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FAuRS-2016

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16th December 2016

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Faculty of Agriculture
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MESSAGE FROM THE VICE CHANCELLOR UNIVERSITY OF PERADENIYA

It is with great pleasure and enthusiasm that I write this message on the occasion that the Faculty of Agriculture is holding its Undergraduate Student Research Symposium (FAuRS) for the third consecutive year.

In the ever-changing process of agricultural development, it has been a challenge to bring in sustainable solutions in meeting the country's food requirements. As the pioneer in agriculture higher education and research in the Sri Lankan University system, the Faculty of Agriculture of the University of Peradeniya has taken the leadership and driving its human resources in the most striking way in finding viable and effective solutions to many challenges in the agriculture sector in collaboration with the stakeholders at all levels, both locally and internationally. In this endeavour, the Faculty's efforts in exposing the final year students to the real world challenges, training them to be creative researchers and leaders in the agriculture and allied sciences, and providing them with an opportunity to share their experiences and unveil research findings in front of an able audience are commendable. This will definitely provide the aspiring graduands an immense strength and courage to be young scientists and productive citizens in the society.

I am confident that FAuRS will fulfil the expectations of the Faculty of Agriculture. This event will also provide an opportunity for the graduands to interact with experts in the government and industries, and potential employers, and for the Faculty to strengthen interactions and collaborations further with leading stakeholder organizations.

I take this opportunity to congratulate the Dean and the staff of the Faculty of Agriculture, the Coordinator FAuRS-2016 and her team for their untiring effort in staging this event.

While wishing all the gradaunds a very successful career, I also wish the deliberations of FAuRS-2016 every success.

Professor Upul B. Dissanayake
Vice-Chancellor
University of Peradeniya

16th December, 2016

MESSAGE FROM THE DEAN FACULTY OF AGRICULTURE

It is with great pleasure and pride I am forwarding this message on the occasion of the 3rd Faculty of Agriculture Undergraduate Research Symposium (FAuRS-2016), University of Peradeniya.

Since its inception during the last 68 years, the Faculty of Agriculture of University of Peradeniya, as the pioneer and leading agriculture higher education institute in Sri Lanka shoulders responsibility of producing agriculture and related professionals needs for country to face challenges and also to give the leadership to the sector. To produce leaders in agriculture sector, the undergraduate programs at the Faculty encourages holistic, independent and critical thinking, and use of innovative and problem solving approaches through integration of modern and traditional blends and technological advancement. The concept of Undergraduate Research Symposia was first introduced to the university system of Sri Lanka in 1993 by the Department of Animal Science, Faculty of Agriculture, University of Peradeniya. Since then, Annual Student Research Sessions had been a tradition of the Faculty. In 2014, the Faculty took another step forward by conducting a common Students Research Symposium for the entire Faculty. The FAuRS is providing a platform for graduating students to present their valuable final semester research findings and interact with experts in the sector, peers and prospective employers. This will no doubt enhance the research culture within the Faculty and the university system. Since inception, the Faculty is in forefront in introducing new dimensions to its degree programs. As in the past, this year too, the Faculty introduces additional dimensions such as a research brief competition, a research video competition and a scientific photography competition. In addition, inventors and innovations of the Final year research projects will be identified by the Sri Lanka Inventors Commission. I hope that this year FAuRS-2016 is a most fruitful and memorable experience for all participants.

I know how difficult it was for the organizing committee to stage the FAuRS-2016 in this glamorous way. I wish to extend my sincere gratitude to the symposium coordinator and her team for their hard work to make this event a successful reality.

I also take this opportunity to congratulate the presenters and the graduating students of all three degree programs.

I wish the FAuRS-2016 a great success.

