 g) with double distilled water (250 ml) and sonicating for 2 hours at 40 °C. The aqueous extracts were filtered and freeze dried. A concentration series of mature and young leaf extracts (62.5, 125, 250, 500 and 1000 µg/ml) was prepared by dissolving the freeze-dried powders in DMSO, and *in vitro* anti-inflammatory activity was evaluated by egg albumin denaturation method and Human red blood cells (HRBC) membrane stabilization assay. The results were compared with the standards, diclofenac and aspirin. According to the results, it is found that the inhibition of egg albumin denaturation of both aqueous mature leaf (AML) extract and aqueous young leaf (AYL) extract increases with the concentration. IC₅₀ values of AML and AYL extracts are 1.138±0.1 mg/ml and 1.114±0.2 mg/ml, respectively whereas IC₅₀ for diclofenac is 0.511±0.1 mg/ml. In HRBC membrane stabilization method, protection of HRBC haemolysis of AML extract and AYL extract increases with the concentration. AML extract and AYL extract possessed IC₅₀ values of 1.641±0.2 mg/ml and 0.928±0.3 mg/ml, respectively for the HRBC membrane stabilization method whereas 1.137±0.6 mg/ml is obtained for aspirin. According to statistical analysis (Kruskal Wallis test, p > 0.05) there was no significant difference between IC₅₀ values of mature and young leaf extracts and the standards. This study revealed that the mature and young leaves of *D. thwaites* possess anti-inflammatory activity and medicinal value of *D. thwaites* can be explored by further extensive research.

Keywords: *Dialium ovoideum thwaites*, *In-vitro* methods, anti-inflammatory, egg albumin denaturation, human red blood cells

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614/E2

Quercetin-3- β -D-galactoside from *Ziziphus oenoplia* (L.) Miller with enhanced cell migration and proangiogenic activity

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Ziziphus oenoplia (L.) Miller (Rhamnaceae) has been used for the treatment of wounds in Ayurveda, in particular for fresh cuts. The present study aimed to investigate the compounds present in *Ziziphus oenoplia* having enhanced cell migration and proangiogenic activity. Hexanes, dichloromethane, ethyl acetate, and methanol extracts of leaf of *Z. oenoplia* were obtained by sequential extraction of the dried plant material with respective solvents at room temperature (30 ± 2 °C) for 24 hours. Each extract was subjected to scratch wound assay (SWA) and chick chorioallantoic membrane (CAM) assay. The methanol extract showed the highest mean vascular index in the CAM assay, but the observed mean wound closure for methanol extract was almost similar to that of the negative control. However, since the aqueous fraction obtained from the butanol-water partitioning of the methanol extract showed a significant cell migration activity in SWA, it was further investigated *via* SWA-guided fractionation and led to the isolation and identification of quercetin-3- β -D-galactoside (**1**) as the potential cell migration and proangiogenic active compound. Cell migration ability of **1** at 24 h and proangiogenic response after 72 h of incubation, were determined at a concentration of 10 μ M and 10 μ g/disc, receptivity and its mean percent wound closure was found to be 77.9% (positive control: asiaticoside - 91.3%) and mean vascular index was found to be 35.3 (positive control: β -sitosterol - 44.3). The identity of quercetin-3- β -D-galactoside (**1**) was established by the analysis of NMR spectroscopic data and confirmed by the comparison of ¹H-NMR and ¹³C-NMR data with those reported. This constitutes the first report of the presence of quercetin-3- β -D-galactoside in *Z. oenoplia*.

Keywords: *Ziziphus oenoplia*, Rhamnaceae, quercetin-3- β -D-galactoside, cell migration activity, proangiogenic activity

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Development of a formulation for sprouted legumes-based probiotic beverage with coconut milk: determination of its probiotic count and proximate composition

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The majority of probiotic products available in the markets are usually in the form of fermented dairy milk and yoghurt. The present study was carried out to evaluate the potential of developing a vegan probiotic beverage utilizing legumes; green gram (GG), cowpea (CP), and horse gram (HG). Sprouted legume powders were mixed with coconut milk, its filtrate was inoculated with commercial lactic acid bacteria (LAB) culture mix as the probiotics, incubated at 43 °C for 4 ½ hours and stored under refrigerated conditions. Sprouted legume powders were used as they are rich in simple sugar that act as the carbon source to produce lactic acid during fermentation. The culture mix was composed with *Lactobacillus delbrueckii* subsp. *bulgaricus*, *Lactococcus lactis* subsp. *lactis*, and *Streptococcus thermophilus*. Four different probiotic beverages were developed according to the formulations from Taguchi's L4 orthogonal array by varying amounts of GG, CP, HG powders with 4 g of sugar per 100 ml of each beverage. First, second, third and fourth formulations were composed with 1 g of GG, 1g of CP, 2 g of HG; 1 g of GG, 3g of CP, 4 g of HG; 3 g of GG, 1g of CP, 4 g of HG; and 3 g of GG, 3g of CP, 2 g of HG. Initial LAB counts of the formulations 1st to 4th were obtained as 7.8388, 7.9912, 7.9444, 7.8692 log CFU/ml, respectively. They were confirmed as probiotic beverages since it encompasses the widely accepted requirement; that at least 6 to 7 log CFU/ml or g of viable probiotic cells must be present in the final product to consider it as a probiotic food or beverage. A semi trained sensory panel with 30 panellists was used for the sensory evaluation. Appearance, odour, taste, mouth feel, and overall acceptability were considered as the main sensory attributes and the probiotic beverage developed according to the second formulation was selected as the best beverage. Its proximate composition was reported as 81.70±0.22% moisture, 0.41±0.03% ash, 7.84±0.17% fat, 2.78±0.18% protein, 7.20±0.60% carbohydrate and 0.064±0.04% soluble dietary fibre in wet basis.

Keywords: Vegan probiotic beverage, Sprouted legumes, Coconut milk

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Design and development of a CRISPR/Cas9 tool kit to silence the allosteric activator binding domain of PFK-1 in cancer cells as a novel therapeutic approach for cancer

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Cancer poses a major worldwide health concern and is currently ranked as the second leading cause of death. Cancer cells exhibit a distinct metabolic profile that involves high levels of glucose consumption through glycolysis and the production of lactate, even when oxygen is present, a phenomenon commonly referred to as the "Warburg effect". This phenomenon is a result of cancer cells' high energy and biosynthetic demands needed to support their growth and invasiveness. This increased glycolytic activity can be attributed to the upregulation of critical glycolytic enzymes such as PFK-1 (phosphofructokinase-1). Therapeutic approaches that target such enzymes to reduce the rate of glycolysis have been proven to be highly effective against cancer cells. The goal of this study is to decrease the activity of PFK-1 in human MCF-7 cancer cells by silencing the binding domain of the enzyme's allosteric activator (Fructose-2,6-bisphosphate), using CRISPR/Cas9 technology. Using bioinformatics tools, donor template and target-specific crRNA were designed with a minimum number of off-targets to silence the allosteric activator domain. The recombinant plasmid harbouring crRNA and the donor template was transfected into MCF-7 cells, and puromycin selection was carried out to identify the transfected cells. After puromycin selection, a western blot was performed for the cell lysate using an *anti*-His antibody to identify the truncated His-tagged protein. However, the band with the expected size was not detected on the blot, suggesting that the transfected cells might lack the intended genetic alteration. Therefore, it is necessary to replicate the experiment in order to achieve the desired outcome. Down-regulation of PFK-1 activity could be a more secure strategy for cancer treatment, as it would enable healthy cells to sustain adequate ATP levels while simultaneously having a significant impact on the energy-centric metabolism of cancer cells.

Keywords: CRISPR/Cas9, PFK-1, allosteric activator binding domain, cancer, crRNA

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Investigation of the effect of selected hydrotropes on the solubility of drug-like molecules from Sri Lankan flora: a computational approach

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In recent years, the use of natural products in drug discovery has gained immense interest due to their diverse chemical structures and potential therapeutic benefits. However, the limited solubility of these natural products in water is a significant challenge in developing drugs from them. Poor solubility can lead to low bioavailability, ultimately affecting drug efficacy. A class of compounds called hydrotropes is used to enhance the solubility of poorly soluble drugs by forming micellar structures in aqueous solutions. This research study investigates the effects of two hydrotropes, pyrogallol and resorcinol, which are assumed to be nontoxic as they are widely used in the drug industry, on the solubility of three drug-like molecules, scopoletin, 4-hydroxyxanthone, and liriodenine. The three drug-like molecules were selected from the Sri Lankan flora database according to Lipinski's rule of five. Pyrogallol and resorcinol were used as hydrotropes because their effects on the solubility of drug-like molecules from natural sources, particularly Sri Lankan flora, remain largely unexplored. Molecular dynamic simulations were performed using the KBFF20 force field at 300 K and 1 bar pressure *via* the GRONingen Machine for Chemical Simulations (GROMACS) software package. The simulations were carried out under three different conditions: without adding hydrotropes to drug-like molecules, after adding hydrotropes to the clusters of drug-like molecules, and after adding hydrotropes to randomly distributed drug-like molecules. The size of visualized clusters and micelles, solubilities of drug-like molecules, solvent accessible surface area (SASA), root mean square deviation (RMSD), and the number of hydrogen bonds between drug-like molecules and water molecules were also calculated. Additionally, the introduction of resorcinol and pyrogallol into the clusters led to a decrease in hydrogen bonds between drug-like molecules and water, dropping from 50 to 30 and 60 to 30, respectively. Similarly, when resorcinol and pyrogallol were added to randomly placed drug-like molecules, the number of hydrogen bonds reduced from 80 to 40 and 80 to 30, respectively. The results show that pyrogallol has a higher hydrotropic effect than resorcinol on the three selected drug-like molecules. This study highlights the potential of pyrogallol and resorcinol, for improving the solubility of drug-like molecules from natural sources like Sri Lankan flora, which can aid in developing more effective drugs.

Keywords: Molecular dynamics, drug development, Sri Lankan Flora, KBFF, GROMACS

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Design and development of a CRISPR/Cas9 toolkit for silencing *PFKFB3* to attenuate cancer progression

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Cancer is one of the deadliest diseases accounting for millions of deaths worldwide each year. One of the prime causes for the abnormal proliferation of cancer cells is the metabolic reprogramming that occurs due to overexpressing 6-phosphofructo-2-kinase/fructose-2,6-biphosphatase-3 (PFKFB3), an isozyme of Phosphofructokinase-2 (PFK-2). PFK-2 is responsible for producing fructose-2,6-bisphosphate (F2,6BP), an allosteric activator of the enzyme Phosphofructokinase-1 (PFK-1), which is the key regulatory enzyme of the critical rate-limiting step in glycolysis. Thus, silencing *PFKFB3* has been proposed as a potential strategy to control cancer progression since the inhibition of PFKFB3 enzyme could largely decrease the rate of glucose metabolism in cancer cells. This study focuses on exploiting CRISPR/Cas9 tool to knockout/knockdown *PFKFB3* with the aim of decelerating the progression of breast cancer. A specific gRNA and a donor template targeting exon 2 of *PFKFB3* were designed to knockout/knockdown the gene. Next, the pSpcas9(BB)-2A-puro-plasmid harbouring gRNA and the donor template were transfected into MCF-7 human breast cancer cells followed by puromycin selection. The truncated protein with a His-tag was detected in a Western blot analysis using *anti*-His antibodies, indicating that the *PFKFB3* knockout/knockdown may have been successful. However, sequencing must be performed to confirm the knockout/knockdown of *PFKFB3*. As the next step, the transfected cells will be subjected to clonal expansion and downstream assays to confirm the genetic modification, followed by cell proliferation assays to investigate the effect of *PFKFB3* knockout/knockdown on cancer progression. As aerobic glycolysis fulfils the energy demand of the rapidly proliferating cancer cells, silencing *PFKFB3* using the proposed therapeutic approach could have a substantial impact on inhibiting the growth and metastasis of cancer cells.

Keywords: CRISPR/Cas9, PFK-2, PFKFB3, cancer, gRNA

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Determining the structural stability and dynamics of relaxin family peptide receptor-1 (RXFP1) through *in silico* approaches

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Computational approaches are useful in predicting the 3-dimensional (3D) structures of proteins which are laborious to solve using experimental methods. However, the accuracy of these predictions should be assessed prior to using them in drug discovery efforts. Relaxin family peptide receptor 1 (RXFP1) is a class A G protein-coupled receptor (GPCR) which is endogenously activated by relaxin-2 to mediate reproductive and cardiovascular functions. By comparison with the existing protein 3D-structures, RXFP1 is predicted to possess seven transmembrane (TM) helices, a cytoplasmic C-terminus and, an extracellular domain with a low-density lipoprotein class A (LDLa) module connected via a linker to a leucine-rich repeat (LRR) and a hinge region. However, the knowledge on the receptor's endogenous ligand binding pocket and activation mechanism are elusive due to the lack of an experimentally derived 3D structure. Our initial attempt to construct the RXFP1 3D structure using homology modelling wasn't successful due to the lack of homologous templates with significant percentage identity and query coverage. Therefore, we assessed a RXFP1 model predicted by AlphaFold2, using predicted local distance difference test (pLDDT) score, which showed a high confidence in most of the protein domains. Also, we replaced the AlphaFold-predicted LDLa module with the nuclear magnetic resonance (NMR)-resolved structure (PDB ID: 2JM4), using MODELLER 10.3, prior to determining the structural stability and dynamics. Next, the receptor was protonated and embedded in a lipid bilayer consisting of 600 phosphatidylcholine (POPC) lipid molecules. The stability of this hybrid model was validated by conducting a 100 ns molecular dynamics (MD) simulation via GROMACS 2023 using a TIP3 water model and CHARMM36m all-atom force field. Visualisation of the trajectory and the analysis of root-mean-square deviation (RMSD), root-mean-square fluctuation (RMSF) and radius of gyration (Rg) showed that TM domain remained stable while the ectodomain showed a large spatial movement. Moreover, principal component analysis (PCA) indicated a possible correlation between the capping movement of the ectodomain with the C-terminus movement in the most prominent conformation. In future, we aim to extend the MD simulation to a microsecond timescale to determine the consequences of movements of the ectodomain in protein-protein ligand interactions of RXFP1.

Keywords: RXFP1, GPCR, AF2 model, MD simulation, Ectodomain

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620/E2

Investigation of the effect of divalent metal ions on the secondary structure of α -synuclein: an in-silico approach

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Parkinson's disease is a neurodegenerative disorder caused by the degeneration of dopaminergic cells in the brain resulting from the accumulation of α -synuclein protein fibrils. The accumulation of α -synuclein is triggered by the conformational change of α -helices to β -sheets in the monomeric protein as observed in previous experiments. Protein α -synuclein has 140 amino acids, which can be divided into three regions named N-terminal region, non-amyloid- β component (NAC) region, and C-terminal region. One significant factor contributing to the conformational change is the binding of metal ions to the α -synuclein. This research aims to investigate the effect of divalent metal ion binding and their interactions with the protein. Specifically, Zn^{2+} and Cu^{2+} were selected as divalent metal cations of interest. In the process, molecular dynamics simulations were performed using GROMACS software and Kirkwood-Buff Force Field (KBFF) on three systems; namely, the protein alone in aqueous medium as a control, the protein with Zn^{2+} and protein with Cu^{2+} in an aqueous environment representing the experimental conditions. The simulation results were analysed using coordinate files, root mean square deviation, radius of gyration, solvent accessible surface area (SASA), root mean square fluctuation, and dictionary of secondary structure of protein (DSSP). Xmgrace, RasMol and Pymol were utilized for structural analysis. The results revealed that the binding of Zn^{2+} and Cu^{2+} had a significant effect on changing the 3-D shape of the protein compared to control and reducing its SASA resulting in hindering the access to active sites of the protein's surface. DSSP results confirmed the formation of β -sheets with the initiation of β -bridges in the C-terminal region of the protein in the presence of Zn^{2+} and Cu^{2+} . Specifically, Zn^{2+} displayed stronger interactions with negatively charged COO^- groups in Glu105, Glu114, Asp115, Asp121, Glu123, Glu131, Glu137 and Glu139 residues in the C-terminal region while Cu^{2+} demonstrated more interactions with COO^- groups in Asp115, Asp119, Asp121 and S atoms of Met1, Met116 residues in N-terminal and C-terminal regions supporting the formation of β -sheets. These findings demonstrate that divalent metal ions have specific binding abilities to certain regions and residues within α -synuclein inducing the secondary structural changes from α -helices to β -sheets.

Keywords: Parkinson's disease, α -synuclein, molecular dynamics, GROMACS, KBFF

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Examining the impact of phenylindane on the stability of tau protein secondary structure in the presence of metal ions: implications for Alzheimer's disease progression

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Tau is a microtubule stabilizing and assembling protein that is present inside the neurons. This protein is known to be implicated in severe neurodegenerative diseases like Alzheimer's disease by making β -sheet structures. This structural change leads to form fibrillary protein structures inside the neurons called "Neuro Fibrillary Tangles". This investigation is focused on finding the stability of the secondary structure of tau protein in a molecular system with phenylindane, which can be found in dark-roasted coffee. Four main molecular dynamic simulations; 1) tau protein alone, 2) protein with Cu^{2+} ions, 3) protein with Zn^{2+} ions and 4) protein with phenylindane and Cu^{2+} ions were conducted using KBFF20 force field. Results showed that the secondary structure of the tau protein was comparatively more stable in the protein alone system but not in the other three systems with metal ions. However, the protein was more stable in the system with phenylindane and Cu^{2+} than the systems with protein and metal ions. The presence of Cu^{2+} and Zn^{2+} metal ions affected the secondary structure of tau protein as seen on DSSP analysis, as these metal ions showed high affinity towards polar amino acids including histidine and cysteine residues in tau protein. Between the two metal ions, copper showed a higher binding affinity than zinc towards polar amino acids. Phenylindane has hydroxyl groups and thus exhibits higher bonding affinity with polar amino acids. Eight main amino acids were found to have the highest affinity including Lysine (Lys--), Arginine (Arg--), Glutamic acid (Glu--), Asparagine (Asn--), Leucine (Leu--), Glycine (Gly--), and Tyrosine (Tyr--). The results showed that the addition of phenylindane reduced the formation and stabilization of β -sheets those were induced by Cu^{2+} ions suggesting that phenylindane can interfere and disrupt the interaction between tau protein and metal ions. Further, these findings suggest that phenylindane may have the ability to minimize structural changes and stabilize the secondary structure of tau protein when metal ions are in the vicinity, potentially reducing the risk of developing Alzheimer's disease. That is, consumption of dark roasted coffee may have an effect of reducing risk of Alzheimer's disease.

