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*Faculty of Agriculture*  
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*“Challenges in Agriculture:  
impact, resilience and adaptation  
for sustainability”*

# **ISAE 2021**

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**Faculty of Agriculture**

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## **Keynote Speech**

### **Investment in Local Agro-ecological Practices to Achieve UN Sustainable Development Goals**

Prof. Tapan Kumar Nath

Professor, School of Environmental and Geographical Sciences, University of Nottingham Malaysia, Semenyih, Selangor, Malaysia.

Agro-ecological practices integrate ecological principles into the design and management of agro-ecosystems drawing on social, biological, and agricultural sciences, and local traditional knowledge. These practices use low cost and locally available input to produce more food on a sustainable basis, and they can help to achieve a number of UN Sustainable Development Goals (SDGs). Drawing empirical data from an agroforestry project in Bangladesh, this paper describes how agroforestry was developed in shifting cultivation areas and how indigenous people maintained the agroforestry in a sustainable manner. Relevant data were obtained from 30 project participants using the participatory rural assessment approach. They established agroforestry on hilly land previously used for shifting cultivation and obtained material, technical and financial assistance from the project. They received training in land preparation and agroforestry management, and connected to research and extension agencies to obtain farming related assistance. A cooperative society was formed with the aim of social development. The participants established diverse cropping systems along with selected fruit trees, and a 3:1 benefit cost ratio was estimated from the agricultural crops. Participants were motivated to continue agroforestry on their land by locally available indigenous knowledge and low-cost inputs, as well as existing market demand for their products. The findings revealed that agroforestry contributed to the achievement of eight SDGs, including poverty reduction (SDG 1), healthy food for consumption and well-being (SDG2&3), gender equality (SDG5), household income (SDG8), reduced inequality (SDG10), increased agro-biodiversity (SDG15), and collaboration with research organizations (SDG17). Recommendations were made to promote agroforestry in suitable areas for indigenous peoples' sustainable livelihoods and environmental conservation.

**Keywords:** Agroforestry, Indigenous people, Shifting cultivation, SDGs

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## **Circulating Insulin-like Peptide 3 and Testosterone Concentrations in Jamnapari x Kottukachchiya Crossbred Bucks during Sexual Development**

**MHD Madumadhawa<sup>1</sup>, STD De Silva<sup>1</sup>, WTL Fonseka<sup>1</sup>, WASM Premaratne<sup>2</sup> and IN Pathirana<sup>1\*</sup>**

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### **Abstract**

The present study was carried out on Jamnapari x Kottukachchiya crossbred bucks: (1) to measure serum testosterone and insulin-like peptide 3 (INSL3) hormone concentrations during sexual development, (2) to examine the association between each hormone concentration and body parameters (body weight, height at withers and scrotal measurements). Blood samples were collected through jugular vein puncture from bucks of three age groups, i.e. below 06 months (group I, n=19), between 06 – 12 months (group II; n=11) and above 12 months (group III; n=18). The body and scrotal parameters were also measured (group I; n=28; group II; n=16; group III; n=20). Serum testosterone and INSL3 were measured using enzyme immunoassays. The detection ranges of the testosterone and INSL3 assays were 0.01 to 40 ng/mL and 0.078 to 80 ng/mL, respectively. The intra and inter-assay coefficients of variations were 11.7% (n=3) and 16.5% (n=2) for INSL3 and 18.6% (n=3) and 16.1% (n=2) for testosterone. Serum INSL3 concentrations ranged from  $2.01 \pm 0.17$  to  $17.84 \pm 1.67$  ng/mL in crossbred bucks. Serum INSL3 concentrations were different among all three age groups ( $p < 0.05$ ). Testosterone concentration was higher ( $p < 0.05$ ) in group II compared to group I, and no significant change was observed between groups II and III. There was a weak correlation between INSL3 and testosterone concentrations ( $r = 0.290$ ;  $p < 0.05$ ). Serum INSL3 showed strong positive correlations with scrotal circumference ( $r = 0.850$ ;  $p < 0.01$ ), scrotal length ( $r = 0.824$ ;  $p < 0.01$ ), body weight ( $r = 0.858$ ;  $p < 0.01$ ) and height at withers ( $r = 0.857$ ;  $P < 0.01$ ). Testosterone concentrations showed weak correlations with scrotal circumference ( $r = 0.467$ ;  $p < 0.01$ ), scrotal length ( $r = 0.438$ ;  $p < 0.01$ ), body weight ( $r = 0.346$ ;  $p < 0.05$ ) and height at withers ( $r = 0.369$ ;  $p < 0.01$ ). In conclusion, the dynamics of serum INSL3 and testosterone were different during the sexual development of Jamnapari x Kottukachchiya crossbred male goats. Serum INSL3 dynamics appeared to be more consistent compared to testosterone dynamics when selected body parameters were considered. The findings demonstrate INSL3 as a potential biomarker to evaluate testicular functionality and puberty in male goats.

**Keywords:** Enzyme immunoassay, INSL3, Jamnapari X Kottukachchiya, Sexual Development, Testosterone

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## Antimicrobial Activity of Actinomycetes from Terrestrial Soils

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### Abstract

Actinomycetes are one of the most studied prokaryotes due to their ability to produce an array of bioactive secondary metabolites. In this context, the present study aimed to investigate the antimicrobial properties of actinomycetes isolated from terrestrial soils of Sri Lanka. Soil samples from four different sites were pretreated using physical and chemical methods, followed by dilution plating on two isolation media, namely starch casein agar medium and Czapeck dox agar medium. A total of nine isolates *viz.* ACM1, ACM4, ACM5, ACM9, ACM10, ACM12, ACM13, ACM15, and ACM23 were successfully isolated with starch casein agar medium which displayed the highest percentage of recovery. Physical pretreatment was found to be more effective in the enumeration of actinomycetes in the two tested culture media compared to chemical treatments. Antibacterial activities of the isolates were evaluated using the cross-streak method. Except for ACM 13, rest of the eight isolates showed 30 – 100 % growth inhibition against all tested bacteria, *i.e.*, *Bacillus cereus*, *Enterococcus faecalis*, *Escherichia coli*, *Klebsiella pneumonia*, *Proteus vulgaris*, and *Staphylococcus aureus*. The antifungal effect of actinomycete isolates was tested against a plant pathogenic fungus *Sclerotium rolfsii*. Three isolates *viz.* ACM15, ACM23, and ACM9 demonstrated a strong antifungal activity. Molecular identification revealed that selected ACM23, ACM4, and ACM10 isolates belonged to the genus *Streptomyces*, whereas ACM13 belonged to the genus *Nocardia*. Their 16S rRNA gene sequences were deposited in the GenBank database with MW785759, MW785762, MW785761, and MW785760 accession numbers, respectively. Moreover, to evaluate the effect of different actinomycetes strains as potential bio-control agents *in-vivo*, a meta-analysis was conducted using recently published literature. Results of the meta-analysis indicated that there are significant beneficial effects of actinomycetes against pathogenic invasions *in vivo*, suggesting that there is a high potential of using these organisms as natural biocontrol agents. In conclusion, this study found a diverse group of actinomycetes in terrestrial soils, and all isolates had a broad spectrum of antimicrobial activity, inferring that they could be used as sources of future antibiotics for pharmaceutical interest as well as for their bio-control potential against plant diseases.

**Keywords:** Actinomycetes, Antimicrobial activity, Terrestrial soil

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## Analyzing Suitable Combinations of Potting Mixtures and Hormone Levels for Vegetative Propagation of Milky Mangrove (*Excoecaria agallocha*) and Study Different Uses of its Leaf Extracts

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### Abstract

Mangrove assessment is a global strategy, which can be used to evaluate the stability in ecosystems and as the foundation species, they control ecosystem dynamics. Three experiments were conducted to (a) identify suitable combinations of potting media and Indole-3-butyric acid (IBA) hormone concentrations for stem cutting propagation (b) find the toxic effect of aqueous leaf extract of *E.agallocha* on brackish fish and the larviciding effect on mosquito larvae. From December 2020 to February 2021, single propagators were maintained at the Faculty of Agriculture, University of Ruhuna for vegetative propagation of stem cuttings using a completely randomized design. Nine treatments (original on-site lagoon silt potting media with T1- 2500 ppm IBA, T2- 3000 ppm IBA, T3- 3500 ppm IBA, clay: sand 1:1(w/w) potting mixture with T4- 2500 ppm IBA, T5- 3000 ppm IBA, T6- 3500 ppm IBA, general potting mixture sand, topsoil, coir dust, compost 1:1:1:1/4 with T7- 2500 ppm IBA, T8- 3000 ppm IBA, T9-3500 ppm IBA) were applied. To evaluate the toxic effects, five replicates with ten mosquito larvae and five replicates with six brackish fish (*Etroplus suratensis*) in each were maintained at 25-27°C and 75-85% relative humidity. Bioassay stock solution of *E.agallocha* leaves was prepared by 100g fresh weight dissolved in 100 mL of distilled water and four concentrations were accessed. According to the observations of the vegetative propagation after 45 days, the survival percentage of stem cuttings was significant with the potting media and IBA concentration. The average number of roots, root length, root volume, and average chlorophyll content (SPAD units) were significant with the interaction effect of the main factors. Root dry weight was significant with the IBA concentration. The average number of new shoots was significant with the potting media. According to the qualitative analysis, significant highest root vigor was depicted by T3 while the highest shoot vigor was observed from T5. After 24hrs, mosquito larvae and brackish fish death percentages were significant with the treatments. Aqueous extraction of milky mangrove leaves was effectively acted against mature mosquito larvae and can be used as a natural larvicide, while a higher concentration (50 g stock solution dissolved in 100 mL of distilled water) of the leaf extract was fatal to brackish fish. Stem cutting propagation is an effective propagation method for milky mangroves.