Professor Gamini Pushpakumara
Dean/Faculty of Agriculture

16th December, 2016

MESSAGE FROM THE COORDINATOR OF FAuRS-2016

It is with great honour and privilege I write this message as the coordinator of the Third Undergraduate Research Symposium (FAuRS) of the Faculty of Agriculture, University of Peradeniya. The Faculty of Agriculture has always given a primary emphasis on research in its curricular and each student of the Faculty completes a research study during the eighth semester of the academic programme, with preparatory work being done from the seventh semester. The FAuRS is the main venue to disseminate findings of such research projects. The findings are presented at the FAuRS-2016 through oral presentations, poster presentations, research briefs, research videos and scientific photographs catering to the interests of different stakeholders. Accordingly, FAuRS-2016 provides opportunities for researchers to identify concepts for further testing and falsification, donors and industry to identify agricultural innovations, development workers to identify pilot studies for up taking, etc.

The proceedings of the FAuRS-2016 present the findings of 196 research projects in the form of abstracts. They are organized under four themes, i.e. Agricultural Production and Product Development, Technological Interventions and Applications in Agriculture, Environment and Resource Management, and Social, Institutional and Economic Development, depicting key thematic areas of the curricular of the three degree programmes offered by the Faculty of Agriculture.

The organizing committee of FAuRS-2016 consisted of a group of extremely talented, devoted and dynamic staff and coordination of the activities of event has been a pleasant and rewarding task. The unsolicited support given by the Dean, Heads of Departments, academic and non-academic staff members of the Faculty of Agriculture throughout organizing FAuRS-2016 is acknowledged with a deep appreciation. The contribution of students, both graduands and their junior colleagues, and all others in staging this event is highly appreciated. The support provided by the Science Industry Interaction Cell (SIIC) of the Faculty of Science in designing the content management system is acknowledged.

The overwhelming response that the FAuRS-2016 received from sponsors is remarkable. All the sponsors owe a big "Thank You" for contributing to a fruitful event for the betterment of agriculture higher education of Sri Lanka.

I sincerely hope that the FAuRS-2016 will be a memorable academic experience for all the participants.

Professor Jeevika Weerahewa
Coordinator, FAuRS-2016
Faculty of Agriculture

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Analysis of Production and Processing of Cashew in Mullaithivu District

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Cashew has the potential to provide sources of livelihood to growers, empower rural women in the processing sector, create employment opportunities and generate foreign exchange through exports. The objectives of the study were to analyze the factors that affect on cashew production and processing and investigate the reason for not processing by growers.The study was conducted in Karaithuraipattu Divisional Secretariat Division. It examined the social characteristics, economic factors, attitudes and knowledge on cashew cultivation among farmers in the study areas. Data were collected using a structured questionnaire administered to 60 respondents selected through a simple random sampling procedure. Descriptive statistics and multiple linear regressions were used in data analysis. It was found that the mean income from cashew production per acre was Rs121,848.00 per annum. The average yield of the sample of respondents was 312 kg/ha.The ages of the farmers, fanged from 28 years to 86 years.The majority of the farmers had primary education. Fifty three percent of the farmers hadmore than 16 years of cashew farming experience.The descriptive statistic shows that 60% of farmershad neutral attitude towards cashew farming and 58% had poor knowledge about cashew cultivation.The regression results showed thatage and education level significantly ($P<0.1$) and negatively affect on yield. Knowledge and training significantly ($P<0.1$) and positively affect the yield.Cashew cultivators were constrained by several limitations. Farmers should be trained and educated in terms of agronomic practices, and processing technologies to increase the productivity. Further, processing was not undertaken by the farmers, whereby they forgo potential sources of income.

Keywords: Cashew, Adoption, Production, Processing

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Analyzing Milk Urea Nitrogen Concentration of Lactating Dairy Cattle at Ridiyagama Farm