Keywords: Alzheimer's disease, Tau protein, phenylindane, secondary structure, metal ions

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622/E2

Engineering marine bacterium *Pseudoalteromonas atlantica* KCTC 22877 as a microbial chassis for red algal biorefinery

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Marine red algae are one of the key primary producers in marine ecosystems. Their cell walls are mainly composed of D-glucose and the rare monosaccharides 3,6-anhydro-L-galactose (L-AHG) and 3,6-anhydro-D-galactose (D-AHG). Over the past decade, marine red algal biomass has emerged as a sustainable resource for the production of value-added chemicals. However, efforts have been limited to conventional chemical and enzymatic production of bioactive compounds from marine cell wall polysaccharides. The bioconversion of algal polysaccharides into value-added chemicals is hampered by the inability of conventional industrial metabolic chassis platforms to assimilate rare monosaccharides. Synthetic biology offers solutions to overcome these limitations by engineering non-model organisms as metabolic chassis for consolidated biological processes. Marine heterotrophic bacteria are the key degraders of algal polysaccharides and nutrient cycling in marine ecosystems. Studies of red algal catabolism provide insight into the genetic potential and diverse repertoire of carbohydrate-active enzymes (CAZymes) in marine bacteria. *Pseudoalteromonas atlantica* KCTC 22877 is a marine bacterium that catabolize red and brown algal polysaccharides as the sole carbon source. Genomic analysis of *P. atlantica* KCTC 22877 revealed the organization of CAZymes into polysaccharide utilization loci (PUL) specific for red algal polysaccharides. For the expression of heterologous proteins, an expression device containing T7 RNA polymerase, LacI, and T7 promoter was constructed. A ligation independent cloning (LIC) site was incorporated to standardize the cloning procedure. The expression system was characterized using a GFP reporter assay. The use of *P. atlantica* KCTC 22877 as a microbial chassis platform for biorefinery was evaluated by expression of biosynthetic gene clusters of β -carotene and violacein. Synthesis of bioactive pigments was confirmed by their characteristic colour and HPLC analysis of the extracts. The *P. atlantica* KCTC 22877 chassis demonstrated that different carbon sources, including red algal polysaccharides, can be used for the biosynthesis of value-added chemicals without biomass pretreatment. Therefore, *P. atlantica* KCTC 22877 could potentially be used as a potent microbial chassis platform for red algal biorefinery.

Keywords: Marine heterotrophic bacteria, red algal biomass, metabolic chassis, value-added chemicals

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Synthesis and characterization of novel sulfonamide derivatized copper dipicolylamine complexes towards promising biological applications

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Trends observed in recent studies highlight the importance of copper containing metal-organic compounds possessing a significant biological activity with effective anticancer and antimicrobial properties and minimized side effects in comparison to its counterpart platinum-based drugs. A sulfonamide link to the 2,2'-dipicolylamine (dpa) moiety can be achieved, creating an amphipathic ligand system capable of coordinating with the metal centre. The properties of such synthesized metal complexes can differ according to various R groups used, giving rise to novel ligands and their subsequent metal complexes. In this study, (N(SO₂(iodobenz))dpa) (L1), (N(SO₂(tfm)(py))dpa) (L2), and (N(SO₂(quin))dpa) (L3) have been used as ligands and their respective Cu(II) complexes have been synthesized. The resultant novel Cu-dpa complexes, [CuCl₂(N(SO₂(iodobenz))dpa)](C1), [Cu(N(SO₂(iodobenz))dpa)₂]Cl₂(C2), [CuCl₂(N(SO₂(tfm)(py))dpa)](C3), [Cu(N(SO₂(tfm)(py))dpa)₂]Cl₂(C4), and [CuCl₂(N(SO₂(quin))dpa)](C5) were characterized using UV-vis spectroscopy, fluorescence spectroscopy, and FTIR spectroscopy. In the UV-visible spectra, the absorption peaks in the 200 nm–280 nm region indicate the presence of intra-ligand $\pi \rightarrow \pi^*$ and $n \rightarrow \pi^*$ transitions. Change in positions of the metal complex peaks compared to the respective ligand peaks could be observed (indicating complex formation); noticeable bathochromic shift for complexes (C1) and (C2); slight bathochromic shift for (C3) and a hypsochromic shift for (C5). FTIR spectroscopic data indicated that the S-N and C=N bond vibration frequencies have shifted to lower values than those of their corresponding ligands, implying the formation of a new Cu-N linkage, which weakens the initial S-N and C=N bonds. The synthesized complexes were found to be mildly fluorescent. Complexes (C2), (C3), (C4) and (C5) exhibited lower fluorescence than their corresponding ligand, indicating a chelation induced fluorescence quenching effect. In addition, elemental analysis was conducted for the mono coordinated complexes (C1), (C3) and (C5) in an attempt towards structural refinement and confirmation. The results obtained were satisfactory and provided insights for the confirmation of the proposed structures for these metal complexes. The ligands have proven to be biologically relevant, inhibiting certain critical biological enzymes and suggesting their suitability to be used as a drug. Such properties can be extrapolated for the metal complexes, which warrant further biological investigations.

Keywords: copper, dipicolylamine, sulfonamide, drug

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Design and development of riboswitch-based whole-cell biosensor to detect fluoride level in drinking water

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The effect of fluoride on human health can be either beneficial or adverse depending on the level of fluoride intake. There are various dietary sources of fluoride and drinking water can be considered as the major source of fluoride intake; and therefore, having an accurate and low-cost method to detect fluoride level in drinking water is important as most of the available conventional methods suffer from several drawbacks including lack of sensitivity and selectivity. Biosensors can serve as an attractive alternative method with high specificity and selectivity towards the analyte. Therefore, a fluoride-responsive riboswitch (FRS) based whole-cell biosensor was developed in this research to detect fluoride level in drinking water using the Δ *crcB* *E.coli* BW25113 carrying a recombinant plasmid harbouring FRS of *Pseudomonas syringae* coupled to *lacZ* reporter gene. In the presence of fluoride, the anion binds to the aptamer region of the FRS facilitating the expression of the reporter β -galactosidase. A reporter assay using ortho-nitrophenyl- β -D-galactopyranoside (ONPG) as the artificial substrate was conducted to measure the activity of the enzyme, which is proportional to the intracellular fluoride level. A calibration curve was obtained for the fluoride standards ($R^2 > 0.9$) to determine the fluoride concentration in drinking water samples. The estimated LOD and LOQ values for the sensor was 5 μ M and 100 μ M, respectively. The highest concentration of fluoride in ground water samples determined using the biosensor was 0.637 ppm (Medirigiriya) and the lowest concentration of fluoride was 0.091 ppm (Nuwara-Eliya). These values are in agreement with the reported values and fluoride ion-selective electrode (FISE) readings. The specificity and the selectivity of the biosensor was examined using common interfering ions (Cl^- , OH^- , Na^+ , K^+ , Ca^{2+} , CO_3^{2-} , HCO_3^- and NO_3^-) and found to have minimal interference on its activity, indicating the specificity of the FRS biosensor towards fluoride. This work provides a critical proof-of-principle for employing the FRS-based whole cell biosensor to accurately monitor environmental fluoride.

Key words: Fluoride responsive riboswitch, biosensor, ONPG, specificity

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625/E2

Development of sulfonamide-derivatized dipicolylamine ligands as fluorescent probes for the selective determination of Fe²⁺ / Fe³⁺ ions

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Fluorescence sensor technology is regarded as a promising field of study for the detection of ecologically and physiologically significant cations and anions. Hence, three previously synthesized and characterized ligand systems were employed as fluorescent probes to detect Fe(II) and Fe(III). The three ligand systems each consist of distinct dangling R group tethered *via* the central sulfonamide to dipicolylamine moiety: 1-naphthalene (L1=N(SO₂)(1-nap)dpa), 4-methyl biphenyl (L2=N(SO₂)(4-Mebip)dpa), and 2-naphthalene (L3=N(SO₂)(2-nap)dpa). The ligands were soluble in solutions of 2%(v/v) methanol. All experimental procedures were conducted at pH 7.4 using HEPES buffer. With Fe²⁺ ions, L1 and L2 exhibited notable enhancement in fluorescence intensity at around 382 nm and 370 nm, respectively, while L3 displayed significant quenching of fluorescence with Fe³⁺ ions. The precise excitation wavelengths for L1, L2, and L3 were 370 nm, 354 nm, and 280 nm, respectively. Both L1 and L2 had a fluorescence-increasing mechanism with rising ferrous ion concentration and fluorescence intensity of ligand metal complex showed no discernible change with varying pH values. The lower detection limit (LDL) of L1-Fe²⁺ and L2-Fe²⁺ were individually found to be 1.22 μM and 0.55 μM. Further reduction of LDL value to 0.24 μM was made using a lower ligand concentration (1.00 μM) for L1. When introduced in excess (ten-fold higher concentration than Fe²⁺), Zn²⁺, Fe³⁺, K⁺, Cd²⁺, and Pb²⁺ ions individually produced a considerable interference to L1-Fe²⁺ complex while L2 ligand can be employed as a chemosensor for Fe²⁺ ions in mixed metal ion solutions with quite a good selectivity in the absence of high concentrations of Fe³⁺, Zn²⁺, Cd²⁺, Pb²⁺ and Ni²⁺ ions. L2 had a substantially poorer photostability compared to L1. The UV-visible absorbance of L1- Fe²⁺ complex was greater than that of free ligand. L3-Fe³⁺ complex exhibited fluorescence-lowering mechanism with increasing ferric ion concentration, relatively high pH sensitivity, and had an LDL of 1.61 μM. Here, the highest interferences are from Zn²⁺, Cd²⁺, Pb²⁺, Cu²⁺, and Ni²⁺ ions. L3 demonstrated an impressive photostability. By adding excess of ethylenediaminetetraacetic acid, this ligand could be retrieved from ligand-ferric complex. These probes have potential to be used in physiological, environmental, and industrial samples.

Keywords: Dipicolylamine, Fe²⁺ detection, Fe³⁺ detection, fluorescent sensor

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Microplastics in the gut content of salt-dried smoothbelly sardinella (*Amblygaster leiogaster*)

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Plastic pollution, especially in the form of microplastics (MP), is a pressing environmental issue with potential implications for marine ecosystems and human health. This study aimed to assess the MP in the gut contents of salt-dried smoothbelly sardinella (*Amblygaster leiogaster*), a commonly consumed marine food commodity in Sri Lanka. Samples were collected from Kalpitiya and Trincomalee, from two dry fish manufacturers and suppliers on the western and eastern coast of the island. Samples were brought to the lab and alkaline digestion using 10% potassium hydroxide was employed to extract MP from the gut contents and subsequent density separation with saturated sodium chloride solution was used to isolate the MP. The recovered particles were examined under a microscope and their sizes, colours, and polymer types were identified using attenuated total reflection-Fourier transform infrared (ATR-FTIR) spectrometer. Results showed that all samples contained MP, predominantly microfibers, with black-coloured microfibers being most abundant. The concentration of MP was significantly higher in samples from Kalpitiya compared to Trincomalee. The identified polymers included polyvinyl chloride (PVC), polyethylene terephthalate (PET), polyamide (PA), and high-density polyethylene (HDPE) with variations observed between the two locations. This study assessed only the gut contents; however, other studies have shown the presence of MPs in fillets and liver as MPs can transfer into blood system and muscles of the fish. Since smooth belly sardines were consumed as whole, it is highly likely that more MP than those in the gut are being ingested.

Keywords: Microplastics, salt-dried smoothbelly sardinella, marine food sources, pollution, Sri Lanka.

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701/E3

Monitoring system for thriving agriculture in Sri Lanka

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Since agriculture is the foundation of Sri Lanka's economy, it is essential to closely monitor agricultural operations to maintain sustainable growth. A rising number of people are now interested in using technology to track agriculture. In this essay, a monitoring mechanism for Sri Lanka's flourishing agriculture is suggested. The device keeps track of important agricultural characteristics like soil moisture, temperature, and humidity using the Internet of Things (IoT) technology. The suggested method is anticipated to increase agricultural production, reduce losses brought on by poor weather, and enhance farmers' quality of life. Millions of people receive work and food security from Sri Lanka's agriculture industry, which is a crucial part of the country's economy. However, the industry faces a few difficulties, such as soil deterioration, pest infestations, and climate change. A monitoring system for prosperous agriculture in Sri Lanka is suggested as a solution to these problems, and it makes use of Internet of Things (IoT) technology to gather real-time data on environmental parameters and crop health. To gather information on crop growth and environmental conditions, the system integrates a variety of sensors, including temperature, humidity, and soil moisture sensors. Machine learning algorithms are then used to process and evaluate the data in order to find potential problems and make suggestions for crop management. The suggested approach is anticipated to increase agricultural productivity, decrease crop losses, and give farmers more precise and useful crop management insights. Integrating other cutting-edge technology, such as drones and satellite imaging, as well as testing and validating the system in actual-world scenarios are possible future research directions. Overall, Sri Lanka's agriculture might change thanks to the planned monitoring system, which would also help the nation's economy and food security grow sustainably.

Keywords: IoT, agriculture, soil moisture, temperature, and humidity

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702/E3

Identification of Sinhala fake news on social media platforms

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Communication is a necessity in human life. There are several modes of communication. People used verbal communication at the start of human evolution and then moved to the writing mode. The emergence of the digital era pushed people to rely on the digital world for convenience, reliability, and low cost. News is the mechanism that keeps people informed about incidents, new regulations, political decisions, and more. News should be communicated to the target audience. Social media are a prominent method of delivering information in the modern world. Even though these platforms allow people to share important facts, it also accelerates the spread of fake news. There are different motives for false news spreaders, like getting attention, financial benefits, political benefits, and religious facts by misleading society. New social media usage statistics in Sri Lanka indicate that adding new users to these platforms is increasing drastically. It accelerates the spread of unreliable information throughout society. It is essential to have a proper mechanism to detect Sinhala social media fake news in the early phases to reduce its negative impact. This study introduces a Deep Learning (DL) based approach to identify Sinhala language false news on social media platforms using content-based features. Content-based methods consider news content features to classify text into target classes. Fake news creators write their content to attract the audience. Using that, we can differentiate the news from legitimate content using available Natural Language Processing (NLP) and Deep Learning techniques. This study focuses on the early detection of Sinhala fake news on social media platforms using a cross-lingual Language Model based on the RoBERTa (XLM-R). No studies are available to detect code-mixed Sinhala language fake news, and this study aims to fill that gap. Publicly available Sinhala news is scrapped from Facebook using a Python tool, and preprocessing is applied to clean collected data. The XLM-R tokenizer is applied to tokenize the text, and the XLM-R base model is used to classify fake and legitimate news. The proposed approach achieved 88% train accuracy, 83% test accuracy, and 84% F1 score on our dataset.

Keywords: Fake news, social media, natural language processing, cross lingual language models

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Adoption of Health Information Systems

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Health Information Systems (HISs) were introduced as a planning system in the early stages and advanced with more functionalities as technology grew. At present, HISs are increasingly used in the healthcare sector. Hence, the research conducted among healthcare practitioners suggests significant gaps in usability, which need to be rectified to increase adoption. Also, the existing adoption models were not created specifically for the health sector. The main objective of the research is to identify the factors influencing doctors to use HISs. The research model was created by adding a construct such as government policies to the existing Unified Theory of Acceptance and Use of Technology (UTAUT2) model. Data collection was carried out through a standard questionnaire based on the UTAUT2 model among the 56 doctors in a Teaching Hospital in Sri Lanka. The results of the study indicate that government policies are unclear and not considered in the adoption and use of HISs. However, studies conducted in other research indicate that policymakers pass policies to increase adoption, and government policies can shape the individual's view of technology. Moreover, the findings of the data collection suggest that the price value can be removed from the model as doctors do not gain or lose any financial value. Thus, to increase the adoption of HISs the government must develop comprehensive policies and regulations.

Keywords: Health Information Systems, Usability, Adoption, UTAUT2

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UI Builder: An automatic code generation tool for design and implementation of user interface

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With the advancement of technology, the growth of software applications has rapidly increased. Both small businesses and large corporations prefer software applications for achieving their business objectives such as marketing, automation, management, etc. With changing business requirements, the software applications had to scale in the direction of adding new features or improving their non-functional requirements. In many aspects, scaling results in increasing the code size and complexity of the application. The question arises of how to improve the software development process to withstand changing business requirements. Automatic Code Generation in Automatic Programming is a suitable solution. This paper introduces a new tool “UI Builder” which can convert user interface (UI) sketches to code. The use of a code generator increases the productivity and efficiency of the organization. The tool satisfies different needs of developers using its enhanced features and easily understandable user flow. With critical experimentation, the effectiveness of the tool is compared with manual implementation to highlight the benefits and advantages. A bug-free, structured, and properly organized code was generated using the tool. The Model used in the tool achieves 91.0% accuracy and 93.0% validation accuracy. The generated code showed a 92.0% improvement in average development time and an 87.5% improvement in code size.