**Keywords:** Hormone, Larvicide, Milky Mangrove, Potting Media, Vegetative propagation

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## **Impact of Brand Transgression on Perceived Image of the Endorsed Celebrity: Sri Lankan Young Consumers' Perspective**

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### **Abstract**

Celebrity Endorsement is a universally accepted powerful marketing tool that uses significant proportion of firm's advertising expenses to enhance firm's profits. However, brands transgression; the violation of the norms of consumer-brand relationship is common and wide spread in the marketplace at present challenging the perceived image of endorsed celebrity and hampering the efficiency of the advertising expenditure. The absence of empirical evidence on the impact of brand transgression on perceived image of the endorsed celebrity keeps marketers at risk of using celebrities in their advertising campaigns. As a result, the current study attempted to ascertain how celebrity image changes in response to brand transgressions in apology and non-apology situations, as well as to assess the influence of apology on regaining consumer-celebrity relationships. Hundred undergraduates of public and private universities were selected by using convenience sampling technique. Primary data was collected through online survey by using pretested structured questionnaire. Celebrity image was measured by the TEARS (Trustworthiness, Expert, Attractiveness, Respect and Similarity) model under apologized and non-apologized brand transgression situations. Results of Regression revealed that trustworthiness ( $t=-3.28$ ,  $p=0.04$ ), respect ( $t=-6.27$ ,  $p=0.001$ ) and attractiveness ( $t=-8.47$ ,  $p=0.001$ ) of celebrity were responsible for 53% ( $R^2=52.82$ ) of the total variance of celebrity image in the eyes of consumers in non- apologized brand transgression condition with a negative correlation. However, in case of apologized brand transgression 61% ( $R^2=61.24$ ) of the total variance of celebrity image has occurred due to trustworthiness ( $t=9.76$ ,  $p=0.001$ ), respect ( $t=9.52$ ,  $p=0.001$ ) and attractiveness ( $t=7.2$ ,  $p=0.03$ ) of celebrity while showing a positive correlation between apologized brand transgression and celebrity image. Therefore, apologized brand transgression had a positive and significant effect on the perceived variables of celebrity image, whereas non-apologized brand transgression had a negative and significant effect, providing very important guidance to marketers who use celebrities in their marketing campaigns. Study further revealed that apology heals the damage of consumer-celebrity relationship under apologized brand transgression and apology is an applicable corrective action to build consumer-celebrity relationship that helps in regaining consumer-celebrity relationship. Therefore, present study recommends using apologized brand transgression to get the maximum return on the investment of celebrity endorsement. This is of great significance for the marketers in particular who use celebrities as their main advertising strategy.

**Keywords:** Apology, Brand, Celebrity, Non- Apology, Transgression

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## Near-Infrared Spectroscopy for Quick Detection of Agarwood Formation in *Aquilaria crassna*

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### Abstract

Detection of fragrant resin formation is the most exigent part of Agarwood industry. The resin is to be removed after the tree has been harvested therefore precise yield estimation is required prior to harvesting. However, prevailing methods are either destructive or based on outside inspection tools that are incapable of accurate estimation. Consequently, the agarwood industry is suffered from harvesting trees before they reach up to potential yield due to misidentification. Near Infrared Spectroscopy (NIRS) has become a well-adopted technology in many aspects of agriculture based industries including property evaluation of wood materials. Therefore, the present study evaluates the factors effecting for the accuracy of NIR based prediction models for agarwood formation in *Aquilaria crassna* trunks in rapid and non-destructive mode. Randomly selected 28 trees of *A. crassna* from two plantations located in *Horapawita* and *Narandeniya*, Southern Sri Lanka were used in the experiments. Fourteen wood logs with agar resin present and similar number of resin free healthy logs were evaluated under the laboratory ex-situ conditions. The influences of bark presence or absence, wood surface roughness, and wood thickness on prediction results were investigated in this study. Then, the effect of tree maturity level was evaluated in the field in-situ method. NIR reflectance spectra obtained from handheld spectrometer FQA-NIR Gun (588-1100nm) were applied in the Soft Independent Modeling of Class Analogy (SIMCA) algorithm in the discriminate model building process. Better results were observed from bark removed samples (97%) compared to the bark present (85%), smooth wood surfaces (95%) compared to the rough surface (90%) and wood thicknesses ranging from 2 mm up to 5 mm. The stage of maturity had no significant impact on the prediction results, as both maturity levels kept an 83% prediction accuracy. Pareto pre-processing with 1<sup>st</sup> derivative math transformation better configured the models via 975.2 nm wavelength representing the maximum discriminating power. The research revealed the potential for utilizing NIR spectroscopy as a non-destructive and rapid tool for detecting of agarwood formation in *A. crassna*.

**Keywords:** Agar wood, *Aquilaria crassna*, NIR spectroscopy, Non-destructive, Rapid

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## **Development of a Novel Bee Honey Wine Incorporated with Lemon (*Citrus limon*) and Ginger (*Zingiber officinale*) with Nutraceutical Importance**

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### **Abstract**

Nutraceuticals are regarded as a therapeutic food that helps in the protection of wellbeing, the strengthening of immunity, and the prevention and treatment of various diseases. Bee honey, lemon and ginger are locally available natural substances that are rich in nutraceutical properties. Value addition of these materials was intended by incorporation of these in an internationally recognized beverage; wine. Product development was done by preparing different wine samples with different ratios of bee honey (0.5, 1, 1.5, 2) mixing with, water, lemon juice and ginger juice 1:1:1 respectively. *Saccharomyces cerevisiae* was used as the fermenting culture. Two Sensory evaluations were carried out in selecting the best bee honey ratio and the best fermenting period. The Sensory evaluations were conducted with 30-membered semi-trained panelists on a 5-point hedonic scale. The selected wine sample was kept 30 days for maturation. The pH, Brix, alcohol content, titratable acidity and proximate compositions were analyzed in developed wine using standard procedures. Folin-ciocalteu reagent method, Ferric reducing antioxidant power method and reacting with Aluminum chloride were used to measure total polyphenolic content, total antioxidant content and total flavonoid content using UV spectrophotometer. The best composition ratio was selected as 1.5:1:1:1 for bee honey: water: lemon juice: ginger juice and 3 weeks' fermentation time was selected as the best fermenting period by the sensory evaluation analysis. The selected wine sample indicated  $3.5 \pm 0.04$  pH, 0.65 g/100 mL Titratable acidity,  $8.16 \pm 0.04\%$  (V/V) alcohol,  $18.7 \pm 0.04\%$  Brix,  $97.1 \pm 1.43\%$  moisture, 0.19% ash,  $0.31 \pm 0.02\%$  protein, zero amounts of fat and fiber per 100 g of the product. Total polyphenolic content, total antioxidant content and total flavonoid content was 718.9 mg/L GAE, 682.18 mg/L TE and 30.52 mg/L QE, respectively. Therefore, the developed wine product possesses significant nutraceutical properties than common white wine and, it could be a novel candidate for the wine industry.