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Milk urea nitrogen (MUN) is a metabolite of dietary protein. Amount of MUN concentration of dairy cows has been used to evaluate the efficiency of dietary protein utilization. A study was conducted to investigate the MUN concentration of dairy cows in National Livestock Development Board farm at Ridiyagama. Milk samples were collected from randomly selected Jersey and Jersey-Frisian crossbred cows (n=200). Milk Urea Nitrogen concentration was measured using an established method with minor modifications. Briefly, 500 µl milk sample was mixed with 500 µl trichloroacitic acid (TCA) and centrifuge at 10,000 rpm for 10 minutes. Thereafter the supernatant was mixed with an equal amount of p-dimethylaminobenzaldehyde (DMAB). Optical density of the mixture was measured at 420 nm using a spectrophotometer, and MUN concentration was calculated using a standard curve which ranged from 500 µg to12.5 µg of urea. Mean comparison of Jersey and Jersey-Frisian crossbred cows was done using 2 sample t-test and least significant difference procedures. Correlation and Regression analysis was performed to establish the relationship of MUN concentration with days in milk, and daily milk yield. Mean MUN concentrations of Jersey (13.03 mg/dl) and Jersey-Frisian crossbred (12.03 mg/dl) cows were significantly different ($P<0.05$). The MUN concentrations decreased with the days in milk ($P<0.05$) but increased with the milk yield ($P<0.05$) in both Jersey and Jersey-Frisian crosses. The results indicate that the Jerseys have higher MUN concentration than Jersey-Frisian crosses in Ridiyagama farm. However, the MUN concentrations of all cows were within the recommended range of 12-18 mg/dl, indicating that the crude protein level of the cow ration is at the correct level. Future studies are needed to recommend reference values of MUN for farms located in different climatic zones of Sri Lanka.

Keywords: Milk urea nitrogen, breed, cattle, protein

This study was financially supported by National Research Council of Sri Lanka (NRC-TO-14-10)

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Breeding Ability of Ceylonese Combtail (*Belontia signata*) under Captive Conditions.

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Ornamental fish sector brings a considerable amount of foreign exchange to Sri Lanka. Ceylonese combtail (*Belontia signata*), which inhabits in the wet zone, is an endemic ornamental fish species of commercial importance. Over fishing for aquarium trade has caused this species to rapidly disappear from their natural habitats. Captive breeding of Combtail is vital to thrive in the industry as an ornamental fish and to conserve their natural population. The objective of this study was to determine the best still water environment for Combtail to breed in captivity. Wild caught fish were acclimatized for two weeks to the experimental conditions in the Ornamental Fish Breeding Station of National Aquaculture Development Authority, Rambodagalla. Males and females were reared separately once sex differentiation was done at the end of the acclimatization period. Three different breeding environmental conditions were provided as gravel with aquatic plants, only aquatic plants, and Styrofoam without aquatic plants, respectively. Experimental fish were accommodated in indoor glass tanks with 1:1 male:female ratio. Water quality parameters measured during the experiment were 7.5-8 of pH and 24-28 ^{o}C and water was free from Ammonia and Nitrite. All fish were fed with (3% of body weight) formulated fish feed and ground meat meal once a day, morning and afternoon, respectively. Analysis of variance was performed under Completely Randomized Design and means of the three treatments were compared using Least Significant Difference. Out of three different conditions, tanks with gravel and aquatic plants (203± 29) and only aquatic plants (230±46) recorded significantly higher numbers of fry ($P<0.05$) compared to Styrofoam treatment (40±4). Hence aquatic plants (with or without gravel) was recommended for captive breeding. The results of this experiment can successfully be used to enhance ornamental trade of Combtail by captive breeding while conserving them in their natural habitat.

Keywords: Captive breeding, Ceylonese combtail (*Belontia signata)*, male: female ratio

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Comparative Study of Roasted Coffee (*Coffea arabica* L.) of Different Origin

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Coffee made from *Coffea arabica* is the most commercialized and most commonly used beverage in the world. This study was conducted to compare the proximate composition, phytochemicals and minerals of *Coffea arabica* beans obtained from four different origins, namely Brazil, Colombia, Ethiopia and Sri Lanka (Ceylon). Coffee bean samples, which have experienced different agro climatic conditions in the plantations were processed in the same manner prior to analysis. Standard Analytical procedures were used for assessments. The phytochemical analysis suggested a caffeine content of 1.20% (dry matter basis), total phenol content of 39.27 mg/gallic acid equivalent per 100 g and melanoidins content of 29.93 g/100 g in Brazilian origin, which is the highest. The results of proximate analysis revealed that the Brazilian origin was richer in acid insoluble ash and total ash content, while Colombian origin exhibited a higher amount of moisture and crude fat. Ceylon origin showed the highest water soluble matter content. In the mineral analysis, significantly higher ($p<0.05$) amount of magnesium, phosphorous, potassium and zinc were observed in the Brazilian origin, while Colombian and Ceylon origins had the highest amount of copper and ferrous, respectively. Ethiopian origin contained a significantly higher ($p<0.05$) amount of calcium. In sensory evaluation, Brazilian origin coffee brew received the highest preference for color, taste, mouth feel and overall acceptability. However, the coffee brew of Ceylon origin had the highest preference for aroma.