Keywords: Software application, Automatic Code Generation (ACG), Automatic Programming, Code generator

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Object Detection using R-CNN, YOLO, SSD

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This paper is to provide a foundational understanding of the deep learning-based object detection algorithms namely, Region-based Convolutional Neural Networks, You Only Look Once, and Single Shot Detector. Definitions of the algorithms are stated, and a comparison is performed to state the differences between each of the mentioned algorithms, it was found that R-CNN has better accuracy but longer training time. YOLO and SSD have better overall speed than R-CNN. R-CNN is a multi-stage region-based algorithm, unlike YOLO and SSD algorithms. Each algorithm's initial foundational state and the latest developed state as of the time of writing of this paper is discussed. It is stated how each algorithm's latest developed state improved the foundational state. The difference between traditional methods for object detection and modern-day deep learning methods is stated, and it is shown that there exists a trend towards improving deep learning-based algorithms. The algorithms mentioned have been rapidly developed in the past few years. For example, the R-CNN algorithm has been improved into Faster R-CNN, YOLOv1 has been improved into YOLOv7, and SSD algorithm has been improved into D-SSD.

Keywords: object detection algorithms, comparison, trend

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Agricultural extension needs of licensed tea leaf dealers: A case study in Matara district, Sri Lanka

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Licensed dealers are authorized by a dealer's license to collect tea leaf from tea estates and supply to tea factories. They play an important role in the value chain ensuring quality tea production. Knowledge and skills of leaf plucking, handling, and delivering to the factory have a significant impact that determines the quality of Ceylon Tea. Despite of the myriad effort on research and extension stemming from the past, the average national production of made tea remains at 1440 kg/ha/year in 2021, which is much below the potential yield of 3000 kg/ha/year. Thus, this study aims to identify the constraints and the advisory and extension needs of the tea leaf dealers' sub-sector. Licensed dealers (n=150) were selected from Matara district, Sri Lanka considering the number of factories, annual tea production, and their contribution to the low country tea sector. Dealers and the locations were selected on a random basis. A questionnaire survey was conducted from January to June 2019. Further, checklists and informal discussions (n=10) were also incorporated. The secondary data were collected from various sources such as Central Bank reports, documents of Sri Lanka Tea Board (SLTB), Tea Smallholdings Development Authority (TSHDA), Tea Research Institute (TRI), and the literature on the tea industry. The collected data were analysed on non-parametric statistics. The study reveals that the drastic competition for collecting leaves (75 %) and the limited leaf availability (58 %) are the main issues for the dealers. Tea factories finance for 74.2 % of the leaf dealers. Other leaf dealers (51.6 %) receive assistance from SLTB and TSHDA, and 43.6 % from tea land owners. It is evident that, 86.3 % of the dealers received extension services from SLTB while 62.0 % of them acquired the same from the agri-inputs supply companies. Pertaining to training need identification, leaf handling and dealing, leaf quality assessment and tea manufacturing, and tea planting and plucking are requested by 86.3 %, 62.0 % and 57.3 % of the dealers, respectively. Training programs, exhibitions and discussions were sought from private sector and state sector at 64.5 % and 61.3 %, respectively. They requested inputs to improve the extension services from both sectors in equal percentage as 62.1 %. The dealers requested awareness programmes from private sector (61.3 %) while 50.8 % from state sector. Moreover, self-study materials (49.2 %) and motivational inputs (45.1 %) were mainly requested from public sector service providers. These findings demonstrate that the licensed dealers compete for leaf are in need of extension inputs in improving the quality of green leaf received to the factories.

Keywords: Advisory, extension, knowledge, tea leaf dealers, training

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An analysis of dried fish price mark-up: A case study in urban and rural dried fish market in Batticaloa

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Price mark-up analysis is important to develop an efficient pricing strategy that would increase profit and recover the cost. Price mark-up analysis is becoming fundamental in supply chain management as a prerequisite for effective pricing mechanisms. Thus, this study attempts to analyse the price mark-ups of main dried fish varieties (large pelagic fish – Shark, Skip jack tuna, String rays and small pelagic fish – Mackerel, Sardinella, Sprats) at producer, wholesaler, and retailer nodes of the supply chains in urban and rural dried fish markets in Batticaloa District. Valachchenai and Batticaloa towns were selected as rural and urban markets, respectively. Four producers, 6 wholesalers, and 10 retailers were selected from each market randomly (n=40). Quantitative data were collected by administering a questionnaire survey. Simple price markup analysis was used for analysis. Wholesalers obtained the highest price mark-ups for both large pelagic (26.66%) and small pelagic (23.42%) at urban dried fish markets. Similarly, wholesalers' price mark-ups were high for large and small pelagic 31.91% and 40.15% in rural markets, respectively. The lowest price mark-ups for both large pelagic (13.83%) and small pelagic (12.7%) were at the producer level. Retailer had the lowest price mark-up on both dried fish categories (large pelagic 10.64%, small pelagic 10.27%) in the rural dried fish market. It can be concluded that in both markets' wholesalers enjoy a higher profit due to high price mark-up while producers suffer with least. Price mark-up between each node of the supply chain for rural and urban is unequal. This indicates an asymmetry in the price and profit distribution along the supply chain for both small pelagic and large pelagic fish species at rural and urban markets. Thus, an intervention is claimed to make the pricing mechanism efficient, especially in semi-perishable markets such as dried fish to ensure fair profits for all the supply chain actors while ensuring fair prices for consumers.

Keywords: Price mark-up, pricing strategy, dried fish, urban and rural, Batticaloa

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An assessment on the preferred drying technology by dried fish producers: A case study in Negombo, Sri Lanka

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Fish drying is a popular fish preservation technique that enhances the shelf life and the keeping quality of fish. Novel techniques and technologies to dry fish have been introduced by the worldwide institutions including National Aquatic Resource Research & Development Agency (NARA) and Ministry of Fisheries and Aquatic Resources Development (MFARD) in Sri Lanka. This research assesses most preferred improved drying technology among dried fish producers in Negombo, Sri Lanka. Pitipana and Duwa were the selected fisheries inspector divisions for the study. Four Focus Group Discussions with 40 participants were conducted together with Participatory Rural Appraisal (PRA) tools including matrix ranking and preference ranking. Affordability, capacity, efficiency, cleanliness, cost effectiveness, resistance to environmental conditions, local availability, and technical know-how were the selected criteria for the matrix ranking. Solar tent, solar-biomass dryers, electric oven, improved rack system, solar cabinet dryers, heat pump, and freeze dryers were the assessed technologies. Friedman's test was applied to data obtained from preference and matrix rankings. The Friedman's test statistic (F_r) of 25.379 with a p-value of less than 0.001 in preference ranking and F_r of 28.141 with a p-value of 0.030 in matrix ranking suggest a statistically significant difference among technologies. The solar tent and solar-biomass dryers have the lowest mean ranks of 1.67 and 2, respectively in preference ranking. The sum of ranks for solar-biomass dryers (55) is the highest while solar tent is the second (40.5) in matrix ranking. In mean comparisons of two rankings, there is no significant difference between solar tent and solar-biomass dryers while other technologies have significant difference. It reveals, despite dried fish producers mostly prefer solar tent and solar-biomass dryers, solar-biomass dryers are the most suitable technology considering all criteria. Therefore, a drying technology, which concerns on capital requirement, capacity/drying volume, efficiency, cleanliness and quality of the final product, cost effectiveness, are of paramount importance. Further, resistance to environmental conditions, local availability, technical know-how need to be considered when adapting an improved technology for dried fish producers.

Key words: Drying, dried fish, improved, quality, technology

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Expectations of small-scale maize farmers towards the public-private collaborative promotional projects: A case study in Polonnaruwa District, Sri Lanka

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Maize is the second most popular field crop in Sri Lanka, especially as an animal feed. Two commercial-level maize cultivation projects have been initiated in the Polonnaruwa district with collaboration of public-private partnerships. One was initiated by Dimbulagala Multipurpose Cooperative Society Limited (DMCSL) in 2017 and the other one was with the Smallholder Agribusiness Partnerships Program (SAPP) in 2020. However, these were halted prior to completion. Thus, this study aims to identify the farmer's perception regarding commercial-level maize cultivation projects and to investigate the expectations of the farmers to have sustainable-driven projects in the future. A questionnaire survey was conducted with Hundred (n=100) farmers as 50 farmers are from each above-mentioned project. A simple random sampling technique was adopted to draw the sample; however, the sample size was determined through proportionate sampling. Mean values revealed that farmers have positive perceptions regarding crop suitability (4.6, 4.68), program awareness (4.24, 4.38), project efficiency (3.74, 4.45), project benefits (3.34, 3.36), and trustworthiness (3.3, 3.36) but technical package of the project has dissatisfied the farmers (2.41, 2.85) in both projects. Moreover, farmer's opportunity cost on participation of the project was lower (2.8, 1.58) of DMCSL and SAPP, respectively. However, the factors such as lack of loan facilities, lack of farmers' organizational support, delay or no agreed input provisions, reduced paddy cultivation in the project implemented area in Maha season, failures in the compensation programs, and wild animal attacks caused the discontinuation of projects. Furthermore, the majority of farmers expected a project that allows them to pay for seeds after selling the harvest (57%, 70%), to receive fertilizer subsidies as materials (90%, 96%), and to sell their harvest as dried seeds (66%, 76%) in both projects of DMCSL and SAPP, respectively. All farmers (100%) recommended a solid organization to operationalize the projects. Thus, the study concludes that most farmers have a positive perception towards maize cultivation promotional projects. Improvement of producer participation through PRAs and forming farmer organizations is vitally important to increase farmer's decision-making ability before implementing a project. Moreover, improvement of maize value chain with collaboration of the private sector by providing high-quality hybrid seeds, producing value added products, encouraging competitive markets as well as enhancement of government's institutional inclusion through conducting training programmes, introducing formal and continuous credit facilities, and inventing subsidy policies for maize are crucial to sustain the maize cultivational projects in the future.

Keywords: Commercial-level maize cultivation, Polonnaruwa, sustainability

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Thai Pongal festival and social harmony in Sri Lanka

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Thai Pongal is a traditional harvest festival celebrated by all Hindus, and non-Hindus in Sri Lanka. The celebration is held each year in mid-January and is known as the 'thanksgiving festival' for the gods of the Sun, Earth, Rain, and other natural elements. Sinhalese also participate in this event with the aim of making farming prosperous. The main objective of this study was to explore the social significance of the Thai Pongal festival and to study the specific social and religious needs of celebrants from different ethnic backgrounds. The study was conducted in Kirimetiya estate village, Kandy district, Central Province in Sri Lanka, and the study population was identified through the purposive sampling method. Data were collected through key informant interviews, direct observation, group discussion, and visual data by using qualitative research methodology, and the Narrative analysis method was used for data analysis. The study revealed that gods respected by respondents—gods of Sun, Earth, Rain, and cattle—are mainly related to the farming cycle; generally, both ethnic communities believe that God has an invisible power. God is impartial and accords everyone with the same rights. Social harmony between the two communities has been fostered through engaging in the festival rituals together and rejoicing. People embrace new things and reject old items during the festival. Tamils and Sinhalese gather during the Thai Pongal festival and exchange stories, as one of the significant roles of the festival. There was no communication issue observed since Tamil speakers were able to speak Sinhala, despite the fact that Sinhalese cannot speak Tamil. The findings of the study indicate that despite the three-decade-long conflict between the Sinhala and Tamil communities and the significant impact of Covid-19 pandemic on everybody's life, festivals and practices in these estate areas are mixed and shared by many people, which can be encouraged further to foster ethnic harmony and reconciliation in the country.

Keywords: Discrimination, ethnic reconciliation, estate areas, social harmony, Thai Pongal festival

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Improving teacher competencies through ICT integration: An online gamified learning intervention using Kahoot

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The integration of Information and Communication Technology (ICT) into education has become an imperative in today's rapidly evolving digital landscape. Teachers play a pivotal role in harnessing the potential of ICT to enhance learning outcomes and equip students with essential digital skills. This design -based study aims to explore the effectiveness of an intervention using the popular gamification platform Kahoot to improve teacher competencies through online gamified learning. The intervention targets various areas including technological proficiency, game design and integration skills, data analysis and assessment practices, collaboration and communication abilities, and continuous improvement. The mixed methods design was adopted for the study. The sample was drawn from all the post graduate diploma in education program using a stratified random sampling method. The data were collected using an online survey administering a structured questionnaire distributed to 74 in-service teachers. They were directed to engage in a series of online training sessions that incorporated gamified elements through Kahoot. Pre- and post-intervention surveys were used to collect quantitative data regarding self-perceived competencies. Additionally, qualitative data were gathered through interviews and focus group discussions, providing deeper insights into the impact of the intervention on teacher practice and perceptions. Descriptive methods were used to analyse the data. The results demonstrate a significant improvement in teacher competencies, with a 30% increase in ICT integration skills and a 25% improvement in effective instructional methodologies. Furthermore, student engagement metrics reveal a 40% increase in participation and interest in the learning process, translating to a 20% improvement in academic performance. The findings of the study hold implications for educators, administrators, and policymakers interested in promoting professional development initiatives that leverage technology and gamification to enhance teacher effectiveness and improve student outcomes.

Keywords: teacher competencies, ICT integration, online gamified learning, Kahoot, professional development

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Formative assessment practices in secondary teaching and learning: A critical explanatory study

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This paper presents a critical explanatory study on the formative assessment practices (FAPs) carried out in secondary classrooms by professionally trained teachers who have undergone university-based teacher education programs. The study was aimed to identify the FAPs of teachers, explore their detailed explanations of implementation, the challenges faced by students during the assessment process, develop a conceptual framework to comprehend formative assessment (FA) in practice, and identify areas for improvement in FAPs in secondary education. A purposive sampling selected ten cases, including ten teachers and twenty students, representing FAPs in secondary teaching and learning contexts. The methodology was a Multiple Explanatory Case Study Design, with data collection through interviews. Cross-case analysis through thematic analysis revealed that debates, quizzes, creative writing, dramatization, singing, oral tests, reflections and self-assessments, and observations were known by teachers as they followed professional development programs. However, the most commonly used assessments were written tests to fulfill the need to train students for written tests to obtain high grades, which will be of help at the national examinations. They used performance-based assessments rarely and especially after school time. However, a major challenge was the poor participation of students in these activities as students were attending extra private tuition classes. It was found that some students preferred performance-based assessments of different types while others showed reluctance to engage in activities promoting creativity. The study generates a conceptual framework for training. One component of the model includes teacher empowerment, which is a dire need to implement formative school-based assessment. Such components could be facilitated by teacher collaboration through learning communities initiated by teacher centres and training of Inservice Advisers to encourage and promote FA as a continuous and ongoing process in schools. On the other hand, the framework needs to focus on teachers' professional development programs, which integrates FA into instructional practices, promoting student reflection and self-assessment and providing timely and actionable feedback using technology in FA. In addition, establishing a system where FA marks are incorporated into the final grade should be formalized. Such an approach would generate interest and motivation among students and educators to actively utilize these FA methods.

Key words; Formative Assessment, Secondary Education

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Discernment towards online learning during the COVID-19 pandemic: A vivid analysis in the University context in Sri Lanka

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The COVID-19 pandemic has interrupted teaching in various institutions, especially in the global higher education system. Challenging it, the University system of Sri Lanka was constrained to using online learning strategies with limited experience. Here, the major concept in education, the traditional face to face education, was converted into a new form that transforms in person or physical learning into a virtual approach of learning. Hence, the purpose of this study is to investigate the perception of university students toward online learning during COVID-19 period. Accordingly, students from four different Government Universities (University of Ruhuna, Pali and Buddhist University, University of Colombo, University of Peradeniya) in Sri Lanka were purposively selected (n=105). An online questionnaire focusing on the knowledge, attitudes, and expectations of students towards online learning was distributed. According to respondents' answers, 57.3% had little or no experience with online learning prior to the coronavirus outbreak, and 76.9% preferred blended learning of traditional learning and online learning. The most popular device used to connect online classes was the smartphone (85.6%). The challenges of online learning during the COVID-19 period included issues related to technical problems (84.6%), reduced interaction between the lecturer and friends (52.9%), and social isolation (28.8%). Nevertheless, students identified online learning is as effective as traditional learning. Further, they noted the ability to record the lectures as video (85.4%), learn from preferable place (68%), and reduction of traveling cost and other expenses (67%) as major advantages. 85.4% of students were positive to integrate online learning into their courses in the future and the overall positive perception regarding online learning during COVID-19 was 91.1%. In conclusion, study show the need of combination of online learning and traditional learning methods to ensure the survival of education. Moreover, it is needed to pay attention to curriculum innovation and adoption of relevant and viable new educational methods.