**Keywords:** Bee honey, Ginger, Lemon, Nutraceutical, Wine

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## Determining Threshold Levels of Soil Physical Indicators of Compaction on Crop Growth

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### Abstract

Soil compaction results from the physical consolidation of soil due to an applied force. It is defined as the process by which the soil grains are rearranged to decrease the void spaces bringing them closer to one another. This process could destroy the soil structure, reduce porosity, limit the movement of water and air, increase resistance to root penetration and growth, and ultimately reduce the crop yield. Soil compaction primarily affects the storage and flow of water and air in the soil and the rootability. Bulk density (DB) and porosity ( $\Phi$ ) are the major soil physical indicators of compaction related to the storage and flow of water and air in the soil, where root density is an indicator of rootability. This study aimed to determine the threshold levels of soil bulk density and porosity for the development of both tap and fibrous root systems of crops. A pot experiment was conducted in the Faculty of Agriculture, University of Ruhuna, using maize (*Zea mays*) and Chili (*Capsicum annum*) as crops having fibrous and tap root systems respectively. Five DB levels (1.1, 1.3, 1.5, 1.7, and 1.9 g cm<sup>-3</sup>), in triplicates, were used as the treatments in a completely randomized design. Shoot growth of plants was taken at weekly intervals for a period of 14 weeks. The time of flowering (maize and chili) and pod initiation (maize) were recorded at respective stages. Shoot growth and the root density of both types of plants decreased with increasing DB/decreasing  $\Phi$ . Up to the third week, plant height showed no significant difference between the treatments, beyond which a gap between the treatments started to develop. The plant height was highest at the lowest DB. At the end of the experiment, the difference in plant height between the lowest and the highest DB levels were 19.31% and 21.19% for maize and chili, respectively. The most suited DB levels for the flowering and pod initiation of maize were 1.3 and 1.5 g cm<sup>-3</sup> (corresponding  $\Phi$  values were 36% and 44%), whereas those for chili were 1.1 g cm<sup>-3</sup>. The maize yield decreased with increasing DB. The root densities of both types of plants decreased with increasing depth of soil and DB levels. The threshold levels of DB and  $\Phi$  for plant height, flowering and pod initiation of maize can be considered as 1.3 g cm<sup>-3</sup> and 44%, respectively. The best DB for the optimum shoot and root growth of both maize and chili and the yield of maize was 1.1 g cm<sup>-3</sup>. Further experiments with lower DB levels and under field conditions are required for longer periods for a more comprehensive understanding.

**Keywords:** Shoot and root growth, Soil compaction, Soil physical indicators, Tap and fibrous root systems

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## **Circular Economy Approaches for Urban Cultural Heritage Building Adaptive Reuse in Sri Lanka to Mitigate Environmental Consequences**

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### **Abstract**

Anthropogenic activities have a tremendous influence on the natural environment. Climate change is one of the key worldwide concerns that has developed as a result of the rapid increase in atmospheric greenhouse gas concentrations. The majority of greenhouse gas emissions that contribute to the climate catastrophe are released by buildings. Circular economy is one of the concepts proposed as a transformation in climate change mitigation. Adaptive reuse of buildings has been identified as a sustainability concept that is largely applied to historical structures and one of the techniques for decreasing the environmental impact of building constructions. Following a comprehensive literature review, this study analyzed the embodied carbon savings from adaptive reuse of Dutch era historic buildings in Sri Lanka and proposed circular economy methods for the adaptive reuse of urban cultural heritage buildings in Sri Lanka. The average greenhouse gas output of Dutch period historic buildings is 448.035 kg CO<sub>2</sub>-eq/m<sup>2</sup>, according to the thirty cases studied. During the Dutch era, the most common building materials were granite, clay, limestone, and timber. Granite accounts for 43.25% of greenhouse gas emissions, whereas clay accounts for 33.25%. The walls are the source of the most greenhouse gas emissions (44.49%). The outcomes of this study may imply that adaptive reuse of urban cultural heritage buildings is more environmentally benign than new construction since it eliminates additional high greenhouse gas emissions. Circular economy solutions for adaptive reuse of urban cultural heritage buildings were created by integrating both circular economy strategies in the construction sector and policies for heritage sites. This might help to promote and encourage the concept of adaptive reuse of urban cultural heritage buildings in Sri Lanka, while also minimizing environmental consequences.

**Keywords:** Adaptive reuse, Circular economy, Environmental impacts, Greenhouse gas emission, Urban cultural heritage buildings

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## **A Study on the Comparative Assessment of the Operational Parameters and Spray Quality of Agricultural Drones and Knapsack Sprayers**

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### **Abstract**

Manual pesticide spraying techniques are more widely used in developing countries, with lever operated knapsack (LOK) sprayers being the most common method. However, the problems associated with manual spray techniques include operator exposure to chemicals, excessive chemical usage above recommended levels, and environmental issues, among others. Unmanned aerial vehicles (UAVs) have been designed to address these concerns. Agricultural drones are still an emerging technology in developing countries like Sri Lanka. The objectives of this paper was to compare the spray characteristics of the agricultural drone to those of the LOK, such as droplet count, area coverage percentage, droplet deposition density, coefficient of variation, average droplet size utilizing water sensitive papers, and operating efficiency. For the investigation, a six-rotor agricultural drone (AGRAS T 20) with eight nozzles and a single nozzle LOK sprayer were employed. The research was conducted in an open field. For the drone experiment, two parameters were taken into account: drone speed and operating height from ground level. Speeds were 14, 17 and 20 kmp/h. Heights were 2, 3 and 4m respectively. The factors were not statistically significant ( $p>0.05$ ) with the parameters tested, but significant ( $p<0.05$ ) with the LOK sprayer. With the LOK sprayer, the agricultural drone reported lower values for droplet count, area coverage percentage, droplet deposition density, and average droplet size. Pesticide consumption was 29.68% lower with the agricultural drone than with the LOK sprayer, while the time required to cover 1 hectare of field was 6 times bigger with the LOK sprayer. Comparable control efficacy results indicated that the agricultural drone is a viable strategy for pesticide application with a higher efficiency, and can be used at speeds ranging from 14 to 20 km/h and heights ranging from 2 to 4m with no significant change in its spray quality parameters.

**Keywords:** Droplet count, Droplet coverage, Droplet deposition density, Knapsack sprayer, Unmanned aerial vehicles

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## Farm Gate Price Determinants of Small-Scale Maize Production: Case Study in Anuradhapura District

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### Abstract

Maize (*Zea mays*) is the second largest cultivated crop next to the paddy in Sri Lanka. A significant price gap is noticeable between farm gate (FG) prices and retail prices of maize. This paper examines the price determinants, which influence on the price gap between FG and retail prices. Hundred small-scale maize farmers were selected by employing simple random sample from the highest Maize cultivating divisional secretariat divisions (DSDs) in Anuradhapura District. Thus, the sample comprised with farmers from Galenbidunuwewa (27), Kebithigollewa (18), Thalawa (25), Kekirawa (13) and Thirappane (17). A pre tested questionnaire was administered for primary data collection considering the variables of marketing practices and production management factors. Descriptive and inferential methods were used to analyze the data. The findings revealed that majority of the farmers sell their harvest through multiple marketing channels including middlemen (19%) and retailers (1%) who offered highest mean price yet majority sells to both middlemen and retailer (80%) depending on the quantity they purchase. Seed color (46%), moisture content (79%), maturity (92%) and damages seeds (92%) were the significant quality parameters that determine FG prices. Types of market (p=0.000), appropriate post-harvest activities (p=0.012), transport mode (p=0.032), information availability about market price (p=0.000), storage capacities of the farmer (p=0.008) and infrastructure facilities for transportation (p=0.001) were the significant price determinants. Quality improvement (92%) and careful post-harvest handling (74%), effectiveness of agronomic practices (89%), infrastructure facilities (97%), awareness programs on technology (100%), input provisioning (100%) and efficient agricultural extension services (97%) were requested for better quality production for better prices. Information dissemination on the FG price determinants to the small scale maize farmers in Anuradhapura District was significance to increase farmers' income.

**Keywords:** Farm gate price, Maize production, Price determinants and quality

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## **Feasibility of Shifting Farmers towards Hot Pepper (*Capsicum chinense*) Cultivation: A Case Study in Minuwangoda, Sri Lanka**

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### **Abstract**

Hot pepper belongs to family Solanaceae, genus *Capsicum* and species of *Capsicum chinense* and recognized as a highly profitable product which is popular across the world. Even though hot pepper has a very good market potential, the farmers of Sri Lanka have not yet recognized its economic values. Therefore, this study was conducted (a) to identify the factors affecting the shifting of farmers towards hot pepper cultivation and (b) to explore the financial feasibility to establish a buy-back agreement in order to assure continuous supply. This research was carried out by using a pre-tested questionnaire through field survey methodology. The total sample size was 70 vegetable farmers selected from *Minuwangoda* divisional secretariat division in *Gampaha* district. Farmers were selected using simple random sampling method and the collected data were analyzed using descriptive and inferential statistics including Kruskal Walli's test, Wilcoxon signed rank test, one-way ANOVA test. The study has revealed that, 87.1% of farmers in *Minuwangoda* prefer to grow hot pepper as a commercial crop. From the total, 88.2 % of farmers are willing to shift from current vegetable cultivation to hot pepper cultivation. Extent of land, cost of production, market potential and agro-climatic compatibility are mainly affecting the shifting of farmers towards hot pepper cultivation on contract basis. Assured market, higher buy-back price, continue fixed prices, legality of buy-back agreement and crop insurance are required by the farmers for the adoption of sustainable hot pepper cultivation program. The farmers in *Minuwangoda* have to bear minimum cost for shifting from existing almost homogeneous cropping systems to hot pepper cultivation compared to heterogeneous cropping systems in the up country. The average buy-back price suggested by farmers in *Minuwangoda* is Rs.940.00 per kg to enable them to earn higher profit from hot pepper than their current cultivations. This study provides a significant insight to plan a highly profitable and sustainable hot pepper cultivation along with buy-back agreement system in *Minuwangoda* area.