Keywords: *Coffea arabica*, Caffeine, Melanoidins, Phytochemicals

This work was funded by the Department of Export Agriculture, Sri Lanka.

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Comparison of Microbial Status, Important Chemical Parameters and Sensory Evaluation of Cold Brew Tea

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To determine the microbial quality, important chemical characteristics and sensory parameters, fruit tea and herbal tea infusions were brewed at different temperatures (cold, hybrid and hot) for 5 min and kept for 2 h. Total plate count, yeast and molds, total *Coliform,* fecal *Coliform* and *Escherichia coli* counts were determined microbial quality of teas. Total polyphenol content and antioxidant activity were analyzed to determine chemical quality. Sensory evaluation was carried out to study the strength of the color, taste and aroma of teas steeped under different brewing conditions. All the tea types tested complied with microbial quality requirements and respective counts were significantly lower than the international specifications. Further, there was no significant difference ($p>0.05$) among samples treated under different brewing temperatures and different keeping times with regard to microbial counts. Cold brewed tea resulted lower antioxidant and polyphenol contents compared to hybrid brewed and hot brewed teas. Among all the cold brewed tea samples tested, fruit tea (blueberry), resulted the highest values for antioxidant and polyphenol contents, 29.0±0.84 and 66.17±3.358 respectively. According to the sensory evaluation data, cold brewed tea exhibited the lowest strengths with regard to sensory attributes taste, aroma and color compared to hybrid brewed tea and hot brewed tea and the differences were significantly different ($p<0.05$).Hybrid brewed tea exhibited higher values of antioxidant activity and polyphenol contents (75.68±1.167 and 97.85±1.697) compared to cold brewed and hot brewed teas. Outcome of the study suggests that hybrid brewing is the preferred method of brewing for fruit tea and herbal tea infusions with regard to microbial quality, antioxidant activity and polyphenol content as well as sensory attributes compared to cold and hot brewing.

Keywords: Cold brew, Herbal infusions, Microbial quality, Chemical quality

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Comparison of Milk Production and Reproduction Performances of Dairy Cattle Breeds and Crosses in Three Up Country Farms

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This study was conducted to determine the effect of five factors, namely genotype, parity, calving month, bull breed and farm, on selected production and reproduction traits, i.e. birth weight, lactation length, total milk yield, days to peak, 305-day milk yield, number of services and mature equivalent yield of dairy cattle in three Up Country farms belong to National Livestock Development Board. A total of 1500 dairy cow records were collected covering the period from January, 2013 to August, 2016, using herd register and *Alpro* windows software maintained at Bopaththalawa, Manikpalama and Dayagama farms. Records were obtained from five different genotypic groups (Friesian (F), Jersey (J), 75% F x 25% J, 50% F x 50% J, and 25% F x 75% J) using available pedigree records and visual observations. Analysis of variance was performed using SAS software package and means of genotypes were compared using Duncan's Multiple Range Test. Production and reproduction traits were significantly ($P<0.05$) affected by the five genotypes tested in the study. The highest performance in production was shown by the 50% F x 50% J cattle group. The highest production and reproduction performance levels were recorded by September to February calvings. It was also revealed that the highest production was obtained at the fourth parity of cows regardless of the genotype. Use of semen from pure Friesian bulls resulted in the lowest number of services per calf. Among the three farms, Dayagama farm showed the highest milk production and Manikpalama farm showed the highest reproduction performance. Further, the results revealed that the 50% F x 50% J was the best performing genotype in Dayagama farm while pure Friesian performed the best in Manikpalama farm.