Keywords: COVID-19, Online learning, Sri Lanka

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809/F

The use of Azolla as a sustainable protein and mineral supplement for livestock feed

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Azolla is a small free-floating aquatic fern, which is now utilized as a feed ingredient for livestock animals, medicine, water purifier, human food, biofertilizer, and in biogas production all over the world. In Sri Lanka, animal feed accounts for approximately 60 to 80 percent of the total cost of livestock production. Moreover, feed price in Sri Lanka is high because the animal diet contains a significant amount of imported raw materials. The objective of this study is to use Azolla as a sustainable and alternative protein and mineral supplement in formulating low-cost animal feed; hence, limiting the importation of feed ingredients and saving on foreign exchange. Today, the challenge faced by livestock production includes improving feed formulations using natural feed ingredients that promote growth while lowering production cost. In this context, the search for an alternative feed needs to concentrate on finding a feed that can cater to many species of animals. One such perfect finding is a plant called Azolla, which has the ability to supply sustainable livestock feeds. This review was conducted to find the significance of Azolla meal as a protein and mineral supplement in livestock feed. Approximately, 30 published online journal papers from Research Gate and Google Scholar published about animal nutrition were reviewed. The information gathered revealed that Azolla can be used as an ideal source of feed for dairy cattle, poultry, and fish providing an alternate protein source without any adverse effect on the production status of the animals. Various studies indicated that feeding of Azolla in dairy cows increased milk production by 15 to 20 percent. The use of Azolla in poultry birds improved the weight of broiler chickens and increased the quality of egg production in layers. In conclusion, the use of Azolla is an economical and sustainable feed supplement for different species of animals, which significantly reduces the cost of feeding. As a result of using Azolla as an animal feed, the market price of livestock products such as meat, milk, and eggs can be lowered for consumers in Sri Lanka.

Keywords: Azolla, cost of production, livestock feed, Sri Lanka

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810/F

Addressing aversion towards learning science *via* content and language integrated learning (CLIL) activities: An action research case study

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Science subject aversion is a significant issue prevailing in diverse educational settings, especially in the bilingual stream of education. This affects the student's academic performance as well as their future career choices. The aversive attitude towards science can often be experienced and it tends to pose a formidable challenge to a teacher at the beginning of every academic year. Therefore, understanding the underlying factors contributing to this aversion and exploring efficacious interventions to address the situation is the responsibility of a professional teacher. This action research was conducted within the first school term of the year 2023 to eliminate the subject aversion among 8th-grade girls in a 1AB Semi Government Catholic girls' school located in the Negombo Education Zone following the concept of teacher-as-a-researcher. Kemmis and McTaggart's Action Research Model was adopted to conduct a teacher-led intervention involving 38 bilingual students. The root causes were investigated by administering a questionnaire, observing the students' responses and interactions by reviewing their writing, worksheets, and conducting informal discussions. Content and Language Integrated Learning (CLIL) activities and CLIL teaching strategies were implemented to address the issue. Pre-test and post-test data along with unit test data were compared across the planned teaching learning scenarios. Data were analysed quantitatively and qualitatively using paired t-test and content analysis and discourse analysis. The substantial impact of CLIL on both subject knowledge and language proficiency is evident. With a remarkable low p-value of 2.6×10^{-16} , well below the conventional significance level of 0.05, these findings robustly affirm the comprehensive and meaningful learning experience fostering by CLIL. Further, this confirms CLIL teaching strategies enhance the students' intrinsic motivation too. It is crucial to re-implement this in another term to confirm the findings. However, these findings provide an insight into the importance of equipping bilingual teachers with the CLIL concepts and empowering them to adopt activities that motivate students to learn science eliminating aversion.

Keywords: CLIL, subject aversion, CLIL teaching strategies

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811/F

An overview of the food and beverages global value chain of Sri Lanka

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World trade and production are ever more structured around “global value chains” (GVCs). GVCs can be defined as the full range of activities – distributed across different countries – that firms and workers engage in to bring a product from its origin to consumers. The diffusion of GVCs has challenged the conventional wisdom on how we look at and interpret trade. Furthermore, Sri Lanka still not reap the full potential of GVCs. Hence, the research objective is to overview the food and beverages (HS 030) global value chain of Sri Lanka between 2007 to 2017. The research used the Regional Integration and Value Chain Analyzer (RIVA) published by UNESCAP and FEALAC covering 72 countries. Value-added indicators in RIVA are based on the Asian Development Bank Multi-Regional Input-Output database. The analysis was limited to the years 2007 to 2017 period based on data availability. In 2017, the backward linkages accounted for 213 \$ million while forward linkage accounted for 288 \$ million in food and beverages trade. The major backward linkage countries were India, China, Singapore, the United States of America, and Indonesia. The major forward linkage countries were the Netherlands, Switzerland, Maldives, Germany, and Belgium. The major share of Sri Lanka’s GVC with India consists of intermediate goods trade (54.43%), which is 48.76% for GVC with Switzerland. The major share of Sri Lankan GVC in China belongs to finished goods traded (64.91%). The GVC participation index indicates that Sri Lanka has the highest GVC participation with the Netherlands (0.43), Switzerland (0.40), and Maldives (0.36). Sri Lanka has the highest overall value chain participation (31.15 \$ million) with the Netherlands. However, Sri Lanka has the highest gross food and beverages exports (217.96 \$ million) to India and the overall GVC participation is 29.56\$ million in the food and beverages sector which is only 13.56%. Those results indicate that harnessing the power of GVC has been particularly challenging for developing economies like Sri Lanka. Therefore, further research to better understand the GVCs is recommended to develop better policies to ensure a more effective seize of these opportunities.

Keywords: GVC participation index, overall value chain participation, RIVA Value chain analyser

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Harnessing the overseas expatriate base to leverage local science, technology innovation (STI) capacities: Initiatives by some science funding agencies from developing countries

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Many countries are looking for ways and means of utilizing their overseas nationals related to Science, Technology, Engineering and Mathematics (STEM) fields to leverage Science, Technology and Innovation (STI) capacities of the motherland. Such expatriate STEM communities are also known as 'Scientific Diaspora', indirectly contributing to achieve the foreign policy objectives of their motherlands through the engagement in 'people-to-people' contacts or 'Tier II' diplomacy. A research gap exists in identifying the methods of engagement of science and research funding agencies in the developing world with their scientific diaspora to bring benefits to their motherlands through science diplomacy. Therefore, this study targets to identify the mechanisms and instruments used by the science and research funding agencies in some developing countries to utilize scientific diaspora to leverage the STI capabilities in their motherlands. The funding agencies are specifically selected as they act as science policy intermediates between the governments and the research community and have a high potential to devise strategies to harness their overseas scientific expatriate bases to leverage national interests. To achieve the study objective, secondary data such as published information (e.g., Web, reports articles, etc.) by three randomly selected science and research funding agencies from the developing world, who are also the members of the Global Research Council (GRC) were studied and analysed qualitatively. The funding agencies were the Science and Engineering Research Board (SERB) of India, Iran National Science Foundation (INSF), and the National Science Foundation of Sri Lanka (NSF) from the Global South. The results indicate that providing greater opportunities for STI capacity building, enhancing research collaboration with facilitation to joint publications, and technology transfer are some of the key methods and instruments used by the funding agencies to utilize their scientific diaspora to build national STI capacities. In the contexts of economic drawbacks prevailing in the developing world, especially in a post-COVID era, digital platforms could be utilized as effective tools for harnessing the potentials of the scientific diaspora for national development with less funding commitments by the national governments.

Keywords: Scientific diaspora, science diplomacy, funding agencies, STI

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An economic evaluation of conventional and organic pineapple cultivation incorporating externalities

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Pineapple cultivation brings significant economic benefits to Sri Lanka. However, the majority of these cultivations follow conventional practices, with only ~1% adopting organic methods despite the known benefits of organic cultivation. Conventional farming remains dominant due to lower market prices, resulting from subsidized inputs and the absence of compensation for external costs generated. Thus, this study intends to estimate and compare the profit of both modes of cultivation incorporating positive and negative externalities. The study was conducted in Gampaha district, which has the highest extent of pineapple cultivation in Sri Lanka. Direct costs and benefits of all inputs were gathered using a survey conducted among twenty conventional and six organic farms covering 54 ha of the cultivated land area. IPCC and other guidelines were used to estimate emission of greenhouse gases and eutrophication potential from the farms, and their damage cost estimates were investigated from the literature. External costs of pesticides were calculated based on the hazardousness of the pesticides. Positive externalities considered are the ecosystem services such as biological pest control, soil formation and soil organic carbon and were valued using benefit transfer approach for both systems. Results indicate that there is land size variation among the systems with maximum of 16 ha for conventional farmers and 3 ha for organic farmers. Under conventional cultivation, agrochemicals and fertilisers are applied twice per harvesting period. The crop under conventional cultivation matures early in about 8 months while organic crop requires 12 months to mature. Labour cost of organic farming was more than double compared to conventional system. Considering direct costs and benefits, annual net benefits is LKR 1.6M per ha for conventional farmers and LKR 1.627M per ha for organic farmers. When the externalities are incorporated the organic system shows a net gain of LKR 3,135,171 per ha while the conventional system is no longer beneficial. The results could provide implications for promoting organic cultivation in order to reduce the impacts on the environment and to improve the economic gains for the country in the long run.

Keywords: externalities, organic cultivation, conventional cultivation, pineapple

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Benefits to beach users: A travel cost analysis of multiple recreational activities

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The beach offers a multiple of recreational opportunities to its visitors including swimming, surfing, fishing, walking, diving, relaxation, or simply savouring the seaside ambiance. This study focuses on examining the benefits that different recreational activities provide to beachgoers, particularly in the coastal regions of Sri Lanka. Our goal is to assess consumer surplus, which represents the extra satisfaction or value people derive from these activities compared to merely being passive beachgoers. Pilot study was conducted involving 15 respondents to validate the structured questionnaire. Subsequently, data was collected from 287 random beach and coastal area visitors in Sri Lanka including both locals and foreigners. Data collection took place during weekdays and holidays from November 2021 to January 2022, spanning the coastal region from Negombo to the southern part of the country. The Individual Travel Cost method, a widely accepted approach to calculate the consumer surplus was used. This method not only allowed to estimate the monetary value of this surplus but also provided insights into the frequency of trips visitors make each year and the factors influencing their decision to visit. Main findings revealed intriguing insights. Notably, factors such as age, gender, and educational level had a positive and significant influence on the frequency of beach visits. This suggests that these demographic variables play a crucial role in shaping visitors' preference for engaging in recreational activities along the coast. The results further revealed that estimated consumer surplus of engaging in recreational activities compared to that of someone relaxing on beach was much higher. A trip to the beach provides a consumer surplus of LKR 7944.305 per trip on average while actively engaging in a beach activity such as swimming, snorkeling etc. provides an additional surplus of LKR 7615.948 per trip. A visitor, on average, incurs a cost of LKR 3616.72 per beach trip. It is important that the authorities promote and regulate beach as a heterogeneous good to attract a diverse group of visitors that enjoy multiple activities and values. Furthermore, the study shed light on the financial aspect of beach visits. Finally, the research contributes to a deeper understanding of the multifaceted nature of beach recreation and its associated benefits. By valuing various activities available at the beach, valuable insights can be provided for policymakers and stakeholders involved in the management and promotion of coastal areas. It is imperative that authorities promote and regulate beaches as diverse attraction sites to get attention of a wide range of visitors who appreciate a variety of activities and values.

Keywords: Coastal areas, consumer surplus recreational activities, visitors

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815/F

Effect of lean tools in minimizing waste: A case study of Sri Lankan apparel industry

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In today's highly competitive business environment, organizations are constantly seeking ways to improve their productivity. *Lean manufacturing*, which aims at reducing waste and improving quality, is popular among manufacturing organizations as a strategy for achieving this goal. The concept of *lean* is rooted in identifying and eliminating the seven wastes commonly associated with manufacturing processes: overproduction, waiting time, transportation, unnecessary inventory, motion, defects, and over-processing. This study aimed to examine the relationship between *lean tools* and the reduction of seven wastes in ABC (Pvt) Ltd Company, with the goal of identifying the most effective lean tools for mitigating each of the seven wastes. The *lean tools* used in the study consisted of *5S*, *Total Productive Maintenance (TPM)*, *Kaizen* and *Pull System*. A representative sample of 175 assistant and above-level employees, who are working in the manufacturing and technical departments of the selected company, was selected using proportionate stratified random sampling. In-depth interviews were conducted using an interview guide. Data were analysed using SmartPLS4, SPSS, and Microsoft Excel. The Pearson correlation coefficient between *lean tools* and seven wastes was 0.719, revealing a significant positive relationship between the *lean tools* and the reduction of seven wastes at the 0.05 level of significance. Partial Least Square-Structural Equation Modelling (PLS-SEM) was employed to identify the most effective *lean tool* for mitigating each of the seven wastes, revealing the positive influence of *lean tools* on the reduction of seven wastes. Here, the influence of the Pull System on the reduction of wastes in inventory, waiting, overproduction, over processing, and defects were significantly positive, reporting the highest values of the path coefficients, which were 0.734, 0.913, 0.835, 0.801 and 0.639, respectively. The influence of TPM, 5S, and Kaizen on the reduction of seven wastes was also positive, according to the positive path coefficients obtained at the 0.05 level of significance: TPM on transportation (0.342), motion (0.724), overproduction (0.100) and over processing (0.155); 5S on defects (0.185); Kaizen on over processing (0.117). Accordingly, it is evident that Pull System is the most effective tool for minimizing the waste in the ABC (Pvt) Ltd Company. Total Productive maintenance is also considerably effective but 5S and Kaizen are the least effective tools.

Keywords: Lean tools, manufacturing organizations, seven wastes, PLS-SEM

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Assessment of the cost of agriculture production loss due to salinity intrusion in the coastal regions of Jaffna Peninsula: A case study in Irupalai South

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The primary source of income of Jaffna peninsula, the northernmost part of Sri Lanka, is agriculture and is mainly supported by the Karstic aquifers of the peninsula. These aquifers consist of freshwater lenses floating atop of a denser layer of seawater, which get diminished due to over extraction, particularly during the dry period. This increases the threat of seawater intrusion in the peninsula. Though the mainland of the peninsula is not exposed to this threat at present, most of the coastal regions are already under severe saline condition as reported in the past studies. Only a few studies are carried out on estimating the cost of agriculture production loss experienced by the region due to salinity intrusion. This study aims at estimating the costs associated with the agriculture production loss due to salinity intrusion in the coastal region of Jaffna peninsula. Irupalai South Grama Niladhari division was selected for the study based on the past studies and Regional Agrarian Office records. A sampling frame was developed by listing the paddy fields located in the selected region and 45 households were selected for the household survey using random sampling method. Only three crop varieties (paddy, gingelly, and jute) were identified during the household survey. A Production function was constructed to identify the relationship between agriculture production of the identified crop types and different factors including capital, cost of input, labour cost, area of the land, distance from the coastal belt, and the groundwater salinity. Several multiple linear regression analyses were carried out to identify the best-fit model to explain the actual scenario. The coefficient of the developed log-log model was used to calculate the production loss in the surveyed lands. Only paddy cultivation expressed a significant relationship between production loss and salinity ($P=0.001$), and the average cost of estimated production loss per hectare per annum was LKR 5,298.20. The estimated value was then extrapolated to the total area of saline-affected land in the peninsula. This study highlights the importance of estimated values in justifying investments in alternative projects/necessary policy implementations regarding water supply for irrigation in Jaffna.

Keywords: Agriculture production loss, production function, salinity, groundwater, groundwater aquifers

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Determinants of consumer attitudes towards an antioxidant-rich herbal tea made from blue butterfly pea flower (*Clitoria ternatea L.*)

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Teas, herbs, and spices are healthy and special products that are consumed widely throughout the world. Herbal teas are considered as a primary source of dietary antioxidants in many cultures. Polyphenolic compounds, in addition to vitamins and carotenoids, have been in the focus of the scientific community for the past few decades. The aim of this research study is to examine the purchase intent and consumer behaviour for a new herbal tea product, which is made from blue butterfly pea flower (*Clitoria ternatea L.*), infused with ginger and cinnamon. A pilot study was carried out with a sample of twenty respondents to validate the questionnaire. Data were collected from 250 participants by administering a structured questionnaire. Data was gathered mainly focusing on supermarket consumers in Western, Southern and Northwestern provinces during the period of February to March 2022. Data were analysed descriptively as well as statistically. For the statistical analysis, Ordinal logistic model was carried out using Statistical Package for Social Sciences (SPSS.16.0) to analyse the relationship between purchase intent and factors associated with purchase intent including demographic variables, product characteristics, and particularly antioxidant activity and price. Out of 250 consumers 60.8% respondents mentioned that they would probably buy the product. The majority of respondents were between 20-30 age category and 70% of the respondents were females. The results highlighted that the category of 'definitely buy' in purchase intent is significant ($p < 0.05$). Age showed a significant negative relationship. Overall appearance and nutritional content are significant determinants of purchase behaviour and intent. Results reveal that Health Relative Index and antioxidant activity has a significant negative relationship on purchase at the significant level of 0.01 ($p < 0.01$) implying that consumers are attracted by health claims. Results revealed that age, nutritional content, and overall appearance have a significant impact on purchase intent compared to price. . These results emphasize that consumers are more sensitive to appearance, nutritional and health-related claims of herbal beverages resulting them being more exposed to being misled. Therefore, trustworthy nutrient profiles and labelling is imperative for food and beverages that is going to be introduced into market. Therefore, these results can be helpful in determining the target market audience for a new herbal tea.

Keywords: Blue butterfly pea flower, herbal tea, consumer attitudes, antioxidant activity, health relative index

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Preference of farmers to participate in a Leptospirosis (rat fever) control program in Kurunegala District

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Leptospirosis is a widespread zoonosis in the world. The major driving force, which leads higher leptospirosis incidents is the lack of awareness among public. Therefore, this study was conducted to assess the awareness among farmers for leptospirosis and to find out the preference of farmers to participate in leptospirosis control programmes in Kurunegala district. This study was conducted by administering a structured questionnaire among n=100 respondents from Barahelagamuwa, Mamunuwa and Ranawana Grama Niladari divisions in Kurunegala district from August 2022 to February 2023. For data collection, simple random sampling technique was used. A Probit regression model was estimated using SPSS software. Results showed that, 16% of respondents have contracted leptospirosis while 43.75% of positive patients stayed at hospital for about 6-10 days for medication. In addition, only 15% of respondents have enough knowledge about leptospirosis. Although 94% of respondents have knowledge on the vector of this disease, only 9% respondents are aware on the actual organism that enters into the human body. A majority of farmers were willing to participate in the awareness programmes (42%) for management of leptospirosis. The amount the farmers were willing to pay was significantly affected based on; if he/she was infected with leptospirosis, if age is above 40 years, and the income level. Moreover, the average amount that farmers prefer to pay was Rs.74.50 per month. The results emphasise the necessity of conducting awareness programmes, providing protective equipment/kits (gloves, goggles, boots, etc.), and conducting rodent management programmes and demonstrations to manage the disease. Additionally, vaccination programmes should be conducted for domestic pests and proper health care service should be established in the country. Eradication of leptospirosis from Sri Lanka is a responsibility of all people in the country, while government makes a prominent intervention. However, this study may provide a better insight to future research and to improve existing leptospirosis control and awareness programmes.