**Keywords:** Buy-back agreement, Contract farming, Hot pepper

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## **Circulating Insulin-like Peptide 3 and Testosterone Concentrations in Saanen Bucks during Sexual Development**

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### **Abstract**

Insulin-like peptide 3 (INSL3) and testosterone are known as hormones of testicular origin and play an essential role in male sexual development. The present study attempted to: (1) quantify circulating INSL3 and testosterone concentrations. (2) examine the association between each hormone concentration and body parameters (body weight, height at withers and scrotal measurements) of Saanen bucks during sexual development. The blood samples were taken from normal male Saanen goats (n=41) at three distinct age groups, i.e., below 06 months (group I; n=11), between 06 - 12 months (group II; n=14) and above 12 months (group III; n=16). Along with body weight, height at withers and scrotal circumferences were collected. Serum INSL3 and extracted testosterone were measured using competitive ELISA. The detection ranges of INSL3 and testosterone assays were 0.08 to 80 ng/mL and 0.01 to 40 ng/mL, respectively. The intra and inter-assay coefficients of variations were 7.7% (n=4) and 11.7% (n=2) for INSL3 and 9.9% (n=6) and 14.9% (n=2) for testosterone. Serum INSL3 concentrations varied from  $3.66 \pm 0.41$  to  $13.76 \pm 1.63$  ng/mL in Saanen goats and concentrations increased ( $p < 0.01$ ) from group I ( $3.66 \pm 0.41$  ng/mL) to group II ( $11.84 \pm 1.18$  ng/mL). However, there was no difference ( $P > 0.01$ ) between group II and III. Testosterone concentrations ranged from  $0.13 \pm 0.03$  to  $0.28 \pm 0.08$  ng/mL and there was no difference ( $p < 0.01$ ) among three age groups. Serum INSL3 and testosterone concentrations were positively correlated ( $r = 0.46$ ;  $p < 0.05$ ). A strong positive correlation was observed between INSL3 and scrotal circumference ( $r = 0.74$ ;  $p < 0.05$ ). Furthermore, INSL3 was positively correlated with body weight ( $r = 0.68$ ;  $p < 0.05$ ) and height at withers ( $r = 0.35$ ,  $p < 0.05$ ). Testosterone showed relatively low correlations with scrotal circumference ( $r = 0.37$ ;  $p < 0.05$ ), body weight ( $r = 0.63$ ;  $p < 0.05$ ) and height at withers ( $r = 0.22$ ;  $p < 0.05$ ). In conclusion, the dynamics of INSL3 seemed to be more consistent with the development of Saanen goats and showed a strong correlation with scrotal development. Circulating INSL3 demonstrates a potential as a testicular biomarker for the sexual development in Saanen goats.

**Keywords:** Enzyme immunoassay, INSL3, Saanen, Sexual development, Testosterone

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## Effect of Substituting Dietary Coconut Oil Meal with *Gliricidia sepium* Leaf Meal on Growth Performance and Meat Quality of Japanese Quails (*Coturnix coturnix*)

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### Abstract

Escalating cereal price has triggered search for cheap unconventional feed resources for poultry production. This study evaluated the effect of substituting dietary coconut oil meal (COM) with *Gliricidia sepium* leaf meal (GLM) on growth performance, carcass, and meat quality of Japanese quails (*Coturnix coturnix*). Twenty-six days old Japanese quails were randomly allotted to five treatments: four COM replacements levels with GLM in the control diet, viz., T<sub>1</sub> (control; 0% GLM+8% COM), T<sub>2</sub>(2% GLM+6% COM), T<sub>3</sub>(4% GLM+4% COM), T<sub>4</sub>(6% GLM+ 2% COM) and T<sub>5</sub>(8% GLM+0% COM). Each treatment had four replicates of four chicks. The control diet had 23% crude protein and 2800Kcal/kg metabolic energy. The experimental diets were fed for 4 weeks. Growth performances (weight gain, feed intake, water intake, feed conversion ratio), meat quality parameters (moisture content, water holding capacity, pH, ash content, and colour), carcass traits (carcass percentage, visceral organ percentage, breast weight and thigh weight) and sensory attributes (flavor, tenderness, juiciness and overall acceptability) were determined. Results showed that fourth-week feed intake of T<sub>5</sub> chicks (203.8± 22.4g) was higher (p≤0.05) than that of T<sub>1</sub> (146.6±33.8g) and T<sub>3</sub> (157.0±5.4g). Total water intake of T<sub>5</sub> (1121.2±41.3mL) was significantly higher than that of T<sub>1</sub> (839.3±15.1mL) and T<sub>3</sub> (896.2±24.4mL). Furthermore, T<sub>2</sub> (70.2±6.0%), T<sub>3</sub> (70.1±2.7%), T<sub>4</sub> (70.4±3.1%) and T<sub>5</sub> (71.3±3.0%) reported significantly (p≤0.05) higher carcass percentage than T<sub>1</sub>(66.4±2.2%). Among sensory parameters, only the overall acceptability of T<sub>3</sub> (3.0±1.1) and T<sub>4</sub> (3.9±1.2) were significantly (p≤0.05) different from each other. Other growth performance parameters and the meat/carcass quality traits of the quails were not significantly different among treatments. Substitution of 8% COM with GLM reported the highest profit of Rs.1450 per thousand birds. Therefore, the results concluded that GLM can replace 8% coconut oil meal in a quail diet without compromising the growth performance, carcass and meat quality.

**Keywords:** Quails, *Gliricidia*, Protein supplement, Production and Performance

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## Development of a Fungal Bioformulation using *Trichoderma* Antagonists for Biological Control of Tomato Damping-Off Disease Caused by *Rhizoctonia solani*

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### Abstract

The aims of this study were to develop a new fungal bioformulation using *Trichoderma* and to evaluate its efficacy against *Rhizoctonia solani*, the causal agent of tomato damping-off disease under *in vitro* and *in vivo* conditions. Initially, soil samples were collected from different locations and fungi were isolated by serial dilution. In order to select potential antagonists, fungal isolates were co-cultured with *R.solani* on PDA. The promising candidates were further evaluated based on modes of antagonism, nature of antifungal inhibition (volatile, nonvolatile) growth rate, and spore forming ability in order to select the two most efficient antagonists for bio formulation. Rice bran, Groundnut shell powder and paddy husk powder were selected as carriers to prepare bioformulations. After inoculation, the effectiveness of each carrier was evaluated by spore counting. Performances of the selected bioformulations were evaluated as seed dressings and soil applications. The best bioformulation was selected and its shelf life (upto 45 days), stability at various temperatures, light and moisture conditions were tested. In this study, ten antagonistic *Trichoderma* isolates were originally selected using the dual culture assay based on percent inhibition of radial growth (PIRG) of the pathogenic fungus. Among them, four aggressive isolates namely MM3, KMM5, NMH1, NMH4 displayed high antagonism (PIRG 57%, 66%, 44%, 50%, respectively), fast growth and profuse sporulation *in vitro*. Isolates MM3 and KMM5 displayed micoparasitism while NMH1 and NMH4 displayed antibiosis. Isolates MM3 and NMH4 displayed the highest inhibition in both volatile (PIRG 63%, 66%, respectively) and nonvolatile testing (PIRG 63%, 67%, respectively), thus these two isolates were selected for the development of bioformulation. Based on the result, both MM3 and NMH4 isolates showed the highest spore count in groundnut shell powder. In seed treatment, NMH4 showed a significantly higher germination percentage than MM3 (75%, 50%, respectively, control 43%). In soil treatment, NMH4 and MM3 displayed 20% and 7% seedling recovery respectively compared to 0% recovery in the control. Based on results, NMH4 isolate was selected to analyze shelf life and stability and the results revealed that shelf life was reduced gradually. Colony counts showed the highest value in 15% moisture content, at room temperature, and under normal light conditions during storage. Based on the overall results of this study, it is concluded that the *Trichoderma* isolate NMH4 in groundnut shell media is a potential bioformulation for the control of tomato damping off disease.