Keywords: Cattle breeds,genotype, milk production, Up Country

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Control Environment Storage System for Big Onions - Construction and Performance Evaluation

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Price of big-onion in Sri Lanka lowers in the harvesting season from August to October. The profit can be increased by storing during this period because of the higher selling price after the season. Mother bulbs for seed production are stored for 8 months and losses in existing stores are 30% to 50%. However, storage of big onions even for a few months is difficult due to high postharvest losses in conventional stores which is done under ambient conditions and without chemicals. Storing big-onions under controlled environmental conditions of 25-50°C temperature and 70-80% relative humidity can reduce postharvest losses. This project developed a big onion storage that maintains these environment conditions with low investment. An unutilized room in an onion farmer's house in Digampataha, Matale district was converted to 3,750 kg onion storage by sealing the room and installing a modified 9000 BTU window air conditioner.The temperature and relative humidity inside the store room were maintained in the optimum ranges by an automated control system and adequate ventilation.The system was improved in response to the farmer's reaction to the operating experience. Weight losses due to rejected onion bulbs were evaluated periodically and compared with the conventional storage maintained simultaneously. Weight loss of rejected onions in control environment storage was 0.66% and it was 1.08% in conventional storage for 5 week monitored period. The storage trial is expected to continue till the mother bulb planting season in April 2017. The electrical energy usage was about 2.4 kWh/day and can be reduced to lower the operating cost by improving the control system.The environmental condition inside the store was maintained close to the optimum range for storing onions meeting the expectations. This low cost technology can benefit onion farmers in Dambulla area and beyond by substantially increasing their farm income

Keywords: Control environment, onions, storage

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Design and Develop a Domestic Level Solar Powered Low Cost Hybrid Water Distillation Unit for Areas Having Hard Water in Sri Lanka

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Lack of good quality drinking water has been identified as a major problem for rural communities in most parts of the dry zone due to ground water hardness and quality deterioration. Most of the water purification technologies and equipment are expensive and highly technical. Most of the electricity power production is based on the non-renewable fossil fuels. These have become a global strategic matter with the concern of greater environmental pollution. Various renewable energy sources were explored and the solar energy is adjudged the best option. Distillation can remove nearly all impurities from water. Solar distillation has great possibility to adapt to generate good quality drinking water for domestic use in rural communities. This research was conducted to develop a combined system of solar still and thermoelectric module to obtain more efficient water distillation unit suitable for Sri Lankan conditions. The developed system is a totally renewable energy based system taking benefit of the clean direct and indirect solar energy. Cooling and condensing capacity of the solar distillation unit was improved by single stage thermoelectric module of 60 W. A solar cell panel unit was used to obtain 20 V DC power requirement of the condensation section and power storage system. The yield of distill water from the improved hybrid solar still was 40 ml per hour. Observed maximum voltage output from the solar panel was 19.6 V. Further experiment and improvement are necessary. The efficiency of the system may possible through improving the capacity of the thermoelectric module and solar still.

Keywords: Solar distillation, thermoelectric module, hybrid sola distillation unit

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Design and Development of a Biomass Solar Pyrolysis Reactor: an Engineering Model

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At present, there are many technologies for pyrolysing biomass. Most of them use part of the biomass or electricity for supplying energy requirements for pyrolysis. Also traditional methods are inefficient, hard to operate, minimum safety conditions and cause environmental pollutions. Also industrial pyrolysis systems need high amount of energy. To overcome these problems, a solar pyrolyzer was designed. The best way to capture solar energy for biomass pyrolysis was investigated by testing different size of convex lenses, parabolic mirror and Fresnel lens. Tracking of the solar radiation was done by manual adjustment of lens. Shredded paddy straw was used as the feedstock for pyrolysis. Using greenhouse effect, the temperature can be increased by 1ºC to 3ºC and reduce temperature fluctuations. The focal point temperature was higher for the same size convex lens than parabolic mirror. Employing a Fresnel lens of 865 cm^2 solar capturing area, average pyrolysing rate in copper tube filled with straw was 2.79 mg/s and in glass tube 1.61 mg/s. In the glass tube inner temperature varied between 400 to 440 ºC and outer surface temperature fluctuated from 500 ºC to 510 ºC. The heating rate was 11 ºC/s. pH, volatile matter and ash content were 8.78, 62.90% and 30.26%, respectively. By analyzing and interpreting the collected data, a prototype was fabricated. Based on that, high efficient inventive, cost effective and environmental friendly engineering model of a solar energy driven pyrolyzer was designed. The engineering model is a continuous system with an upward crew feeding mechanism. When feedstock approached the focal point pyrolysis did take place. The produced biochar did automatically fall into the outer chamber of the pyrolyser. Filtered gas can be combusted. The lessons learnt from this research are to undertake step by step approach to finally produce a marketable pyrolyser.