Keywords: Rat fever, farmer preferences, Kurunegala, disease, control

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Poster Presentations



901/A

Analysis of the treatment outcome of *Plasmodium falciparum* and non-falciparum malaria parasites in the malaria POR phase in Sri Lanka, by iDES.

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Sri Lanka, after eliminating indigenous malaria in 2012, is in the prevention of re-establishment (POR) phase. As a country with high malariogenic potential, maintaining vigilance is important. All patients treated need to be ensured a complete cure. Follow-up of malaria patients by integrated drug efficacy surveillance (iDES), is recommended for monitoring drug efficiency by the WHO for countries with a low malaria caseload. The objective of this study was to assess the outcome of iDES of malaria patients during the POR phase in Sri Lanka. All malaria patients that were detected and treated according to the national treatment guidelines from April 2014 to December 2017 were included in this study and were treated. Accordingly, Artemether/Lumefantrine and a stat dose of primaquine were given to *P. falciparum* patients. Non-falciparum patients were treated with Chloroquine. Primaquine was given for *P. vivax* and *P. ovale* as a liver schizonticidal drug. Follow-up was done daily on D1, D2, and D3, and thereafter on a weekly basis for up to 28 days. In addition, patients were advised to get tested for malaria if they developed a fever at any time over the following year. Classification of treatment outcomes was done based on the WHO guidelines for classifying the treatment outcome of malaria patients as early treatment failure (ETF), late treatment failures (LCF), late parasitological failures (LPF) or adequate clinical and parasitological responses (ACPR). The electronic data collection form (in Excel programme) developed by the WHO and the Kaplan-Meier survival curve was used to analyse the outcome of the 28 day follow up of individual patients. Among the 61 *P. falciparum* patients that were successfully followed up, there were 1.6 % (95% CI = 0-8.8) ETF, 6.6 % (95% CI = 1.8-15.9) LCF and 91.8% (95% CI = 81.9-97.3) ACPR, with a cumulative incidence of success of 0.92 (95% CI= 0.82-0.96) and cumulative incidence of failure of 0.08 (95% CI = 0.03-0.18). A total of 76 nPCR-confirmed *P. vivax*, 3 *P. malariae*, and 10 *P. ovale* cases were followed up. There was 100% ACPR (95% CI = 95.3-100). With no treatment failures, the cumulative incidence of success of *P. vivax*, *P. ovale*, and *P. malariae* was 1 at D28. This study shows that the current antimalarial treatment regimens offered in Sri Lanka are effective against imported malaria cases reported among travellers.

Keywords: malaria, iDES, patient follow-up

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902/A

Anxiolytic activity of an herbal preparation in rats subjected to light dark exploration model

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Mental health disorders affect quality of life. Anxiety is one of the common psychological disorders found in society. Anxiolytics are the substances used to treat or prevent anxiety and related psychological disorders. These medications have serious side effects, such as low blood pressure, dependency or habit formation, nightmares, aggressive behaviour, and mood swings. However, there are abundant unrevealed herbs and herbal preparations that possess anxiolytic activities. The present study is focused on evaluating the anxiolytic activity of an ancient herbal formula mentioned in the Ayurveda texts using an animal model. The test medicine was prepared in granule form. Aqueous and alcohol extracts were obtained. Twenty-four healthy albino Wistar rats were randomly divided into four groups. 5 mL/kg of distilled water, caffeine (20 mg/kg), 200 mg/kg of aqueous extracts and 200 mg/kg of alcohol extracts of the drug were administered orally for groups 1, 2, 3, and 4 accordingly for 14 days. The rats were placed for the light dark exploration model on the 15th day. Animals were placed into the cage and then observed for 15 minutes. Greater locomotion and novelty seeking behaviour of rats can be exhibited from light dark behavioural model of rats, which indicates positive anxiolytic effect of a substance. Hence, time spent in the light chamber and number entries to the light chamber were considered the key observations. The animals who received caffeine and the aqueous extract of the formula spent more time in the light chamber. Similarly, they entered a comparatively higher number of times into the light chamber. When compared with the negative control, animals who received caffeine and the aqueous extract showed highly significant ($p < 0.001$) anxiety relief; 0.0005 and 0.0010 accordingly. The study showed positive anxiolytic activity of the aqueous extract of the formula compared to the alcohol extract. Suggested reasons include different antioxidant capacity, immunoglobulin level, or the number of bioactive compounds in 02 extracts. These findings provide important insight regarding an herbal anxiolytic formula. Thus, need further studies to establish the efficacy as an anxiolytic compound.

Keywords: Anxiety, behavioural model, herbal granules

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903/B

Development of a ready-to-eat, vegan sandwich filler by incorporating underutilized food commodities in Sri Lanka

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The main objective of this study was to develop a ready-to-eat vegan sandwich filler in glass bottles using underutilized but readily available food commodities in Sri Lanka. As the main raw materials, tender jackfruit (*Artocarpus heterophyllus*), banana blossom (*Musa acuminata*), sea lettuce (*Ulva fasciata*) and soy flour (*Glycine max*) were used. Eight formulations were developed using the Taguchi method and the most acceptable formulation was selected using a sensory panel consisting of thirty semi-trained panellists. The data were assessed using Minitab19 software through the Wilcoxon signed rank test and Friedman test to select the most consumer-accepted formula. The proximate composition (AOAC 2012), fatty acid composition (gas chromatography-mass spectrometry-Agilent 7890A), colour, pH, antioxidants, phytochemicals, mineral content including heavy metals namely Pb, Cd, As (atomic absorption spectrophotometry-Thermo Scientific ICE3000), rancidity as thiobarbituric acid (TBA), peroxide values (PV), and microbial quality were analysed in triplicates. The selected formula (tender jackfruit 30%, sea lettuce 20%, banana blossom 15% and soy flour 10%) had $76.83 \pm 0.29\%$ moisture, $6.25 \pm 0.14\%$ protein, $5.82 \pm 0.15\%$ lipid, $4.99 \pm 0.26\%$ fibre, $4.10 \pm 0.08\%$ carbohydrates and $2.01 \pm 0.01\%$ ash. The 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging activity, 2,2-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) diammonium salt (ABTS) value, total phenolic and total flavonoid contents were 29.44 mg/ml, $16.97 \pm 1.67 \mu\text{mol (TE)/ mg}$, $3.09 \pm 0.22 \mu\text{g (GAE)/mg}$ and $7.01 \pm 3.15 \mu\text{g (QE)/mg}$, respectively. The chroma meter values of the product were reported as $L^* 46.53 \pm 0.25$, $a^* 7.93 \pm 0.75$ and $b^* 19.4 \pm 0.98$. The pH of the final product was 4.36 ± 0.05 . The TBA and PV values indicated that the antioxidant-added sample has an improved protection against rancidity compared to the control ($p < 0.05$). The fatty acid analysis revealed that the product consists of polyunsaturated (10.43%), monounsaturated (13.02%) and saturated (76.49%) fatty acids. No detectable microbial growth was observed during the two-month storage period at room temperature. The product reported no detectable heavy metals at ppm level. Finally, it can be concluded that the developed product has high consumer acceptability and is chemically and microbiologically safe for human consumption during the tested period of two months.

Keywords: *Artocarpus heterophyllus*, *Musa acuminata*, proximate composition, sandwich filling, *Ulva fasciata*

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904/B

Development of strained yogurt spread incorporated with fresh mint leaves and coriander leaves and evaluation of its quality parameters

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Strained yogurt, also known as Greek yogurt, is obtained by draining the whey from regular yogurt to achieve a thicker consistency, higher total solids, and lower lactose content. This study was aimed to introduce a protein-rich strained yogurt spread made from fresh milk as a cheese spread substitute. Proper sanitation and hygiene protocols were followed during production to minimize microbial contamination. Fresh milk, pasteurized at 63 °C for 30 minutes, was inoculated with a 2% yogurt starter culture and incubated at 42 °C for 2-4 hours to curdle the milk protein. The whey was separated by draining overnight in a refrigerator. Fresh mint and coriander leaves were washed, pat dried and oven-dried at 65 °C until a constant weight was reached. The dried leaves were then ground separately. The treatments T1 (control - 0.2% salt, 0.5% pepper), T2 (0.15% dried mint, 0.5% dried coriander), T3 (0.5% dried mint, 0.15% dried coriander), and T4 (0.1% dried mint, 0.1% dried coriander) were prepared in triplicates. All treatments incorporated 0.2% salt and 0.5% pepper. No significant difference was seen in the composition between any treatments. The total solid content ranged from 23.6% to 24.2% while milk solids non- fat (MSNF) ranged from 19.3% to 23.8%, fat content from 8.3% to 8.5% and protein from 8.1% to 8.6%. Sensory evaluation was conducted with 20 untrained panellists using a 5-point hedonic scale. It was observed that the T3 received the highest overall score across sensory attributes including taste, texture, appearance, odour, and spreadability, suggesting that T3 was the most favoured option among the panellists in terms of sensory perception. Microbiological testing was carried out immediately after the production, and T3 demonstrated that the product complies with Sri Lankan standards for fermented dairy products. The cost of production of one litre of T3 strained yogurt was Rs. 979.00. Since it has favourable sensory attributes and satisfactory chemical and microbiological qualities this product would be an appealing alternative to expensive cheese spread.

Keywords: Coriander leaves, microbiological quality, mint leaves, sensory attributes, strained yogurt

Acknowledgement: Financial assistance by Veterinary Research Institute

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905/B

Assessing the suitability of in-bottle pasteurization techniques for small-scale dairy production

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Small-scale dairy producers often struggle with maintaining aseptic conditions during the filling stage following milk pasteurization. This study is aimed to extend the shelf life of pasteurized milk by minimizing post-pasteurization contamination through an alternative filling method. Lactoperoxidase (LPO) serves as a heat treatment indicator in milk, as it remains stable up to 75 °C–80 °C, resulting in a negative LPO assay reaction. In contrast, standard pasteurization at 63 °C for 30 minutes yields a positive reaction due to residual LPO activity. A series of preliminary trials were conducted to determine the most suitable time-temperature combination, including 63 °C for 30, 45, and 60 minutes; 68 °C for 30 minutes; 70 °C for 10 minutes; 72 °C for 10 minutes; 75 °C for 10 minutes; 80 °C for 10 and 30 minutes; 90 °C for 30 minutes, and 93 °C for 30 minutes. The minimum time and temperature combination yielding a negative LPO assay result was 75 °C for 10 minutes, which was subsequently adopted for in-bottle pasteurization. A completely randomized design with three replicates was employed. Treatments included T1, fully submerging the product in 75 °C water for 10 minutes, immediately followed by cooling; T2 and T3, partially immersing the product under similar temperature and time conditions but differing in cooling methods (T2 cooled to room temperature before gradual cooling, while T3 opted for immediate cooling); and T4, fully submerging the product in water, followed by cooling to room temperature and gradual cooling. Descriptive analysis revealed the highest negative LPO assay observed in T2. The standard plate count of raw milk decreased from 1.8×10^5 CFU/ml to zero immediately after pasteurization as well as 5 days after pasteurization and increased to 1×10^2 CFU/ml 10 days later in treatment 2. It was lower than pasteurized milk in the market. All microbiological tests were conducted in triplicates. This study revealed that in-bottle pasteurization can effectively replace the filling stage after pasteurization, avoiding post-pasteurization contamination. This method enhances food safety for consumers and profitability for small-scale dairy processors. Further research is needed to explore shelf life and sensory qualities.

Keywords: Lactoperoxidase assay, pasteurization, standard plate count

Acknowledgement: Financial assistance by Veterinary Research Institute

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906/B

Evaluation of physicochemical characteristics of milk fat obtained from two locally reared pure European cattle breeds of Friesian and Ayrshire in Sri Lanka

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Milk fat is one of the most complex fats found in nature and it is also one of the most commercially expensive fats. The aim of this study was to investigate and compare the physicochemical properties of milk fat obtained from two European pure cattle breeds; Friesian and Ayrshire, reared in Sri Lanka. Milk was collected from three different locations; two private and one government, in Nuwara Eliya, Sri Lanka, in December 2022 and fat was separated using the cream separator. Physicochemical properties; peroxide value (PV), saponification value (SV), acid value (AV) and free fatty acid value (FFA), Reichert meissl value (RMV) and Polenske value (P) were analysed using the standard American oil chemist's Society (AOCS) procedures; AOCS Cd 8b-90 (97), AOCS Cd 3-25 (02), AOCS Cd 3d-63, AOCS Cd 5-40, respectively and the refractive index (IR) was determined according to the method specified by the Association of Official Analytical Chemists (AOAC); AOAC 17th edition, 2000, Official method. There were significant differences ($p < 0.05$) in the tested parameters (using One-way ANOVA of Minitab '17) between the Friesian and Ayrshire breeds, in SV (227.91 ± 0.25 and 236.50 ± 0.22 mg KOH/g), AV (0.4202 ± 0.0016 and 0.4458 ± 0.0010 mg KOH/g), FFA (0.2101 ± 0.0008 , 0.2229 ± 0.0005), RMV (27.6833 ± 0.0635 and 28.9667 ± 0.0635) and P (1.8667 ± 0.0577 and 1.5667 ± 0.0577). Results showed that the significantly higher ($p \leq 0.05$) PV (0.8000 ± 0.0016 meqO₂/kg), SV (236.50 ± 0.22 mg KOH/g), AV (0.4458 ± 0.0010 mg KOH/g), FFA (0.2229 ± 0.0005), RMV (28.9667 ± 0.0635) and RI (1.4582 ± 0.0014) were recorded from Ayrshire milk fat, while only the P (1.8667 ± 0.0577) was significantly higher ($p \leq 0.05$) in Friesian milk fat. This study concludes that among the two locally reared, pure European cattle breeds; Friesian and Ayrshire, the highest PV, SV, AV, FFA value, RMV, and IR are recorded in the Ayrshire cattle breed while only the Polenske value was recorded as significantly higher in Friesian cattle breed.

Keywords: Ayrshire, European cattle breeds, Friesian, milk fat, physicochemical properties

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907/B

The effect of different types of biowaste based-vermiwash in combatting *Aphis fabae* (black bean aphids)

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Vermiwash contains micronutrients and can be used as a foliar spray to promote plant growth while reducing pest attacks. In order to assess the effectiveness of biowaste-based vermiwash spray against black bean aphids (*Aphis fabae*), the effectiveness of vermiwash spray produced by exotic and locally available earthworms was tested. The study was conducted with four types of biowastes, including onion (*Allium cepa*) and garlic (*Allium sativum*) peels and neem (*Azadirachta indica*) and marigold (*Tagetes erecta*) leaves. Earthworms of both exotic (*Eudrilus euginea*) and native type were mass-cultivated in laboratory conditions under room temperature 32 ± 2 °C and RH $80 \pm 5\%$ providing cow dung. Ten distinct types of vermiwash were prepared by alternately feeding each type of earthworm with the above-specified four biowastes separately, and without feeding the biowastes. The qualitative analysis was carried out on each vermiwash to detect the phytochemicals separately for ten distinct vermiwashes. An *in-vitro* test was carried out to check the effect of vermiwash on black bean aphids by feeding the black bean aphids using the plant sap of yard long bean (*Vigna unguiculata*) with and without vermiwash. Twenty black bean aphids were introduced into each Petri dish, covered with the parafilm and one millilitre of each feeding liquid was placed and another parafilm was laid over it to have a sandwich model leaf membrane. For the survived number of black bean aphids, $\log_{10}(n+1)$ data transformations were performed. The effects of the treatments on black bean aphids were evaluated using a two-way analysis of variance (ANOVA) in SAS software. Duncan's Multiple Range Test (DMRT) was used to compare mean separation values at a 5% significant level. The study revealed a significant difference ($p < 0.05$) among treatments against black bean aphids where vermiwash derived from the neem leaves using native earthworm species (0% survival) was superior in reducing the black bean aphids compared to other treatments including untreated control (85% survival). The phytochemical analysis demonstrated the presence of alkaloids, flavonoids, tannins, and phenols in all vermiwash. Particularly, alkaloids and flavonoids were slightly more abundant in exotic earthworm derivations than in the native variety of earthworm. The findings revealed the efficacy of neem-based vermiwash against black bean aphids.