**Keywords:** Bioformulation, Damping-off, *Rhizoctonia solani*, Tomato, *Trichoderma*

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## Evaluation of Four Seed Priming Techniques for the Management of Damping-Off Disease in Chilli Caused by *Rhizoctonia solani*

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### Abstract

This research was undertaken to evaluate four seed priming techniques for the management of damping-off disease in chilli caused by *Rhizoctonia solani*. The four experiments *viz*, hydro priming, osmo priming, halo priming and bio priming were conducted in a completely randomized design with five replicates. The seeds of chilli variety MI-2 were subjected to different priming treatments in the laboratory followed by sowing and seedling evaluation in greenhouse as per recommended package of practices. Hydro priming (water), osmo priming (polyethelene glycol, PEG1000 -1Mpa) and halo priming (NaCl, 1%, 3% and 5%) were performed with seed soaking time for 24h, 48h and 72h. In addition, a positive control with fungicide Captan and a negative control were also maintained. In bio priming, nine different antagonistic fungal isolates obtained from composting material were used. The performances of the primed seeds were evaluated in terms of disease incidence percentage, mean germination time and seedlings length. Results revealed that, osmo priming, halo priming and biopriming have a significant impact on reducing damping off disease incidence in chilli seedlings. In osmo priming, seed soaking in the osmoticum for 12h, 24h, and 48h reduced disease incidence by 75, 75 and 60.4%, respectively. In halo priming, all treatments showed disease incidence percentages significantly lower than the negative control. Seed priming with 5% NaCl for 24h displayed the lowest disease incidence percentage (25%), which was below than that of the positive control (45%). This priming treatment showed the lowest mean germination time (4.9 days) and the highest seedling length (9.59 cm). In bio priming, all nine antagonistic isolates (KMM2, KMM5, KMM3, MBS1, MM3, MM4, NMH1, NMH4, NMH2) displayed significantly lower diseases incidence percentages 60.4, 34.5, 29.6, 79.4, 39.6, 25, 55.2, 50, 44.7%, respectively compared to the negative control (100%) and showed reduced mean germination times and higher seedling lengths compared to the control ( $p < 0.05$ ). Seeds subjected to biopriming displayed better disease tolerance than the seeds coated with the same antagonists just prior to sowing. This study concludes that, chilli seeds acquire damping off disease tolerance and better growth performances at nursery stages when they are subjected to osmo priming, halo priming and bio priming under the tested conditions. The findings of this research can be effectively used as a reliable, environmentally sound disease management practice in chilli nurseries.

**Keywords:** Antagonists, Chilli, Damping-off, Seed priming

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## Development of an *In-Vitro* Propagation Protocol for *Spilanthes paniculata* (Akmella)

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### Abstract

*Spilanthes paniculata* (Akmella) is one of the most important medicinal plants which consist vast range of pharmacological properties and serves as a suitable traditional treatment for various ailments. There are lots of constrictions in its conventional propagation methods and that hinders the commercialization of the plant. Therefore, the present study was carried out to develop an efficient protocol for *in-vitro* propagation of *S.paniculata*. Nodal segments were used as the explants and the best surface sterilization procedure was identified using different combinations of Clorox concentrations (5%, 10%) with exposure to different time periods (5min, 10min, 15 min). Different concentrations and combinations of plant growth regulators were used to identify the best treatment for shoot proliferation (1mgL<sup>-1</sup> NAA + 1mgL<sup>-1</sup> BAP, 1mgL<sup>-1</sup> NAA + 1.5mgL<sup>-1</sup> BAP, 1mgL<sup>-1</sup> NAA + 2mgL<sup>-1</sup> BAP, 1mgL<sup>-1</sup> NAA + 2.5mgL<sup>-1</sup> BAP) and root induction (0.5mgL<sup>-1</sup> IBA + 0.5mgL<sup>-1</sup> NAA, 0.5mgL<sup>-1</sup> IBA + 1mgL<sup>-1</sup> NAA, 0.5mgL<sup>-1</sup> IBA + 1.5mgL<sup>-1</sup> NAA, 0.5mgL<sup>-1</sup> IBA + 2mgL<sup>-1</sup> NAA). The best potting media (A mixture of sand: compost: soil (1:1:1), Coir dust, Coco pallets) for acclimatization with high survival were tested. After one week of incubation, 10% Clorox with 10 min exposure time revealed a significantly higher (p<0.05) non-contamination percentage (68.4%). Shoot proliferation rate was recorded for eight weeks from culture initiation and a significantly higher (p<0.05) shoot proliferation (8.8 shoots/explant) was observed in the MS medium fortified with 2.5 mgL<sup>-1</sup>BAP and 1 mgL<sup>-1</sup>NAA. The best plant growth regulator combination for significantly higher (p<0.05) root induction (14.8 roots/shoot) was observed in the MS medium fortified with 2mgL<sup>-1</sup> NAA and 0.5mgL<sup>-1</sup> IBA after four weeks. Rooted plantlets were acclimatized for four weeks and a significantly higher survival rate (100%) was observed in the plantlets acclimatized in a mixture of sand, compost and soil (1:1:1), (p<0.05). The findings of this study can be used for the commercial production of this valuable medicinal plant and for further studies.

**Keywords:** Acclimatization, *In-vitro* propagation, Nodal segments, Root induction, shoot proliferation, *Spilanthes paniculata*, Surface sterilization

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## **Cultivation of Clove Bean [*Ipomoea muricata* (L.) Jacq.]; an Underutilized Vegetable in Sri Lanka**

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### **Abstract**

Clove bean (*Ipomoea muricata*) belongs to the family Convolvulaceae and known as Alanga in Sinhala is one of the neglected local vegetables found in Sri Lanka. It is a herbaceous annual vine cultivate mainly for its thickened pedicels as an edible portion. Clove bean is not a seasonal bound crop hence can be grown year-round in warm climates. The seeds, leaves and stems have medicinal properties and use to treat skin ailments. The present study consisted of three experiments ie. 1) identification of the best storage period (two weeks intervals up to eight weeks) and condition (room temperature and refrigerator) for seed viability, 2) the effect of the number of nodes and leaves on rooting of stem cuttings (single node and double node cuttings with or without full leaf and half leaf) and 3) the type of potting mixture and fertilizer type for growth and yield (topsoil:sand:compost; 1:1:1, 2:1:1, 1:2:1, 1:1:2 with inorganic and organic fertilizer). The first and second experiments were carried out as a two-factor factorial completely randomized design and the layout of the third experiment was a two-factor factorial randomized complete block design. The interaction effect between storage period and condition was not significantly affected the final germination percentage and germination rate index. However, only storage condition was significant for the final germination percentage and germination rate index where seeds stored under room temperature showed the highest values. There was no interaction effect or single factor effect of a single node or double nodes cuttings with or without full leaf or half leaf. The interaction effect between the potting mixture and fertilizer type was not significant in terms of number of pods per vine, fresh and dry weight of edible and non-edible portions of the pod and dry weight of total above-ground biomass. However, all of the previously-mentioned parameters vary significantly depending on the type of potting mixture and fertilizer used. According to the results of the present study, it can be concluded that there was no effect of storage period up to two months on the germination rate of seeds and the seeds store at room temperature showed the best performance. Further, the rooting of cuttings was not influenced by the number of nodes and presence or absence of the leaves. The high yield of clove bean could be obtained by applying organic fertilizer into the potting mixture prepared with equal proportions of topsoil, sand and compost.

**Keywords:** Clove bean, Cuttings, Fertilizer type, Potting mixture, Seed germination

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## **Application of Human Resource Management Practices in Agricultural Farms: a Perception of Farm Employees**

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### **Abstract**

Human resource management is the process of managing people in an organization in order to achieve organization objectives. This study was conducted on both a private and a public farm. Recruitment and selection, performance evaluation, reward management, training and development, discipline and grievances, health and safety, leadership and motivation, working condition and relationships were analyzed as the human resource management practices of these farms. The objectives of this study were (a) to identify the existing human resource management (HRM) practices in agricultural farms (b) to contrast the HRM practices in public and private farms and (c) to give suggestions and recommendations to improve the HRM practices in agricultural farms. The primary data were collected by administering pre tested questionnaire from 40 employees from each farm which were selected using simple random sampling. Descriptive analysis and Wilcoxon signed rank test were used for the data analysis. According to the results, the private farm (mean=3.88) has the formal recruitment and selection practices and but not in public farm (mean=3.45). Reward management practices are well functioning in public farm (mean=3.25) than that in private farm (mean=3.1). The performance evaluation process of the private farm (mean=2.93) is more informal and public farm (mean=3.65) has formal evaluation process for permanent employees. Public farm (mean=3.3) do not have a good health and safety management process compared to private farm (mean=4.05). In comparison to private farms (mean=4.05), public farms (mean=3.02) do not have a planned training program for its employees. Both farms do not conduct proper orientation program for newly recruited employees. In terms of other practices, the overall satisfaction towards the working conditions and relationships, disciplines and grievance management and leadership and motivation of the both farms were satisfactory. As the conclusion of the study, reward management, health and safety management, training and development should be improved in a public farm. The reward management and performance management should be improved in a private farm.

**Keywords:** Employee perception, Function of HRM, Private farm, Public farm

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## **Assessing Farmers' Knowledge of Reproductive Management Practices in the Dairy Sector: Case of *Kamburupitiya* Veterinary Division**

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### **Abstract**

Livestock farming is a key component of Sri Lanka's agricultural sector. However, the reproductive performance of the sector is very low as most small-scale farmers' lack of knowledge on artificial insemination techniques. This study aims to discover current practices while assessing farmers' knowledge of standardized reproductive management practices. The study was conducted in *Kamburupitiya* veterinary division in *Matara* district where there are 120 dairy farmers and 402 dairy cows. Among them, 60 dairy farmers were randomly selected and conducted a pre-tested questionnaire survey. The results showed that most of the farmers practiced standard procedures in selecting feeds for dairy cows, pregnant animals and calves. They may get one calf every year from their herd, which has an average of three cows. Although dairy farmers have heard of artificial insemination, the results revealed that they do not have a comprehensive understanding of it. Cows are not re-inseminated in the first or second months after parturition, but within the 4<sup>th</sup> or 5<sup>th</sup> month. Most farmers do not have a proper understanding of the dry period. This results in a long dry period. The majority of the small-scale dairy farmers were unimpressed with the Artificial Insemination officer. Milk production is poor, owing mostly to lack of high-quality feed. Finally, the study suggests expanding outreach programs to improve farmers' knowledge of artificial insemination and reproductive management.