Keywords: Solar pyrolysis, biochar, fresnel Lens

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Design and Development of a Closed Cycle Heat Pump Drying System for Industrial Drying of Rice & Chilli

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A closed cycle heat pump drying system was developed for drying and moisture control of agricultural commodities. Two units of dehumidifiers made with heat pumps with a capacity of 0.95 kW each was placed in an air-tight room of 10m long 3 m wide 3 m high. The commodities to dry was tested inside this dehumidified room for the drying rate variations and the efficiency of the heat pump dehumidifying system. Dehumidifiers with heat pumps were controlled by primarily a duty cycle control with 20 min on time and 10 min off time with a microcontroller (PIC16F684) based control system. A secondary control system was used in controlling the relative humidity of the dehumidified room by using a RH sensor (DHT11, MICROPIC) and a microcontroller (ATmega328) based control system. The temperature and RH of the empty dehumidified room was recorded at 5 minute intervals and the water condensate from the evaporator was collected for 1 hour. The variation of moisture content of rice and chilli was observed in thin layersand in a vertical column (2.5 m) ventilator inside the dehumidified room. After 65 minutes of operation, the relative humidity of the empty store room was 16% and the room temperature was 30 ^{0}C. The specific moisture extraction ratio was 1.9 for condensing water in the empty space. The average moisture content of rice was decreased from 13% to 11% w.b. after 28 hours and average moisture content of chilli was decreased from 12% to 5% w.b. after 22 hours of drying under closed cycle heat pump drying system.

Keywords: Drying, heat pump, dehumidification

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Design and Development of a Fresh Pineapple (*Ananas comosus* L.) Incorporated Yogurt

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This study was conducted to assess the suitability of incorporating pineapple chunks into yogurt without changing the physico-chemical, nutritional, microbial and sensory qualities. Three types of pineapple chunks were used as treatments to develop the pineapple incorporated set yogurt. Fresh pineapple chunks, osmotically dehydrated chunks (in 60% (w/w) sucrose solution) and oven driedpineapple chunks (at 60 ^{o}C) were used as three treatments. All three types of chunks were steam blanched as a pretreatment prior to use. Fresh pineapple chunks were only steam blanched without any further treatment. Amount of fat (%), protein (%), ash (%), moisture % (wb), carbohydrate (%), pH, syneresis (%), total soluble solids (TSS%) and viscosity (mPa.s) of yogurt samples were analyzed. Values of pH,syneresis, TSS and viscosity were analyzed in two day intervals upto 14 days. Sensory evaluation was done by using hedonic test for the yogurt and microbial analysis was done to assess yeast and mold counts. Moisture and carbohydrate contents of three samples showed significant differences ($P<0.05$). Value of the pH of three samples decreased during 14 day storage period and syneresiswere also increased significantly ($P<0.05$). Viscosity of all three samples showed lower values than the normal set yogurt and lowest viscosity was reported from the steam blanched fresh pineapple incorporated yogurt sample. According the sensory results, higher overall acceptability was obtained by both osmotic and oven dried pineapple incorporated samples. Yeast and mold counts were higher than the acceptable level set by the Sri Lanka Standard Institution. However, the result of this study demonstrated that osmotic dehydrated and oven dried pineapple chunks can be successfully incorporated into set yogurt without affecting the quality characteristics and consumer acceptance of set yogurt with treatments to suppress growth of yeast and mold.