Keywords: Alkaloids, earthworms, exotic, flavonoids, native

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908/B

Exploring the adoption levels of scientific practice in agroforestry home gardens: A case study in Weligama divisional secretariat (DS), Sri Lanka

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Agroforestry home gardens are unique land use systems with high biodiversity. Even though agroforestry has become a hotspot in scientific research around the globe, at present, the exploration of the adoption of scientific agricultural practices in agroforestry home gardens seems very limited in the existing literature. Therefore, the present study attempts to assess the adoption of scientific agricultural practices in agroforestry home gardens with special reference to Weligama Divisional Secretariat (DS), Sri Lanka. Ministry of Agriculture, Sri Lanka is conducting the “Haritha Dayak” Home gardening project in Weligama at present. Three Grama Niladari (GN) divisions were selected through a reconnaissance survey conducted with agriculture instructors based on the availability of the highest number of agroforestry home gardens. The primary data were collected from randomly (simple) selected 30 households from each GN division (n= 90) through personal interviews using a pre-tested structured questionnaire. The adoption level was measured by a 5-point Likert scale ranging from 1 to 5 where, 1=Never, 5= highly adopted. The level of adoption of agricultural practices (Selection of land and plant materials, Land management practices, Management of plant protection and Maintenance of plants) was calculated using the adoption quotient and compared with Roger's standard adoption curve. The study revealed that there are no innovators in home gardens, but the percentage of early adopters (20%) is higher than the standard of Roger's curve which is only 13.5%. The early majority is 36% which is greater than 34% in the standard curve. The late majority is 30% and laggards constitute 14%, which is less than 34% and 16% of Roger's curve, respectively. The findings suggest that, in order to encourage the use of scientific agroforestry practices in the study area, support, motivation, and effective extended intervention need to be provided and that can reduce the percentage of the late majority while increasing the number of early majority and early adopters. The development and distribution of feasible production techniques that are site-specific and meeting the needs of the households should be prioritized.

Keywords: Adoption, agroforestry, extension, home garden, scientific

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909/B

The role of hydrophobic characteristics of organic soil amendments for aggregate stability

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Aggregate stability is an important soil property that influences soil physical behaviour. Stable aggregates improve soil structure, water-holding capacity, and protect organic matter in the soil. Organic materials used in fields as soil amendments can contain hydrophobic characteristics that might interfere with the stability of soil aggregates. This study examined the role of hydrophobic characteristics in organic soil amendments on aggregate stability using model aggregates. Organic soil amendments, namely, cattle manure (CM) and a hydrophobic litter material, *Casuarina equisetifolia* (CE), were mixed with sieved-surface soil to obtain six different mixing ratios (5% CM, 4% CM + 1% CE, 3% CM + 2% CE, 2% CM + 3% CE, 1% CM + 4% CE, and 5% CE), where the total soil-amended ratio was kept at 5%. Only surface soil was used as the control. The initial moisture content was kept at 80% of the field capacity for all samples. The prepared soil mixtures were filled into plastic cylindrical blocks (19 mm in diameter and 10 mm in height) to make model aggregates. The model aggregates were placed on a moistened surface to maintain the moisture content throughout the experiment. The percentage of water-stable aggregates (%WSA) was determined using a wet sieving apparatus at 1, 7, 14, 35, and 70 days after preparation. The %WSA was recorded at short time intervals initially, considering the fact that %WSA alteration. The %WSA values were significant ($p < 0.05$) for all the time intervals (Minitab 19, one-way ANOVA). The model aggregates with 5% CE showed the highest %WSA (89%–99%), whereas the control aggregates without added organic materials showed %WSA values of 66%–83%. The model aggregates prepared from six different soil mixtures showed significantly higher %WSA compared with the control (Dunnett's test, $p < 0.05$). The %WSA showed an increasing trend with the increasing percentage of CE in the organic amendment and with the increasing time. Results revealed that the increment of the added hydrophobic litter material, CE, enhanced the %WSA, where the increased stability did not diminish after 10 weeks. Further experiments are required to identify the aggregate stability in relation to the soil amendments, considering longer time periods.

Keywords: Aggregate stability, model aggregates, soil amendments, hydrophobic

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910/B

Development of a functional malted powder with selected pulses and date seeds

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In recent years, functional beverages made with plant-based, non-dairy milk alternatives have drawn increased consumer interest. Due to exorbitant pricing and health claims made about milk powder, consumers are seeking alternatives with high nutrient content. The study aims to address the prevailing nutritional deficiencies in society by formulating a functional malted drink powder with selected pulses and underutilized date seeds. Formulations with different constituent proportions were developed using Taguchi L4 orthogonal array experimental design. Through sensory analysis, the best formulation was selected and proximate analysis along with shelf-life evaluation was carried out on the selected formulation. Powder of soybean (*Glycine max*) malted green gram (*Vigna radiata*), and date seed (*Phoenix dactylifera*) were selected as the ingredients. Four developed formulations were screened out through a sensory evaluation by 30 semi-trained panellists using a five-point hedonic scale. Friedman non-parametric test in Minitab 19 statistical software along with radar diagrams were used to evaluate the responses. The formulation with the highest mean rank for all sensory attributes included powders of 50% soybean, 25% malted green gram, and 25% date seed. Proximate composition analyses were carried out in triplicate for the above formulation and revealed the presence of carbohydrates, crude protein, ash, total fat, crude fibre and moisture content at, $40.92 \pm 0.84\%$, $26.61 \pm 0.50\%$, $3.62 \pm 0.026\%$, $12.70 \pm 0.18\%$, $11.21 \pm 0.32\%$, and $9.49 \pm 0.23\%$, respectively. The water solubility index was $69.92 \pm 1.79\%$ and colour measurements were $53.33 \pm 0.57(L)$, $5.87 \pm 0.24(a)$, $12.3 \pm 0(b)$, $13.6 \pm 0.113(c)$, and $64.5 \pm 0.90(h)$. The mineral composition was analysed using atomic absorption spectrophotometry (Thermo scientific ICE 3000) and the obtained results for potassium, calcium, sodium, magnesium and iron were $1,140.43 \pm 166.85$ ppm, $3,063.36 \pm 261.54$ ppm, $2,408.45 \pm 218.47$ ppm, $11,365.29 \pm 445.62$ ppm, and 4.42 ± 1.72 ppm, respectively. Under bioactive compound analysis, DPPH radical scavenging half maximal inhibitory concentration related to antioxidant activity was 0.0261 mg/ml, and the Gallic acid equivalent phenolic content was 23.0347 μg GAE/ml. The product was evaluated for shelf-life in triple-laminated packaging at room temperature and concluded that it was safe to consume within a two-month period, based on the total plate count as well as yeast and mold count results. At the end of two months, less than 30 colonies were detected, and the peroxide value was 0.9136 ± 0.0714 mEq/1kg.

Keywords: Date seed powder, malted drink, proximate analysis, sensory analysis

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911/B

Development of a ready to serve beverage using *Dioscorea esculenta* (Kukulala)

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Kukulala (*Dioscorea esculenta*) is one of the traditional, underutilized yam species found in Sri Lanka. The objectives of this research were to assess the nutritional, anti-nutritional, and functional characteristics of raw Kukulala and formulate a ready-to-serve beverage to increase the utilization of Kukulala by Sri Lankans. Moreover, this study evaluates the effect of processing methods on the retention of nutrients and anti-nutrients, and the functional properties of the ready-to-serve beverage. The proximate composition of the raw Kukulala was analysed according to AOAC methods. Crude saponin content was determined gravimetrically and total alkaloid and total flavonoid content were determined using the ultraviolet spectrometric method. In terms of fresh weight basis, raw Kukulala exhibited moisture content of $67.03 \pm 0.05\%$, crude protein content of $1.88 \pm 0.01\%$, total fat content of $0.62 \pm 0.04\%$, crude fibre content of $5.61 \pm 0.05\%$, and ash content of $0.78 \pm 0.01\%$. The phytochemical analysis revealed the presence of total phenolics, total flavonoids, total alkaloids and crude saponins at 6.04 ± 0.05 mg/ml, 0.15 ± 0.05 mg/ml, 85.19 ± 0.31 mg/ml and $7.75 \pm 0.01\%$, respectively. DPPH assay exhibited IC₅₀ value of 29.26 ± 0.64 for raw Kukulala. To develop the beverage, a total of nine formulations were prepared using Taguchi's L9 orthogonal array method. Based on sensory evaluation of these formulations, the one with the highest overall acceptability was selected as the optimal formulation, consisting of 10% yam, 12% sugar, and 12 minutes of steaming time. The developed beverage underwent further analysis to determine its proximate composition, antinutrients, antioxidant activity, and shelf life. The proximate composition of the beverage was determined, revealing the following content percentages: moisture ($85.02 \pm 0.10\%$), crude protein ($0.26 \pm 0.05\%$), total fat ($0.24 \pm 0.02\%$), crude fibre ($4.23 \pm 0.08\%$), and ash ($0.21 \pm 0.01\%$). Due to various processing steps involved, the beverage exhibited relatively lower levels of saponins, alkaloids, flavonoids, and total phenolic content. Therefore, the beverage obtained higher consumer acceptability and it met the requirements for ready-to-serve beverages in terms of total soluble solids (15°) and titratable acidity (0.85% as critic acid). Additionally, the shelf-life analysis indicated that the beverage had an acceptable level of total plate count and yeast and mold counts for a duration of three weeks at 0–4 °C.

Keywords: Antioxidants, *Dioscorea esculenta*, functional beverages, phytochemicals, proximate composition

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912/B

The effect of hot water, ultrasound-assisted, and microwave-assisted extractions on bioactive compounds of spent tea from mid-country, Sri Lanka

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Tea, the second most consumed beverage globally, is often brewed for a short period, leaving bioactive compounds incompletely extracted. This makes spent tea leaves (STL) a potential source of natural polyphenols. Thus, the objective of this study was to assess the impact of Hot Water Extraction (HWE), Ultrasound-Assisted Extraction (UAE), and Microwave-Assisted Extraction (MAE) on bioactive compounds in spent black tea infusions from the mid-country region of Sri Lanka, with a focus on analysing total polyphenol (TP), total flavonoid (TF), and total antioxidant (TA) contents. The TP, TA and TF contents of original tea infusion (OTI) and spent tea infusion (STI) were determined using Folin-Ciocalteu, DPPH and aluminium chloride colorimetric methods, respectively. A two-sample T-test was employed to determine the significant difference ($P < 0.05$) between means of OTI and STI. A one-way ANOVA test was used to determine the significant difference ($P < 0.05$) between extraction methods. According to the results, bioactive compounds were significantly higher in OTI than in STI. During OTI brewing, a proportion of bioactive compounds were extracted and resulting a lower bioactive content for STI. Results indicated that the extraction efficiency can be ranked as $MAE > UAE > HWE$. MAE, which uses microwave energy can accelerate the extraction process by boiling the sample, resulting in faster and enhanced extraction of bioactive compounds from tea leaves compared to UAE and HWE. Physico-chemical parameters of OTIs and STIs, including pH, colour, and total ash content were also determined. STI had a lower pH than OTI where higher concentrations of bioactive compounds are found in OTI. HWE differed significantly in colour compared to MAE and UAE. UAE and MAE were found to enhance colour release from tea leaves by disrupting cell structures and speeding up heat transfer, resulting in a more pronounced colour. The ash content in STI was measured for HWE, UAE and MAE, and it was found that HWE had significantly lower ash content ($0.95 \pm 0.03\%$) compared to UAE ($1.13 \pm 0.01\%$) and MAE ($1.17 \pm 0.04\%$). This decrease in ash content in STI is due to the rapid solubilization of minerals from tea leaves during the initial brewing, resulting in higher mineral concentrations in the OTI. Hence, MAE can be recommended as the most effective method to extract bioactive compounds from spent tea in potential industrial applications.

Keywords: Antioxidant content, microwave-assisted extraction, spent tea, total polyphenol content, ultrasound-assisted extraction

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913/B

**Technical efficiency comparison and socio-economic factors influencing coconut plantations maintained under different cropping systems:
A case of Kuliypitiya Division, Kurunegala District, Sri Lanka**

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Coconut, a key plantation crop in Sri Lanka, significantly contributes to GDP and foreign exchange earnings. Despite coconut-based intercropping enhances yield performance, most Sri Lankan plantations are small, old, and underutilized. This research analysed the technical efficiency of coconut plantations under mono-cropping and intercropping cropping systems and the socio-economic factors affecting them in the Kuliypitiya Divisional Secretariat division. The primary data were collected using a pretested structured questionnaire within the purposive random sampling technique. The final data comprised 184 respondents out of 201 samples. Of this, 91 samples belonged to traditional mono-cropping, and the rest fell under intercropping. A stochastic frontier production analysis was performed using the FRONTIER (version 4.1c) software to obtain the mean technical efficiency of coconut plantations maintained under these two cropping systems based on the parameters of annual coconut yield, the extent of the plantation, and the total number of labour hours per year. The mean technical efficiencies of the coconut plantations maintained under mono-cropping and the intercropping system were 79.8% and 84.1%, respectively, and the difference between the means was found to be statistically significant at the 5% α level. The regression analysis revealed that the age, education of the household head, the extent of the plantation, access to formal credit, the type of cropping system adopted, and the owner residing in the estate had significant effects on the average yield of the plantation at 1, 5, 5, 10, 10 and 10% α levels, respectively. Implementing intercropping strategies, increasing formal credit access, and encouraging farmers to expand cultivation, and plantation residence could enhance the technical efficiency of coconut plantations in the Kuliypitiya division. Hence, it can be concluded that Intercropping, a crucial cropping system in coconut cultivation, significantly contributes to the yield performance of coconut plantations in the Kuliypitiya division.

Keywords: Coconut cultivation, frontier analysis, intercropping system, Kuliypitiya division

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914/B

Dung removal and seed dispersal by dung beetles and germination success of the dispersed seeds

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Dung beetles perform critical ecosystem service in terrestrial environments all over the world by removing dung during feeding. Dung beetle feeding and breeding activities involve dung burial, which allows dung beetles to carry out a number of ecosystem services. They are frequently regarded as secondary seed dispersers in ecosystems. This research was conducted at Belihuloya region, Ratnapura, Sri Lanka from November 2022 to the end of January 2023 to determine the dung removal percentage of dung beetles across five different land use types, *i.e.*, forests, forest patches, tea plantations, pine plantations, and home gardens. Additionally, seed dispersal and germination success of dispersed seeds were also studied. The dung removal experimental setup was carried out by placing 100 g cow dung at each sampling point. Twenty experimental setups were placed per land use type and left open for 24 hours before quantifying dung removal. Another special experimental setup was made to quantify the seed germination function through dung removal. Three wooden boxes (60cm × 60cm and 15cm) were used as experimental setup to determine the seed dispersal of dung beetles under laboratory conditions. A hundred grams of dung mixed with *Capsicum annum* seeds were placed in the middle of each wooden box and twenty adult dung beetles (mixed species) were put in each wooden box. After 48 hours, the number of seeds removed by the beetles and seed dispersal rate were calculated. Seed germination success was used as an indicator for effective dispersal other than the seed been consumed. After two weeks, the seed germination success was evaluated from dispersed seeds. The highest dung removal percentage was recorded in forests (14.88%) and the lowest dung removal percentage was recorded in tea plantations (2.82%). The average seed dispersal rate was 58.3% under laboratory conditions. The average germination success of the dispersed seeds was 91.87%. Accordingly, the results suggested that the seeds were not consumed as food by the adult dung beetles. Ecosystem services performed by dung beetles are significant for the functioning of natural ecosystems.

Keywords: Dung removal, ecosystem services, germination success, seed dispersal

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915/B

Developing of seedling pots and seed balls using elephant dung

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Zoo habitats show detrimental effects, such as excessive resource consumption and waste generation, which contradict the main goals of conservation. This study sought to find a valuable use for elephant dung. The objectives were to compare plant growth rates using different combinations of dung media, assess the potential of the growing media as seedling pots, and evaluate the suitability of elephant dung for seed balls. Five combinations were investigated: P1; elephant dung + wood ash + clay (2:1:1), P2; elephant dung + chicken manure + clay (2:1:1), P3; elephant dung + sawdust + clay (2:1:1), P4; elephant dung + clay (2:1), and P5; soil. For testing the seed ball approach, the following medium was prepared: elephant dung + clay (2:1). Germination percentage of seed balls was measured under various environmental conditions—riverside, forest area, roadside, greenhouse—and based on packaging time. The study measured growth rates in terms of shoot height and the number of leaves of Okra (*Abelmoschus esculentus*). Criteria for selecting the best seedling potting medium included water-holding capacity, dry weight of pots, chemical composition by AAS and UV spectroscopy, and germination speed of Okra by number of days taken for germination. One-way ANOVA was conducted to compare all the parameters and significant differences ($P < 0.05$) were observed among the combinations. The findings showed that all of the macronutrients were richer in comparison to soil in specific combinations including nitrate (6.7% in P3), phosphate (2266 ppm in P2), K, Cu, Zn, and Cd (in P1). In terms of leaf count, P2 and P3 demonstrated superior performance. P3 showed a rapid germination within 3 days, the lightest weight at 193 g, and the highest water-holding capacity at 56%. Based on results, P3 outperformed all other seedling pots. In conclusion, the study revealed that the seed ball approach using elephant dung could be a cost-effective method for vegetation restoration with germination rates exceeding 52%. Furthermore, it was observed that germination and packing time had a negative relationship by Karl Pearson's Correlation, suggesting that longer packing times negatively affect the germination rates.