**Keywords:** Artificial insemination, Dairy sector, Farmers, Reproductive management

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## Performance Evaluation of Four-Wheel Tractor using Biodiesel Derived from Coconut Oil

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### Abstract

The rate of use of fossil fuel consumption exceeds the rate of production of fossil fuels. The transportation and agriculture sectors are the largest users of energy and rely largely on diesel engines. Diesel combustion has a significant impact on environmental pollutants. As an alternative and renewable fuel source, biodiesel is one of the best solutions to this problem. This study focused on the production of biodiesel from coconut oil derived from scraped coconut waste (SCW) and commercially available (CA) coconut oil, and the performance of a four-wheel drive tractor (45 hp) was evaluated utilizing biodiesel and mineral diesel (MD) under Sri Lankan field conditions. Extracted oil amount from SCW collected from the *Kamburupitiya* area was recorded as 485.78 mL/kg (with 2% moisture content). Coconut methyl ester (CME) was produced by transesterification process. The physical properties such as specific gravity, viscosity, kinematic viscosity, calorific value, flash point, and pH value of the biodiesel from both sources were comparatively tested with mineral diesel according to the American Society for Testing and Materials (ASTM) D 6751-07a standards. Physical properties of SCW-derived biodiesel included 0.89 g/cm<sup>3</sup> specific gravity, 5.24 mPa.s dynamic viscosity, 5.88 mm<sup>2</sup>/S kinematic viscosity, 37.28 MJ/kg calorific value, 126°C flash point, and 7.9 pH value. CA coconut oil biodiesel had a specific gravity of 0.89 g/cm<sup>3</sup>, a dynamic viscosity of 4.89 mPa.s, a kinematic viscosity of 5.49 mm<sup>2</sup>/S, a calorific value of 40.09 MJ/kg, a flash point of 110.5°C, and a pH value of 7.7. The ASTM biodiesel requirements were met by the evaluated characteristics of both kinds of CME. CME derived from SCW and CA coconut oil can be utilized as an alternative fuel for diesel-powered engines. Field efficiencies were reported to be 93.9 % and 95.9 % utilizing mineral diesel and CME, respectively, during the operation of a four wheel drive tractor coupled to a spring tine cultivator. CME and mineral diesel fuel usage and ploughing time were not significantly different (p=0.05). According to the findings, biodiesel derived from coconut oil could be successfully employed in existing diesel engines in tractors.

**Keywords:** Biodiesel, Biodiesel properties, Coconut methyl ester, Scraped coconut waste, Tractor performance

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## **A Case Study of Land Use Analysis on Land Surface Temperature to Detect Urban Heat Island Effect Using Satellite Imagery in Colombo, Sri Lanka**

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### **Abstract**

A study was conducted to determine the anthropogenic Land-Use (LU) effect on Land Surface Temperature (LST) to detect Urban Heat Island (UHI) development in Colombo Divisional Secretariat Division (CDS), Sri Lanka. Landsat 8 Satellite imageries were used from 2014 to 2019. The Esri ArcMap software was used to calculate the Normalised Difference Vegetation Index (NDVI), Normalised Difference Built-up Index (NDBI), Emissivity (E), and LST. The relationships among NDVI, NDBI, and E and LST were found to be significantly high, moderate, and non-existent, respectively. According to the LU classification, there was a significant increase in 'Bare Land and Sand (BL)' and 'Impervious Surfaced (IS)' areas in the studied area. Green spaces (VG) increased slightly, but commercial and residential (CR) areas decreased and water bodies (WB) were significantly lost. Each LU type was subjected to Geographically Weighted Regression (GWR) analysis to determine its spatiotemporal relationship to LST on location basis. The Getis-Ord  $G_i^*$  tool was used to spatially analyze the LST values for clustering in order to determine the UHI effect. UHIs were discovered in the harbor, port-city, key transportation networked areas, and coastal belt. UHIs tended to build in the western coastal area over time, with a relatively wide-spread cluster and higher LST. Throughout the study period, the IS, CR, and BL all had a significant impact on UHI development. Because of their surrounding cooling effect, WB and VG have reduced the UHI phenomenon. This scenario was mostly observed around the CDS's northern and eastern borders, with trend of increasing range. This research discovered that LU dynamic patterns had a significant impact on LST values while expanding and intensifying UHI in CDS. The study's overall findings could be used to provide acceptable solutions for urban greenery and eco-system management for national policy planning.

**Keywords:** Geographically weighted regression (GWR), Land surface temperature (LST), Landsat 8 Urban Land-Use (LU), Urban heat island (UHI)

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## **Development of a Food Safety Cloud for the Meat Industry in Sri Lanka**

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### **Abstract**

Food safety received a great deal of attention worldwide in the recent past. Due to the current lifestyle, most of the consumers prefer to consume processed foods. Food additives are widely used in processed foods and regular consumption of them appears to have increased the occurrence of non-communicable diseases (cancer, diabetes, cardio vascular diseases etc.). The present study was carried out to assess the consumer awareness on the use of food additives in meat and meat products and to develop a Food Safety Cloud for the processed foods. As the first step, the study aimed at developing a food safety cloud for the raw meat and processed meat products. MySQL database service, phpMyAdmin free software and Hypertext Markup Language (HTML) were used for the development of Food Safety Cloud. All the secondary data and standards were collected from the Food Act 1980 of Sri Lanka, Sri Lanka Standards Institute Standards (SLSI), Food and Agriculture Organization (FAO) Standards, Codex Alimentarius Commission Standards and United States Food and Drug Administration Standards (USFDA). A total of 120 consumers were selected from the different locations for the collection of data using the questionnaire. Data were analyzed using simple descriptive analytical tools and Chi-Square test. The mostly consumed meat type in the country is chicken (83%). Age and educational level of the consumers significantly affect ( $p < 0.05$ ) the awareness on types of food additives and also appear to have contributed to the awareness on food safety standards. No mechanism is available at present for the consumers to obtain further information regarding the safety of the food products. In this backdrop, Ruhuna Food Safety Cloud facilitates consumers to get scientific information on food additives in the food products via a cloud computing platform and it may help to take a learned decision before purchasing processed meat products. The Food Safety Cloud can be further improved/ developed by adding data on other processed foods in Sri Lanka and analyzing the exact amount of food additives in the processed food. Therefore, the Food Safety Cloud will be a user friendly platform for decision making on the food safety. Future research on validation of the developed Ruhuna Food Safety Cloud needs to be carried out.

**Keywords:** Cloud computing, Food additives, Processed meat products, Ruhuna Food Safety Cloud

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## **Development of Fiber-Rich Biscuits from Composite Flour**

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### **Abstract**

Biscuits are enjoyable, ready-to-eat foods consumed by all age groups throughout the world. The present study was conducted to develop a fiber-rich biscuit using composite flour as the fiber-substitute to minimize the risk of non-communicable diseases such as obesity, diabetes, cholesterol, and heart diseases. Different composite flour mixtures were prepared by substituting the wheat flour with fiber-rich flour; brown rice flour, finger millet flour, and oat flour as T<sub>1</sub> (85:15), T<sub>2</sub> (70:30), T<sub>3</sub> (55:45), T<sub>4</sub> (40:60), T<sub>5</sub> (25:75), T<sub>6</sub> (10:90) and T<sub>7</sub> (0:100). The ability to produce biscuits from the composite flour and the developed biscuits' proximate composition and shelf-life (total plate count, peroxide value and free fatty acid value) were determined using standard methods. The best mixing ingredients and the best mixing ratio of flour types in the composite flour for the production of fiber-rich biscuits were determined through the sensory evaluation conducted with thirty semi-trained members of panelists on a 7-point hedonic scale. Data obtained through the functional properties of composite flour revealed that prepared seven different composite flour mixtures can be used to produce biscuits. Based on the sensory data, it was decided to produce biscuits incorporated with margarine, fresh milk with no eggs. It was also observed that among the biscuits produced from seven different composite flour mixtures, biscuits made from T<sub>5</sub>, T<sub>6</sub>, and T<sub>7</sub> consisted of 25%, 10%, and 0% of wheat flour, respectively, were mostly preferred by the sensory panel. Proximate data revealed that the biscuits made from T<sub>6</sub> (10% wheat flour) showed the highest crude protein content of  $9.22 \pm 0.13\%$ , while that of the biscuits made from T<sub>5</sub> (25% wheat flour) and T<sub>7</sub> (no wheat flour) was found as  $8.17 \pm 0.27\%$  and  $8.75 \pm 0.88\%$ , respectively. Substitution of brown rice flour, finger millet flour, and oat flour to the wheat flour has resulted in increasing both total minerals and crude fiber in biscuits. In fact, biscuits made from T<sub>7</sub> (no wheat flour) showed the highest fiber content of  $3.7 \pm 0.35\%$ , and T<sub>6</sub> (10% wheat flour) showed the highest total mineral content of  $2.6 \pm 0.2\%$ . Compared with all the sensory attributes, the developed biscuits from the composite flour T<sub>5</sub> were mostly preferred by the panelists than that of the fiber-rich biscuit commercially available in the market. The shelf-life study revealed that the biscuits packed in triple laminated aluminium packing materials could be stored for six weeks of the period under ambient temperature. This study revealed that fiber-rich nutritive biscuits could be produced even without using the wheat flour (T<sub>7</sub>). The selected fiber-rich flour could enhance the biscuits' sensory, safety, and nutritional qualities.