Keywords: Physico-chemical parameters, Pineapple chunks, Sensory qualities, Set yogurt

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Design and Development of a Web-Based Management System for International Food Safety Standard

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With the development of the communication technology, many utilize internet as a marketingtool. Web-based management systems are using by many organizations in the world to manage large volume of information within a short period of time. This has been identified as the most efficient data management system in the world. Food safety system introduced by British Retail Consortium (BRC) is used by many food producers and dealers all over the world which provides standards for food safety, food quality and operational criteria required to manage food manufacturing organizations. BRC system contains many obligations with regard to legal compliance and protection of the consumer. However regular maintenance and implementation of the BRC requirements are very important. It should be conducted in a convenient and effective way to enhance the efficiency of implementation process of food safety standards. One of the best solutions for this is the adoption of the web based management system. In Sri Lanka, there is no such system to manage food safety standard in the food processing industries at the moment. Most important requirements of a food safety standard are auditing, training, documentation and traceability. This web-based food safety management system was developed to achieve all such basic requirements. In addition, this system has improved features of auto event reminder system, gap analysis, one to one communication, easy documentation process and a document sharing system. In order to develop this system, Adobe® Dreamweaver, Adobe® Photoshop and Wampserver® software and HTML, CSS, PHP, Javascript® web development languages were used. This web system was uploaded to the World Wide Web via "hjsbrcgloble.6te.net". Therefor registered user can log in to the system from anywhere in the world. Using this web-based system, any organization can easily improve their food safety standards, while saving the cost of documentation process and time.

Keywords: BRC, Food safety standard, Web-based management system

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Design and Development of an Engine Driven Machine for Land Preparation and Weeding in Small Paddy Fields

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Weed management is one of the most important operations in paddy cultivation. In Sri Lankan hilly regions land surfaces are high sloped and paddy farmers cultivate those lands by making terraces. Adoption of large or medium machine for weeding or to land preparation is impossible in these areas and farmers do manual weeding. Because of labor costs, time and tedium, manual weeding is unfavorable and introduction of chemical weed control methods has alleviated these undesirable factors. However, the emergence of herbicide-resistant weeds, environmental impact and increasing demand for chemical free foods has led to investigations of alternative methods of weed control.This study was conducted to Design and development of a small scale weeder powered by a small 2stroke gasoline engine, compatible for 18cm line spacing with an adjustable mechanism to adjust the soil cutting depth and suitable for hilly regions paddy land condition in Sri Lanka. Machine was fabricated by using low weight materials and frame was decided to minimize the weight while maintaining the strength and high efficient soil cutting blades were used for better weeding.Fabricated machine was 19kg in weight which can be carried by a single farmer from one paddy field to another and having complete weeding with 330 working rpm on rotary blades in to 3" depth and 1500 engine rpm. Also the total cost of production was Rs.18000.00. So this low weight and low cost single farmer operated machine can be used to weed in hilly sloped paddy lands to save the time and increase the weeding efficiency instead of doing manual weeding.

Keywords: Mechanical weeder, Inter-raw weeder, Paddy weeder, Hill country paddy farming

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Design and Development of Multi-store Constructed Wetlands for Wastewater Treatment

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One of the limitations for using Constructed Wetlands for wastewater treatment is the large land area requirement. In this study, to increase land use efficiency, the performance of small vertical multi-store constructed wetlands (MS-CWLs) in greenhouse was investigated. Three plastic containers (55x30x30 cm) were stacked one over the other in an iron frame with the vertical gap of 80 cm between containers. Emergent (Vetiver*)*, floating (Water hyacinth) and submerged (Hydrilla) were used in upper, middle and lower units, respectively. These units were connected to send wastewater continuously from upper unit. Two set of MS-CWLs were prepared and kept one inside a greenhouse while the next one outside the greenhouse. Both MS-CWLs were continuously fed by synthetic wastewater at flow rate 1.25 ml/s for one month. After first month, both system was kept under greenhouse and additional light was provided for one set of MS-CWLs for one month. Influent and effluent samples were taken and analyzed for BOD_5, COD, nitrate and phosphate. Plant growth is also monitored in both conditions. The BOD_5 , COD, Nitrate and Phosphate removal efficiency of MS-CWLs in greenhouse were 80.9, 76.5, 75.6 and 76.5%, respectively. The BOD_5, COD, Nitrate and Phosphate removal efficiency of MS-CWLs kept outside were 66.6, 74.7, 70.2 and 74.4 %, respectively. The BOD_5, COD, Nitrate and phosphate removal efficiency of MS-CWLs with light were higher, 85.7, 81.8, 83.3 and 85.9 %, respectively compared to that of without light. The Vetiver plant had a higher growth rate compare to the other two plant types. BOD_5, COD, nitrate and phosphate removal per unit land area in inside greenhouse with light was 5454.6, 3721.2, 40.7 and 41.6 mg/l/m^2. Thus it can be concluded that MS-CWLs can be used for high removal efficiency land area in greenhouse with supplementary light system.