Keywords: Bio-degradable pot, elephant dung, germination percentage, packing time

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916/D

Assessment of the effect of traditional Sri Lankan spice mix on selected haematological and immunological parameters in male Wistar rats

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Being the pearl in the 'land of spices', Sri Lankans have had the privilege of incorporating a variety of spices in their day-to-day meals since ancient times. In addition to individual usage, spices are also included in culinary in the form of spice mixtures known as curry powders. The traditional Sri Lankan spice mix (TSSM) which is also known as 'thuna-paha' is such a powder generally prepared by combining seeds of coriander (*Coriandrum sativum*), cumin (*Cuminum cyminum*) and fennel (*Foeniculum vulgare*). Nevertheless, as studies on the therapeutic value of TSSM are scarce, the *in vivo* effect of the mixture on selected haematological and immunological parameters was studied in this project. TSSM solution was made using authenticated seeds mixed at a proportion of 3.64:1.56:1.00 as determined *via* a questionnaire survey. A dose of 200.42 mg/kg of the TSSM solution was orally administered to adult male Wistar rats (n = 6) for four consecutive weeks as the test group while the control group (n = 6) received an equivalent volume of distilled water. Various parameters were evaluated including red blood cell count, total and differential white blood cell (WBC) counts, platelet count and viability of internal organs (thymus, spleen, bone marrow). Cell viability and phagocytic capacity of peritoneal cells were obtained employing trypan blue exclusion assay and neutral red dye uptake assay, respectively. Serum nitric oxide (NO) production was measured using the Griess assay, and serum alanine aminotransferase (ALT) levels were quantified with a commercially available kit to assess hepatotoxicity of the administered TSSM concentration. There was a significant difference in white blood cell concentrations on day 28 between the two groups ($p=0.035$). In addition, the analysis revealed a significant decrease in the eosinophil percentage of the test group on day 28 compared to day 0 ($p=0.038$). Other measured parameters were comparable between the two study groups. This study suggests that TSSM has the potential to increase total white blood cell count and decrease eosinophil percentage. However, further research is recommended to validate these findings in order to confirm TSSM as a food adjunct with therapeutic value.

Keywords: Haematology, immunology, *in vivo*, spices, therapeutic value

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917/D

Species richness and activities of bird communities against different climatic variables along a 1 km elevational gradient in the Issengard Biosphere Reserve, a submontane forest in Belihuloya, Sri Lanka

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Climatic conditions play a major role in changing the species' distribution. Climatic conditions could also change along an elevational gradient. Here, we investigated the bird community variation in response to the climatic conditions along an elevational gradient of one kilometre in the submontane zone of Sri Lanka. The bird community was studied in the Issengard Biosphere Reserve, a submontane forest at Belihuloya, in Ratnapura District, of the Sabaragamuwa Province (6°42'50.93"N, 80°45'6.39"E). Data collection was done along a 480 m to 1420 m (above Mean Sea Level) gradient, from August 2022 to April 2023 from 5:45 am –10:30 am in the morning and 3:00 pm– 6:30 pm in the afternoon. Bird identification, counting, and measuring climatic parameters were conducted each month. Temperature, wind speed, relative humidity, light intensity, cloud cover, and visibility were measured as climatic parameters utilizing the Sper Scientific 800015 large display indoor/outdoor thermometer, VA-8020 digital anemometer, Sper Scientific 800015 humidity monitor, 1333 Metravi digital lux meter, 8 cm x 6 cm square shaped mirror, and a visibility chart with three-digit numbering system, respectively. Pearson and Spearman correlation tests were done, and graphs were plotted in R statistical platform. Visibility, relative humidity, wind speed, light intensity, temperature, and cloud cover significantly correlated with species richness with respective P values of 0.04, 0.007, 0.03, 0.002, 0.036 and, 0.003. Visibility and relative humidity are positively correlated, whilst wind speed, light intensity, and cloud cover correlated negatively with species richness. The species richness was higher at around 25 °C, above 75% relative humidity, wind speed of 1.5 ms⁻¹ or below, light intensity of 25 kLux or below, at 90-100% visibility, and below 50% cloud cover. Bird activity was higher at moderate temperatures.

Keywords: Belihuloya, birds, climatic conditions, Sri Lanka

Acknowledgement: This study was supported by the Department of Zoology and Environment Sciences, Faculty of Science, University of Colombo and the Department of Wildlife Conservation.

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918/D

Analysis of the impact of rainfall variation on landslide occurrence at village and sub-district scale: A case study in Akurana sub-district of Kandy District

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Landslides are one of the major natural disasters in hilly regions of Sri Lanka and Kandy District has high landslide risk. Landslides are highly localized and fine-scale study is needed. Our objectives were (a) to characterize the seasonality (b) determine the spatial variability of landslides at sub-district (DS) and village (GN) scale and (c) to relate the landslide events with precedent rainfall. Data for historical landslide events at GN level were obtained along with hourly and daily rainfall at Akurana and Katugastota from 2005–2022. Digital survey maps at 1:10,000 scale and demographic data were obtained. 159 landslides were recorded from 2005–2022 in the DS. The monthly average of landslide incidence shows a bimodal distribution with peaks in April and November. This seasonality coincides with bimodal rainfall from April to June (AMJ) and from October to December (OND). The ratio of landslide incidences in AMJ and OND is 1:13 even though the ratio of seasonal rainfall for AMJ and OND is 1:2. The incidence was high in Udaweliketiya, Kurugoda, Waragashinna, and Neerella GN divisions. These GN have high slopes and high building density. Population density too showed statistical significance with landslide events at the GN scale. The rainfall from the same day and the previous day were compared with the landslide occurrence dates. The landslide occurrence for ranges of daily rainfall are as follows: 2 dates recorded daily rainfall below 6 mm, 16 dates recorded daily rainfall between 6–19 mm, 4 dates recorded daily rainfall between 19–32 mm, 3 dates recorded daily rainfall between 32–45 mm, and 16 dates recorded daily rainfall above 45 mm. Half of the landslide events had rainfall of at least 19 mm/day. Rainfall value higher than 45 mm/day led to high risk. Landslides in OND was 75% and AMJ was 10% of the total. Almost all the landslides were preceded by rainfall and heavy rainfall led to higher number of incidences.

Keywords: Fine scale risk identification, landslide, rainfall, sub-district

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919/D

Evaluation of antioxidants, antioxidant-activity, and mineral composition of commercially cultivated mushroom species in Sri Lanka

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Mushroom is known to be an important ingredient in our daily diet due to its high protein content and essential macro and micronutrients. Although Sri Lanka is extensively cultivating different types of mushrooms, there is a lack of information regarding their nutritional and bioactive molecules. Hence, a recent study was conducted to investigate the total phenolic content (TPC), total flavonoid content (TFC), antioxidant capacity, and mineral composition of commercially cultivated mushrooms. Previously authenticated mushroom samples were collected from private mushroom farm and brought into the laboratory under cold condition. Samples were labelled as *Pleurotus cornucopiae* (Abalone) (M1), *Pleurotus ostreatus* (Bhutan Oyster-M2), *Pleurotus ostreatus* (American Oyster-M3), *Agaricus bisporus* (White Button Mushroom-M5) and stalks of *P. albidus* (M4) using standard protocols. The research showed that all mushroom species contained significant amounts of antioxidants and essential minerals. In addition, these mushrooms were found to be rich in sodium, potassium, calcium, zinc, iron, selenium, manganese, and magnesium, which are crucial for maintaining human health. Potency of TPC and TFC was M1>M5>M2>M3>M4 and M5>M4>M3>M1>M2, respectively. Potency of antioxidant activities for FRAP and DPPH was M1>M5>M4>M2>M3, for ABTS M2>M1>M3>M5>M4, and for ORAC it was M5>M2>M1>M3>M4. Notably, button mushrooms (M5) exhibited high values of antioxidants and metal contents compared to other species. These results indicate that mushrooms can be a valuable source for producing nutraceuticals and other value-added products.

Keywords: Mushroom species, antioxidant activity, total phenolic content, mineral composition

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920/D

The current status of the human- purple faced langur conflict in the Matara District, Sri Lanka

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The loss and fragmentation of forests in Sri Lanka have intensified the human-monkey conflict in recent years. Here, we ascertain the nature of the conflict associated with the Purple faced (PF) langur (*Semnopithecus vetulus vetulus*) in the Matara District. Data was collected through questionnaires covering many aspects (e.g., troop sizes of the PF langurs, negative impacts associated with the langur, measures taken for mitigating the conflict and threats to langurs). The survey (n=91 participants) was conducted during January to May 2023, through online platform and physical interviews. The online survey was distributed through social media, receiving responses from across the Matara district whereas the physical survey was conducted in randomly selected areas within the Matara district. The survey revealed that only 58% of the participants were aware that the PF langur was endemic to Sri Lanka but as much as 69% knew that the species was nationally threatened. The majority claimed that troops are comprised of 5-10 individuals (47 % respondents). Most respondents were of the view that natural food trees (cotton leaves), crops (coconut), and fruits (papaya) attracted langurs into home gardens. With respect to damage, crop loss (76% respondents) and roof damage (68%) were recorded as being prevalent. Shouting (60% respondents), firecrackers (35%), and masks (23%) were used as scaring methods, firecrackers being reported as the most effective. Respondents felt that translocation (43% respondents) was the best means of reducing the conflict, although this has been proven to be an ineffective method in Sri Lanka. With respect to threats to langurs, 30% reported incidents of electrocution and 23% of dog attacks. The findings show that there is some lack of awareness about the importance of the species in terms of its endemic status, and ecofriendly means of mitigating the conflict. Considering that the Purple faced langur is listed as one of the world's 25 most endangered primates, increasing the awareness among communities that are exposed to the conflict might, at least in part, be useful in safeguarding the species and reducing the conflict associated with it.

Keywords: Purple faced langur, Matara District, survey, conflict

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921/D

An evaluation on clinical waste from small healthcare sector in Dehiwala Mount-Lavinia area and current waste management practice

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Waste is an unavoidable by-product of human activities. Clinical waste is a type of solid waste, which can be infectious, hazardous or non-hazardous. About 75% to 90% of the waste produced by health institutions is considered as “non-hazardous” or “general healthcare waste”. The remaining 10–25% of health-care waste is regarded as “hazardous” and causes a variety of environmental and health risks. Presently, around 20000 medical officers are actively practicing in the country. Most of them are doing part time General Practice (GP) by running small scale medical centres, dispensaries, and health care centres. Clinical waste disposal has been neglected in small scale health care centres and open dumping is the current practice of clinical waste management in Dehiwala-Mount Lavinia. The main dumping site is at Karadiyana garbage dump in Borupana, Moratuwa. The main objective of this study is to evaluate the present situation of clinical waste generation and their practices in small health care centres in Dehiwala-Mount Lavinia region. Thirteen sites have been selected for sample collection. Sample collection was carried out for a month segregating it as hazardous and non-hazardous. According to the data collected in the research, an average of 9-10% hazardous waste is being generated by small health centres. The amount and type of hazardous waste was different according to the site. According to the clinical waste composition survey, hazardous waste generation for a month was 25.4 kg and non-hazardous waste generation for a month was 255.2 kg. Presently, the clinical waste management in these sites is clearly absent. There is no segregation of clinical waste in the sites and the transportation of waste from sites to the disposal area is unhealthy and not up to the standards. In this study, clinical waste generation and composition were identified in Dehiwala-Mount Lavinia area and it includes hazardous and non-hazardous waste. PHSRC is an authority who is in charge of private medical institutions. Power has to be given to the PHSRC to make all the small clinics to register under them in order to look into clinical waste management. Clinical waste management should be implemented, to make sure it is disposed in a sustainable way to avoid any contaminations in future.

Keywords: Hazardous, non-hazardous, clinical waste, waste management, PHSRC

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922/D

A rapid assessment of phytoplankton assemblages in Mundel Lagoon, Sri Lanka

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The composition of phytoplankton in water is subjected to variability according to changing physicochemical parameters of water and act as a pollution indicator. Mundel Lagoon is such a shallow coastal lagoon in the Northwest coast, where the water quality is subjected to change due to shrimp farm effluent discharges. This study is focused on the diversity and the composition of phytoplankton assemblages in Mundel Lagoon during the month of June 2018. Phytoplankton samples were collected from 08 locations in the lagoon by filtering 50 l of surface water using 20 µm plankton net followed by preserving by adding Lugol's Iodine solution. Quantitative analysis was carried out through sub sampling techniques using a Sedgwick rafter cell under the compound light microscope. Phytoplankton were identified to the nearest taxonomic level using the standard guides. Relative abundance and Shannon diversity index of phytoplankton were calculated. A total of 23 phytoplankton species belonging to 09 classes (Bacillariophyceae, Coscinodiscophyceae, Fragilariophyceae, Cryptophyceae, Euglenoidea, Cyanophyceae, Ulvophyceae, Zygnematophyceae, and Dinophyceae) were identified during the study period. The phytoplankton community was dominated with diatoms (*Pleurosigma* sp., *Lithodesmium* sp., *Thalassionema* sp.) with a relative abundance of 59.2% and dinoflagellates (*Peridinium* sp., *Prorocentrum* sp.) with a relative abundance of 29.6%. Species abundance values of the most dominant species were 558 ind./ml (*Pleurosigma* sp.), 149 ind./ml (*Prorocentrum* sp.), 132 ind./ml (*Peridinium* sp.), 102 ind./ml (*Thalassionema* sp.) and 101 ind./ml (*Lithodesmium* sp.). Highest phytoplankton density in the month of June was recorded at Mangala Eliya (368 ind./ml) sampling point located at northern end of the lagoon, whereas the lowest phytoplankton density was at a location (66 ind./ml) near the eastern periphery of the lagoon. The highest phytoplankton diversity was at Kiriyanakalliya location (2.44) and the lowest (0.75) was recorded at a central location of the lagoon. In conclusion, Shannon indices were below 2.0 for 06 sampling locations (0.75 to 1.84) thus low species diversity was encountered in many sampling locations indicating that the aquatic health was in poor condition. Therefore, it was recommended to take immediate measures to prevent water pollution in order to avoid harmful impacts on fish populations.

Keywords: Mundel Lagoon, Phytoplankton, Shannon diversity index

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923/D

Physicochemical and sensory properties of rice flour-based cookies incorporated with germinated mung bean flour

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This study is focused on developing a rice flour-based (RFB) gluten-free cookie incorporated with germinated mung bean flour (GMBF). Here, the physicochemical characteristics and sensory attributes of the cookies were examined against a control group prepared with wheat flour. Improved rice varieties At 306 and At 313 by Rice Research Station, Ambalantota, Sri Lanka were selected for the study. Cookies were prepared by varying RF to GMBF ratios in 90:10, 80:20 and 70:30 using a completely randomized design. At 306 RF:GMBF (90:10) ratio was selected as the best combination for cookie preparation according to the sensory evaluation results. The proximate composition for RFB cookie was obtained as $3.68 \pm 0.36\%$ moisture, $23.51 \pm 0.28\%$ fat, $7.02 \pm 0.25\%$ crude protein, $1.05 \pm 0.14\%$ ash, $0.59 \pm 0.14\%$ crude fibre, and $64.15 \pm 1.17\%$ total carbohydrate. The proximate composition was not significantly different ($p > 0.05$) from the control; however, RFB cookie had a significantly high total phenolic content ($618.24 \pm 5.53 \mu\text{g GAE/g}$) and DPPH radical scavenging activity as well as significantly lower ($p < 0.05$) IC_{50} value ($60.55 \pm 1.02 \text{ mg/ml}$). The mineral composition of the cookie was found as Na ($193.1 \pm 77.3 \text{ mg/L}$), K ($228.1 \pm 24.7 \text{ mg/L}$), Ca ($18.67 \pm 1.46 \text{ mg/L}$), Mg ($118 \pm 14.0 \text{ mg/L}$), Fe ($0.84 \pm 0.08 \text{ mg/L}$) and Zn ($2.08 \pm 0.61 \text{ mg/L}$). The RFB cookies showed significantly lower lightness ($L^* = 66.83 \pm 0.38$), redness ($a^* = 9.17 \pm 0.23$) and yellowness ($b^* = 26.33 \pm 0.15$) values than the control ($p < 0.05$). RFB cookies were darker in colour compared to the control having lower value of L^* . No significant differences ($p > 0.05$) were observed in terms of thickness, diameter, and spread ratio between the control and the RFB cookie sample. According to the results of the present study, developed gluten-free cookie with higher antioxidant properties, can be a better substitute for conventional wheat flour-based cookies.

Keywords: Germinated mung bean flour, gluten free cookie, physicochemical properties, rice flour

Acknowledgement: Rice Research Station, Department of Agriculture, Ambalantota and University of Sri Jayewardenepura, Sri Lanka

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924/D

Development of gluten-free crackers incorporated with two curry leaves varieties (*Murraya koenigii* and *Clausena indica*), and assessment of proximate composition

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In this study, *Dioscorea alata* flour was employed to substitute wheat flour to formulate gluten-free crackers enriched with locally available domestic curry leaves (*Murraya koenigii*), widely used for culinary practices, and *Clausena indica*, which is called 'Mee-gon karapincha' by the local community in Sri Lanka. The study is focused on assessing the comparative proximate composition of the developed crackers. Unlike *M. koenigii*, *C. indica* is underutilised and its usage is basically limited to medicinal purposes. Initially, *D. alata* flour, *M. koenigii*, and *C. indica* were characterised individually using their proximate composition as per the AOAC standard methods: percentages of moisture (AOAC 925.10), total ash (AOAC 923.03), total fat (AOAC 922.06), crude protein (AOAC 978.04), and crude fibre (AOAC 978.10). Data was statistically analysed at 0.05 significance level by one-way analysis of variance (ANOVA) using Minitab-21 software. The percentages of moisture, total ash, total fat, crude protein, and crude fibre of *D. alata* flour were found to be 15.921±0.398, 2.087±0.030, 1.040±0.287, 2.460±0.178, and 2.241±0.124, respectively. *M. koenigii* had moisture, total ash, total fat, crude protein, and crude fibre percentages of 10.130±0.124, 8.458±0.735, 6.713±0.198, 8.584±0.232, and 13.459±0.089, respectively. P while those of *C. indica* were found to be 7.378±0.353, 9.410±0.055, 3.658±0.616, 12.920±1.339, and 9.739±0.406, respectively. *D. alata* flour was processed to make crackers with 2, 4, 6, and 8% *C. indica* and subjected to sensory analysis to select one percentage. Selected percentage (4%) of cracker formulation was incorporated with corresponding quantities of *M. koenigii* and a control was prepared with no curry leaves powder, to assess the comparative proximate composition of crackers. The comparative proximate composition of crackers prepared with *D. alata* flour incorporated with *M. koenigii* and *C. indica* demonstrated moisture, total ash, total fat, crude protein, and crude fibre contents of 1.324±0.057–1.291±0.098, 2.234±0.332–2.081±0.242, 7.923±0.548–5.088±0.066, 7.912±0.374–6.822±0.087, and 1.686±0.420–1.107±0.085, respectively. *M. koenigii* incorporated cracker showed significantly greater total fat, crude protein, and crude fibre values compared to those of *C. indica* incorporated cracker.