**Keywords:** Biscuits, Fiber-rich, Flour, Functional properties, Nutritional value

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## **Surface and Sub-surface Hydraulic Properties of Water-Repellent Dune Sand Under Casuarina Shelterbelt in Dry Zone, Sri Lanka**

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### **Abstract**

Soil water repellency is a global phenomenon that is caused by the presence of organic substances. The organic substances that induce soil water repellency are mostly related with vegetation types such as Eucalyptus, Pines, Casuarina, Cypress, and Cedar. The objective of this study was to determine the surface and subsurface hydraulic dynamics of a water repellent coastal dune sand under Casuarina shelterbelt forest located in the Dry zone of Sri Lanka. Experiments were conducted onsite and, in the laboratory, considering two blocks (Block 1, 2) identified in the field. Infiltration, hydraulic conductivity, and sorptivity of the soil were measured in the field using a mini-disk infiltrometer. Water repellency of the soils was examined using the water drop penetration time (WDPT) test and the molarity of an ethanol droplet (MED) test. In addition, pH, electrical conductivity, and volumetric moisture content were measured onsite, at the depths of 0-5, 5-10, 10-15, and 15-20 cm. Soil samples taken from the same depths were used for the laboratory experiments. Water entry value, water retention, water-dependent repellency curve, and the diminishing water repellency with time were determined in the laboratory. Water repellency (WDPT= $\sim$ 5300 s) and the organic matter content ( $\sim$ 1.96%) were highest in the surface soil layer (0-5 cm) and diminished with increasing soil depth, showing strong positive correlations (0.84). Both blocks showed extreme water-repellent levels on the surface (WDPT $>$ 3600). However, the soils of block 01 showed higher hydraulic conductivity, sorptivity, and infiltration compared to block 02. The water entry value (0.74) and the water retention at 150 cm suction (0.69) of soil samples were highest in the topsoil layer (0-5 cm) and increased with increasing WDPT, showing moderate to strong positive linear correlations. The water-dependent repellency curve showed that the water repellency gradually increased and then decreased with drying, where the maximum level of repellency was recorded at approximately 1% moisture content. It can be concluded that the extreme water-repellent levels in the beach sand under the Casuarina shelterbelt influenced both surface and sub-surface hydraulic dynamics.

**Keywords:** Casuarina, Hydraulic conductivity, Infiltration, Sorptivity, Water repellency

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## Impacts of Heat-induced Alterations in Water Repellency on Aggregate Sizes and Particle Size Fractions in a Eucalyptus Forest Soil

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### Abstract

Soil water repellency (SWR) is the resistance of soil for spontaneous wetting when water is applied on the surface. Soils under vegetation types such as Cypress, Pines, Casuarina, and Eucalyptus, which produce litter rich in hydrophobic waxes and resins, exhibit severe SWR conditions. Wildfires are very common in these forests, where different levels of heat generated are known to influence the water-repellent nature of these soils. The objective of this study was to examine the impacts of heat-induced alterations in water repellency on aggregate sizes and particle size fractions in a water-repellent *Eucalyptus grandis* forest soil in the up-country intermediate zone. Four sizes of natural aggregates (3-5, 8-10, 14-16, 20-22 mm) and six particle size fractions separated through sieving (>362, 167-362, 149-167, 92-149, 44-92, <44 µm) heated at four heating temperatures (150, 200, 250, 300°C) and three exposure times (30, 60, 120 min). SWR, percentage of water-stable aggregates (%WSA), organic matter content (OM%), and floating time (FT) were measured in aggregates, whereas the SWR was measured in particle size fractions, both before and after the heating. The SWR was highest in the smallest aggregates and gradually decreased with increasing aggregate size. SWR and OM% of aggregates decreased with increasing heating temperature and time of exposure. SWR disappeared at 250°C, 200°C, and 150°C, respectively with 30, 60, and 120 min of exposure times. The %WSA increased with temperature and the increment was highest in the smallest aggregates. The %WSA increased at low-temperature heating (150, 200°C) for shorter durations (30, 60 min) and decreased at high-temperature heating for longer durations. The %WSA of all sizes of aggregates for all heating durations decreased when heated at 300°C. SWR of all the size fractions slightly increased and then decreased with increasing heating temperature to be eliminated around 200-250°C. Only the 3-5 mm aggregates showed floating. FT increased and then decreased with heating temperature, and lowest at the longest time of exposure (120 min). The heat produced by wildfires in eucalyptus forest soil may lead to a loss of small aggregates due to increased SWR and floating ability. Further experiments are required to understand the structural changes that occur in the organic substances when exposed to heat.

**Keywords:** *Eucalyptus grandis*, Heat impacts, Soil water repellency, Water stable aggregates

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## Prediction of Harvesting Stage and Economic Value of *Saccharum Spp* (Sugarcane) by Near Infrared Spectroscopy

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### Abstract

Sugarcane, *Saccharum spp.* is a multipurpose crop that produces sugar and numerous other raw materials for many numbers of industries. Present sugar demand for Sri Lanka has been estimated as 590,000 Mt per annum out of which 91% of requirement is imported spending 33.5 billion LKR of foreign exchange. Sugarcane is harvested at 11 to 14 months of age and at the Brix value of equal or higher than 18. However, at present, the Brix value is measured by refractometer following destructive method which does not permit large number of detection at the harvesting field. Similarly, sugarcane price is assigned based on cane weight at the factory grading point though the final sugar yield which is correlated to the Brix value. This motivate farmers to produce high cane mass with a low Brix value. As such, development of quick detection methodology for Brix value prediction has a high impact on the industry. Therefore, the present research evaluates near infrared (NIR) spectroscopy as a rapid Brix value prediction tool for sugarcane stems. Samples were obtained from 6 sugarcane varieties, four replicates and three cuttings per plant. NIR spectra obtained from NIR spectrometer FQA-NIR Gun (588-1100nm) were used in partial least square (PLS) algorithm to develop a regression model. Handheld refractometer was used to obtain the reference data for the PLS models. Results revealed that there were two clusters in the regression line for higher and lower end data range which was consistence with two populations observed in the descriptive statistics. This concludes further with the better results accounting by two separate PLS models as for higher range of 16 to 25 Brix ( $R^2=0.97$  and  $SEC=0.62$ ) and lower ranges of 3 to 15 Brix ( $R^2 =0.89$  and  $SEC=1.69$ ) when compared to one single regression model for the total range of 3 to 25 Brix ( $R^2=0.94$  and  $SEC 2.09$ ). Regression vector coefficient shows that 967 nm wavelength having the highest contribution for the Brix value prediction. The research revealed that the potential possibility of using NIR technology as a nondestructive and rapid method for Brix value of prediction of sugarcane as a quick detection method.

**Keywords:** Brix value, Near Infrared Spectroscopy, Rapid, Sugarcane

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## Improving Cocopeat Medium for Living Wall in Greening the Building

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### Abstract

The thermal comfort of urbanized residences decreases as a result of the urban heat island effect. Restoring thermal comfort requires more energy. The green wall concept was proposed as an environmentally friendly solution to this problem. The most popular growth substrate for green wall structures is cocopeat, although its nutrient level is extremely low. The objectives of the study were (a) to improve the cocopeat media with adding agricultural organic bio waste for living wall and (b) to evaluate the temperature reduction performances. The chemical and physical characteristics of different growing media as well as growth parameters (leaf count, plant height, and area coverage by canopies) were examined and temperature reduction was tested in the space between the wall and plants. The aesthetic value of the living wall was assessed through questionnaire survey. A living wall setup was constructed in the premises of the new auditorium, Faculty of Agriculture, University of Ruhuna, utilizing 60 cm rain gutter pieces with a volume of 3 liters that were connected to the wall in a wooden frame. Three growing media, including cocopeat + compost mixture, cocopeat + goat manure mixtures, and only cocopeat, were employed with two plant species, *Rhoeo spathacea* and *Petunia*. With four replicates, the split plot experimental design was utilized. The standard properties of growth media were fulfilled by the most of the chemical and physical properties of the cocopeat + compost medium. The cocopeat + goat manure mixture was found to be the most lightweight medium, with a weight reduction of 85.35% when compared to typical soil. However, *Rhoeo spathacea* (area coverage) and *Petunia* (height and leaf count) performed the best on cocopeat + compost media. At 12.00 p.m., the highest temperature drop of 3.14°C was reported in *Rhoeo spathacea* between wall and plant. In terms of aesthetic values, participants to the questionnaire survey preferred ornamental flowering plants and wooden frames as construction materials. *Petunia* was voted the most popular ornamental plant. The cocopeat + compost media was the best potting mixture for plant growth performance. A cocopeat + goat manure combination had the lowest weighted medium.