Keywords: Gluten-free, *Dioscorea alata*, *Murraya koenigii*, underutilised, curry leaves

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925/E2

Removal of nitrate by biosynthesized iron nanoparticles using *Coffea arabica*

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Water contamination due to excessive nitrate poses severe effects on the ecosystems. Accumulation of nitrate in water bodies promotes eutrophication and nitrate in drinking water is toxic and carcinogenic to both humans and animals. This study investigated the biosynthesis of zero-valent iron nanoparticles (BnZVIs) using *Coffea arabica* extract. Biosynthesis of nanoparticles is recognized as an alternative to conventional synthesis methods due to its eco-friendliness, biocompatibility, non-toxicity, and cost-effectiveness. The biosynthesized nanomaterials were characterized by scanning electron microscope (SEM), Fourier transform infrared spectroscopy (FT-IR), and X-ray diffraction (XRD). According to the SEM analysis, the BnZVIs show a spherical morphology and size in the range of 20–60 (± 18.78) nm to micrometer-region due to aggregation of particles. The band at 560 cm^{-1} in the FT-IR spectrum, which corresponds to the Fe-O bond, confirms the formation of zero-valent iron nanoparticles using coffee leaf extract and the fabrication of the nanoparticles by the polyphenol/caffeine compounds in the coffee leaf extract. Further, the XRD pattern of the BnZVIs indicates an amorphous structure with a broad peak appearing near the 2θ of 44° corresponding to zero-valent iron particles ($\alpha\text{-Fe}$) and the peak at 21.23° corresponds to the polyphenolic compounds. Synthesized BnZVI was employed in the removal of nitrate from aquatic systems. In the batch experiment, a fixed amount of BnZVIs ($\sim 20 \pm 1$ mg) was added into a series of conical flasks containing 25.0 mL of NO_3^- solution with an initial concentration of 20 ppm. The residual concentration of nitrate in the solution was determined by measuring the difference in the absorbance at 220 nm and 275 nm. The batch experiments revealed that the incubation of BnZVIs for a duration of 100 minutes resulted in a 51% removal efficiency of NO_3^- , with an approximate concentration of 9.8 ± 0.1 ppm remaining after treatment. Kinetic studies revealed that the pseudo-second-order adsorption kinetic model ($R^2=0.99$) is better suited in explaining nitrate removal mechanism by BnZVIs compared to the pseudo-first-order kinetic model. The data indicate a successful synthesis of BnZVIs using coffee leaf extract and an effective nitrate removal by BnZVIs from aqueous systems.

Keywords: Biosynthesis, coffee, nitrate removal, eco-friendly

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926/E2

Development of gluten-free cookies using a composite flour mixture of rice, mungbean, and horse gram flour

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The popularity of gluten-free food products has been increasing due to increased consumer awareness of celiac disease, gluten allergy, and gluten intolerance. This study aimed at producing a novel gluten-free cookie, rich in nutrients from a traditional rice variety Pachchaperumal (*Oryza sativa L.*) flour, horse gram (*Macrotyloma uniflorum*) flour, and mung bean (*Vigna radiata*) flour, to meet consumer demand for wheat-free and gluten-free products to prevent celiac disease. The quality of the cookies was evaluated in terms of sensory attributes, proximate composition, antioxidant properties, physical parameters (weight, diameter, thickness and colour), textural properties (cookie hardness, adhesiveness, fracturability, and cohesiveness), and shelf-life evaluation. The functional properties of flour, both germinated and non-germinated, were compared including water-holding capacity, oil-holding capacity, and swelling capacity. According to the sensory analysis, a cookie developed from germinated composite flour (sample 801) has been selected as the best formula as it has shown a significant increase in sensory attributes compared to a cookie developed from non-germinated composite flour (sample 301). The sample 801 was compared with a control sample which was made from 100% wheat flour (sample 901). The proximate composition obtained for sample 801 was $4.17 \pm 0.08\%$ moisture (AOAC 925.09), $11.80 \pm 0.25\%$ protein (AOAC 960.52), $15.11 \pm 1.08\%$ fat (AOAC 989.05), $1.74 \pm 0.09\%$ ash (AOAC 923.03), $2.02 \pm 0.32\%$ crude fibre (AOAC 962.09), and $67.18 \pm 1.38\%$ carbohydrate (subtraction method). According to atomic absorption spectroscopy results, the sample contains sodium 1468.26 ± 1.88 mg/100 g, potassium 9209.29 ± 1.21 mg/100 g, calcium 1716.24 ± 2.92 mg/100 g, magnesium 6849.45 ± 1.58 mg/100 g, iron 3.3023 ± 0.0037 mg/100 g, and zinc 0.9485 ± 0.0010 mg/100 g. According to the one-way ANOVA test, there was a significant difference ($p < 0.05$) in moisture, protein, fat, ash, crude fibre and mineral contents between sample 801 and sample 901. Sample 801 exhibited greater free radical scavenging activity than sample 901, with an average IC₅₀ value of 68.061 ± 0.0227 mg/ml. The shelf-life of the gluten-free cookie was 4 weeks. Results of the study suggest that a cookie made from germinated composite flour has a greater content of macronutrients, micronutrients, and antioxidants compared to a cookie made from 100% wheat flour.

Keywords: Gluten-free cookie, germinated flour, green gram, horse gram, Pachchaperumal rice

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927/E2

Evaluation of antimicrobial activity of saponins extracted from *Sapindus emarginatus*

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Researchers have shown significant interest in the investigation of biocompatible and naturally occurring surfactants with inherent antimicrobial activities due to their widespread use in therapeutics and cosmeceutical applications. *Sapindus emarginatus* has traditionally been utilized as a natural alternative to soap. It is a plant rich in “saponin”, a class of phytochemicals that possesses a diverse array of biological and pharmaceutical properties including antimicrobial activity. This work was mainly focused on the separation as well as the purification process of saponins, extracted from the pericarp of *Sapindus emarginatus*, and investigation of their antimicrobial activity. Maceration was used to extract saponins. An aqueous solution of the residue from maceration was extracted with diethyl ether and *n*-butanol, subsequently to obtain crude saponins. Purification of the crude saponin extract was performed by means of flash column chromatography technique with gradient elution from ethyl acetate to methanol. The extracted crude saponins and purified saponin fractions were then subjected to evaluate their antimicrobial activity in comparison to Gentamycin and Miconazole as the positive controls. The efficacy of two of the fractions against *Candida albicans* (ATCC 10231) was found to be superior according to the agar-well diffusion method with minimum inhibitory concentration (MIC) values of 0.31 mg/ml for crude extract and 0.16 mg/ml for the purified saponin fraction. However, their efficacy against the bacterial strains *Staphylococcus aureus* (ATCC 25923) and *Pseudomonas aeruginosa* (ATCC 27853) were lower. The crude saponin extract exhibited significant activity against *Trichophyton rubrum*, (ATCC 40051), which is a dermatophyte with an MIC value of 0.16 mg/ml, whereas the purified saponin fraction demonstrated even stronger antifungal activity with an MIC value of 0.08 mg/ml. This enhanced efficacy could be probably due to an elevated concentration of saponins in the purified fraction than that of the crude extract, which contains carbohydrates as an impurity. In addition, TLC-bioautography studies revealed the antifungal activity of purified saponins is found with bands having low R_f values. These findings highlight the potential of saponins as plant-derived antifungal agents that can effectively target common pathogenic fungi.

Keywords: Saponins, extraction, column purification, TLC-bioautography, antibacterial activity, antifungal activity

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928/E2

Determination of functional and physicochemical properties of vitamin enriched iced tea beverages

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In today's health-conscious society, there is a growing demand for convenience and nutritious food. Functional beverages provide hydration along with additional health benefits. Tea, a widely consumed beverage known for its potential health benefits, contains bioactive compounds with antioxidant and anti-inflammatory properties. Essential nutrients can be incorporated into beverages to meet the increasing consumer interest. Accordingly, researchers and beverage manufacturers have been exploring the fortification of tea with essential vitamins, particularly B-vitamins. This study is focused on determining the functional and physicochemical properties of iced teas that are enriched with vitamins B1, B5, B6, B7, and B9, which are known for their energy-enhancing and other health benefits. To ensure the stability of these vitamins, vitamin C was added as a treatment. The incorporation of these vitamins into tea can elicit alterations in both functional and physicochemical properties. The addition of vitamins synergistically enhanced the antioxidant activity of the product, which is further complemented by the presence of polyphenols in tea. The results show that green tea- and black tea-based iced teas fortified with vitamin B and vitamin C exhibit the highest antioxidant activity compared to the beverages containing only vitamin B. The antioxidant activity of the two beverages was quantified as 138.30 ± 4.10 mg and 102.72 ± 3.51 mg of ascorbic acid equivalents per 100 ml of beverage, respectively. The study also analysed the total polyphenol content in the beverages, finding a mean value of 78.32 ± 3.33 mg GAE/ 100 ml in black tea-based iced tea and 100.25 ± 5.04 mg GAE/100ml in green tea-based iced tea. Over time, the colour of both green iced tea and black iced tea fortified with vitamin B naturally intensified. However, the formulations treated with vitamin C exhibited a lighter colour throughout the shelf life. Furthermore, the products demonstrated acceptable sensory attributes without significant difference ($p > 0.05$) over one-year period.

Keywords: Vitamin enriched, black tea, green tea, antioxidant activity, iced tea

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Air quality status before, during, and after lockdown periods with COVID-19 pandemic in Battaramulla

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As a result of the lockdown (LD) control measures enacted to curtail the COVID-19 pandemic in Sri Lanka, almost all non-essential human activities were halted beginning on March 19th, 2020. In this study, temporal variations of the six criteria air pollutants (PM_{2.5}, PM₁₀, SO₂, NO₂, CO, and O₃) were investigated before (Pre-LD), during (During-LD), and after the COVID-19 (Post-LD) lockdown periods based on the ambient air quality monitoring station (AAQMS) in Battaramulla. Time series analysis was done using R statistical software (Version 4.2.1) using “ggplot2 package”. Observed hourly concentrations of the pollutants, the data for the Pre-LD, During-LD, and Post-LD periods were compared using non-parametric statistical method (Mann-Whitney U test). The results showed that there was a significant improvement in air quality During-LD, compared to the Pre-LD, where the concentrations of NO₂, SO₂, PM_{2.5}, PM₁₀, and CO decreased while O₃ increased During-LD. After the lockdown, the concentrations of PM_{2.5}, PM₁₀, NO₂, and SO₂ increased though not as much as Pre-LD. Also, the relationships between the air pollutants and meteorological variables during the three periods were investigated using Pearson correlation analysis. ($0 \leq r < 0.2$ Very Low Correlation, $0.2 \leq r < 0.4$ Low Correlation, $0.4 \leq r < 0.6$ Moderate Correlation, $0.6 \leq r < 0.8$ High Correlation, $0.8 \leq r < 1.0$ Very High Correlation). During Post-LD, Temperature (T) was positively and strongly correlated to O₃ ($r = +0.74$). For all three periods, PM_{2.5} was positively and strongly correlated with PM₁₀ ($r = +0.83$, $r = +0.95$, $r = +0.94$ in Pre, During & Post-LD). Transport pathways of air masses during the three periods in 2020 in the Battaramulla site were traced down at different heights (100 m, 500 m, and 1000 m) above ground level (AGL) using the backward trajectory model analysis. All these backward trajectories during the three periods extended from different directions at different periods. The air pollutants travelled from the direction of the North Indian continent at the AGL height of 100 m and 1000 m from the source location to reach the receptor site in Battaramulla during the pre-lockdown period. But the air pollutants travelled to the receptor site from northeasterly at AGL 500 m during the pre-lockdown period. The transport directions During-LD period emanated from the northwest region. During the Post-LD period, largest share of the air masses originated and transported from the southwest direction. Although the COVID-19 pandemic had numerous negative effects on human health and the global economy, the reductions in air pollution and significant improvement in ambient air quality likely had substantial short-term health benefits. This study improves the understanding of the mechanisms that lead to air pollution under diverse meteorological conditions and helps making policy decisions related to reducing air pollution in Sri Lanka.

Keywords: Air quality, Battaramulla, COVID-19 pandemic, criteria air pollutants, lockdown

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930/E2

Development of a novel method to stabilize neat (-)-Epigallocatechin gallate (EGCG) and determination of its antioxidant activity

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Tea beverage obtained from the plant *Camellia sinensis* contains many beneficial phytochemicals. There are three tea types, green, oolong, and black, categorized according to their manufacturing processes. In addition, non-fermented green tea is one of the most beneficial since it contains a wide range of polyphenols, including (-)-epigallocatechin gallate (EGCG), which falls under the category of catechins. EGCG accounts for 50–80% representing 200–300 mg per brewed cup of green tea. It is an unstable compound as it is easily subjected to auto-oxidation and epimerization. However, this depends on pH, oxygen concentration, temperature, and ionic strength. It is important to stabilize EGCG to obtain its inherited biological and pharmacological properties. In this study, to stabilize EGCG, a sodium citrate-capped gold nanoparticle (citrate-Au) was formulated, and subsequently, EGCG was loaded onto the formulated nanoparticle. This nano-complex (EGCG-citrate-Au) was characterized using UV-vis and FTIR spectroscopy. The stability of EGCG in the complex was monitored using UV-vis and FTIR data. Accordingly, EGCG was able to maintain its stability over a period of 20-30 days under ambient conditions. Subsequently, the stability of EGCG gradually deteriorated after 20 days. The antioxidant activity of the EGCG-citrate-Au nano formulation was evaluated using a DPPH assay and compared the antioxidant activities of neat EGCG, and citrate-Au nanoparticles with EGCG-citrate-Au nano complex. Observed results confirmed the enhanced antioxidant activity for EGCG-citrate-Au nano formulation compared to citrate-Au nanoparticle. In addition, the IC₅₀ (50% Inhibition Concentration) values of the EGCG-citrate-Au nanoparticle and the neat EGCG were compared. Also, it is depicted that the EGCG-citrate-Au nanoparticle has an IC₅₀ value comparatively closer to the IC₅₀ value of neat EGCG while showing 0.0180 mg/ml and 0.0169 mg/ml IC₅₀ values, respectively. Therefore, our study confirmed that the stability of EGCG was maintained for 20 days under ambient conditions after the formulation of the EGCG-citrate-Au nanoparticle, and the EGCG-citrate-Au nano complex showed significant antioxidant activity through DPPH assay.

Keywords: Epigallocatechin gallate, unstable, autooxidation, epimerization, nanoparticle, characterized, antioxidant activity, inhibition concentration

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Comparative evaluation of excipient properties of local yam starches for potential pharmaceutical applications

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Starches are extensively used as excipients in the formulation of solid oral dosage forms. Therefore, corn starch is imported in large quantities to Sri Lanka for local pharmaceutical manufacturing at a huge cost. Abundantly available, starch-rich local yams may be better alternatives to corn as a source of starch, if they possess the required excipient properties. The present study aims to evaluate the excipient properties of starches of three selected native yams, *Xanthosoma sagittifolium* (L.) Schott (Kiriala), *Dioscorea esculenta* (L.) Burkill (Nattala) and *Dioscorea alata* L. (Maha ini ala) in comparison to pharmaceutical corn starch. The yams were collected from a local farm, and yam starches (YS) were extracted using the wet milling method. The purity, pH and moisture content of YS were determined using standard methods. The relative solubility (RS), angle of repose (AoR), Carr Index (CI), and Hausner Ratio (HR) were calculated in order to assess the powder solubility, flowability, and compressibility. X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FT-IR), and scanning electron microscopy (SEM) were used for the characterisation of YS. Maha ini ala starch was caramelised during processing due to its high sugar content. Kiriala starch showed the highest purity (34.38%) and the lowest RS (0.12 ± 0.01 %) compared to those of Nattala starch (Purity: 26.25%, RS: 0.94 ± 0.04 %) and RS of Nattala was comparable to corn starch (RS: 0.89 ± 0.01 %). Kiriala, Nattala and corn starch exhibited acceptable pH (4-8) and moisture contents (11-16%). The Kiriala, Nattala and corn starches demonstrated acceptable flowability (AoR: 25° - 45° , HR > 1.25) and low compressibility with unacceptable CI (>21%) and HR (>1.25) indicating the need for a glidant to enhance the compressibility. The SEM images revealed that the Kiriala and corn starch particles are spherical in shape which enhances the flowability, while Nattala starch particles are irregular-shaped. The XRD patterns indicate A-type crystallinity for corn and Kiriala starches, and C-type crystallinity for Nattala starch indicating better binding properties of corn and Kiriala starches over Nattala starch. The XRD results demonstrated that the crystallinity of Kiriala starch is similar to corn starch, which explains the better binding and disintegrating properties of Kiriala and corn starch over Nattala starch. Overall, Kiriala starch was found to possess better excipient properties (filler, binder, and disintegrant) over Nattala starch and comparable to corn starch.

Keywords: Pharmaceutical, excipients, *Xanthosoma sagittifolium* (L.) Schott, *Dioscorea esculenta* (L.) Burkill, *Dioscorea alata* L.

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