**Keywords:** Cocopeat, Green wall, Potting media, Temperature, Urbanization

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## **Use of Thiocyanate Based Ionic Liquid Electrolyte in Supercapacitors**

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### **Abstract**

The present energy and environmental crises has sparked the concept of creating energy storage devices such as supercapacitors utilizing natural resources and conducting research to determine their capacity to work under various conditions with various substitutes. Organic solvents were once the most common commercially utilized electrolytes in supercapacitors, but they had several significant drawbacks. The use of ionic liquid electrolytes has several benefits over traditional organic and aqueous electrolytes. This research presents the results on the fabrication and characterization of a supercapacitor using activated carbon, which is fabricated with coconut shells as the activate material and Triethylamine hydrothiocyanate (THT) ionic liquid (C<sub>7</sub>H<sub>16</sub>NS) as the electrolyte. In this experiment, both electrodes were constructed using spray pyrolysis method. Furthermore, the performances of the supercapacitor were optimized with sintering temperature of electrodes and the amount of binder (Polyvinylpyrrolidone-PVP) in electrodes. The electrodes were characterized with CV measurements, SEM images, P-XRD patterns, and Raman spectrometer. Finally, THT based ionic liquid electrolyte in Supercapacitor was compared with existing literature. As per the optimization, the best binder percentage was recorded as 5% of the active material's mass, and the best sintering temperature was recorded as 200°C with a hold-time of 30 minutes. The cell exhibited a specific capacitance of 34.89 F g<sup>-1</sup> measured from two-electrode cyclic voltammetry experiments at a scan rate of 0.020 V s<sup>-1</sup>. The enhanced performance with the demonstration of comparatively high-specific capacitance with THT ionic liquid electrolyte is suitable for high-temperature applications.

**Keywords:** Activated carbon, Electrolyte, Ionic liquids, Supercapacitor

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## **Developing A Cassava (*Manihot esculenta*) Value Added Product to Export Japanese Market: A Study with Bernard Botejue (Pvt.) Ltd**

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### **Abstract**

Value added products in Agribusiness will explore the new market ventures for many agricultural products in export market. In this context, private sector plays an important role by investing for new value added products. Though the export market for cassava (*Manihot esculenta*) value added products are tremendously improving during last few years, Sri Lanka has not sufficiently targeted to export cassava based products. Therefore, the major objectives of the study were (a) to analyze the consumer preferences in Japan for the proposed value added cassava product, (b) to examine of the possibility of development of cassava value added product using trial and error method and (c) to evaluate the export readiness of the Barnard Botejue Company. A pre-tested semi structured questionnaires were used to collect primary data by interviewing 40 consumers in Japan. The sensory analysis and trial and error methods data were used to examine the possibility of development of cassava value added product. Data were analyzed descriptively. Preliminary survey revealed that most of the Japanese consumers (50%) likely to consume the proposed cassava rice pasta as the value added product. As the results, cassava chips flour showed better characteristics than the cassava mash flour. According to the trial and error method, the final cassava value added product was consisted of cassava flour, corn flour and rice flour mixture. It includes egg white, coconut oil, water and salt as the additional ingredients. The Bernard Botejue Company is sufficiently ready to export new products in context to their management commitment and skills, financial resources, manufacturing capacity, technical knowledge and international marketing intelligence. The cassava pasta can be modified as gluten free, low calories and as a 100 percent snack or fried instant noodles with the further improvements. The Bernard Botejue Company can contribute to the development of agriculture sector in Sri Lanka by expanding their R&D activities and exploring new export destinations for agricultural products.

**Keywords:** Cassava pasta, Consumer preference, Export readiness, Value added product

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## **Strategies to Enhance the Market Share of Small & Medium Enterprise (SME) Millers in *Polonnaruwe* District, Sri Lanka**

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### **Abstract**

The Rice milling industry has become an attractive profitable industry over the past few years due to expanding market opportunities in the paddy sector. However, the market share of small and medium enterprise (SME) millers seems gradually decreasing at present. Therefore, present study aims to suggest strategies to enhance the market share of SME millers in *Polonnaruwe* district. The study was based on field survey of 68 SME millers who were selected using simple random sampling technique from the identified 100 SME millers. In addition to the pre-tested questionnaire-based survey, key informant interviews (KIIs) as well as face-to-face interviews were conducted to collect primary data. Descriptive statistics were mainly used to analyze the data. Results showed that all SME millers are male (100%) and they faced lot of problems attached to their milling process that reduce their potential market share. Low production due to insufficient financial capability (many SME millers, i.e., 38.2% were taken less than Rs. 10 Mn. bank loan due to resettlement issues); low purchase of paddy, i.e., less than 100 MT paddy for *Yala* (47.4% of SME) and *Maha* (36.2% of SME) due to lower storage capacity for paddy (100-500 MT for 44.8% of SME) and rice (less than 100MT for 52% of SME); low use of electrical machinery (75.6% of SME) due to insufficient money for paying bills; price fluctuations (50%) as pricing strategy was mainly based on large millers' monopoly power (30%); lack of training to use advanced technology (60%), thereby the machinery processes in milling industry such as hot/cold soaking, shortening, drying and boiling capacity of paddy were low in operation. Moreover, many millers produced milled rice through hot (60% of SME)/cold soaking (32.1% of SME), boiling (84.2% of SME), drying (41.9% of SME) processes with lowest capacity of 1-10 tons even though the potential capacity is 100 tons. These are among the main problems that challenge their market share. Hence, this study suggests providing government regulated prices, training programs, enough government intervention with sufficient financial aids to enhance processing/purchasing/production capacity, support to use new technology, proper pricing strategy, and product diversification strategies to enhance the market share of SME millers. The findings of the study have a great significance for the policy makers, researchers and marketers in particular to develop the strategies to promote market share of SME millers. Study proposes conducting similar studies in other areas as well where SME millers are operating to generalize these findings.

**Keywords:** Market share, *Polonnaruwe*, Rice Milling, SME millers

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## **Role of Facets of Social Media Marketing on Consumer-Based Brand Equity and Purchase Intention: A Case of Undergraduates, Faculty of Agriculture, University of Ruhuna**

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### **Abstract**

Social media platforms connect people to promote a brand, improve sales, and drive towards massive profits. Social media marketing (SMM) is one of the efficient marketing strategies that use to market products and services among the youth in particular. However, SMM has not adequately been popularized in the Sri Lankan context while keeping its real role unexplored. Hence, the exploration of the role of SMM on consumer-based brand equity (CBBE) and purchase intention (PI) is timely required, as these components are the important precursors of earning profits. Thus, the present study aims to identify the role of SMM on CBBE and PI and to suggest companies the way of using SMM effectively in their marketing strategies to enhance profits. The target population is undergraduate students (N=862) of the Faculty of Agriculture, University of Ruhuna. Primary data were collected through an online questionnaire via a "Google Form." The fictitious (hypothetical) fast-food brand identified through the pre-test was used as the stimulus brand in order to avoid confounding effects that might occur when using real brands. Results with respect to twenty nine percent respondent rate showed that all respondents responded are using social media platforms. Ninety three percent of respondents daily use social media to get an idea and aware of the product before buying the items they want. The present study used entertainment, interaction, trendiness, customization, and word of mouth as main facets of SMM anchored by the past literature in this domain. Results revealed that SMM affects significantly on CBBE and PI. Analysis of two regressions showed that entertainment ( $\beta=0.221$ ,  $p=0.000$ ), interaction ( $\beta=0.150$ ,  $p=0.001$ ), trendiness ( $\beta=0.253$ ,  $p=0.000$ ) and customization ( $\beta=0.141$ ,  $p=0.001$ ) have positive effects on CBBE, while entertainment ( $\beta=0.263$ ,  $p=0.000$ ) and word of mouth ( $\beta=0.366$ ,  $p=0.000$ ) have positive effects on PI. Since SMM affects positively on CBBE and PI; the study suggests marketers to incorporate entertainment, interaction, trendiness, and customization strategies to enhance CBBE while incorporating entertainment and word of mouth strategies to enhance PI, when using SMM as their main marketing tool to market these products among youth in particular. Even though the use of the product category and the target consumer group limit the generalizability of present findings, present study directs future researchers to consider real product categories with respect to general consumers to confirm the generalizability of the current findings.

**Keywords:** Consumer-based brand equity, Purchase intention, Social media marketing

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