Keywords: Constructed wetlands, wastewater, greenhouse, light

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Design and Development of Solar Powered Hot and Cool Twin Chambers by Using Peltier Plates

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Domestic level refrigerators and ovens are used separately for cooling and heating using electricity. Some foods need to be kept in cool while other food items require hot environment for consumption. But refrigerators and ovens are less efficient in term of energy consumption, space usage and with high cost. Therefore, this study was conducted to designa combined cool and hot chamberspowered by solar energy. Even though inefficient in terms of power consumption, peltier plate heats up one side and cools down the other side simultaneously, without making any noise, and therefore it was selected and powered by a solar cell. Two chambers with a common center wall were fabricated. All walls were well insulated using 2.5cm thick polystyrene sheets. Peltier plate with heat sinks and blowers on either side was placed near the top center of the center wall. The DTH11 sensors were placed inside the chambers to measure temperature by an Arduino Uno microcontroller and same time it is used to control 12 V DC supply for the peltier plate to maintain required temperature inside the cool chamber. Results shows that, the temperature inside the cool chamber did not drop down significantly while that in the hot chamber kept on increasing gradually. Even though temperature in the cool side reduced initially, the heat from the hot side transferred to cool side making the system unusable.An energy dissipation mechanism at hot side may solve the problem. In addition, the design parameters also can be improved.

Keywords: Peltier plate, solar cell, DTH11 sensors, Arduino Uno microcontroller

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Design of a Full Scale ICFiWet System for Black Water Treatment: Case Study at Royal Botanical Gardens, Peradeniya

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Effective and efficient treatment of black water from public places that generate excessive quantities of wastewater is an important and urgent issue to be solved. This study aimed at designing and construction of full scale, Integrated Charcoal Filter Constructed Wetland (ICFiWet) system for treating black water generated from public toilets at Royal Botanical Garden in Peradeniya. The ICFiWet system was designed as a cost effective secondary treatment method to further purify the effluent from the primary treatment soakage pit. This system has showed excellent performances for grey water treatment during previous studies; therefore the new full scale system was up scaled using kinetic parameters obtained from the kinetic modeling. The proposed ICFiWet system is consisted of three components; up-flow anaerobic sludge blanket, charcoal granular media and a subsurface flow constructed wetland system. The system was designed with 3 m height and 3 m diameter to match with site specific location and soil conditions. Constructed wetland component was placed on the top, 1 m above the ground surface. The structure of the system was designed to be constructed with reinforced concrete and masonry bricks walls. Wastewater enters to the bottom of the reactor and flows in an upward movement through charcoal granular media to the constructed wetland system. *Typha angustifolia* was selected as the wetland plant considering growth characteristics, tolerance to the nutrient loads, shade of the area, invasiveness and the aesthetic appearance of the design. The standard engineering drawing for the constructions was prepared by using AutoCAD software and the standard estimates with the construction specifications were prepared. The preliminary site works has already started and construction will be commenced. The influent and effluent water quality should be monitored and evaluated to verify the design objectives and also to meet the effluent discharge limits.

Keywords: Black water, charcoal, constructed wetland, up flow anaerobic sludge blanket

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Developing and Testing a Television News Format to Disseminate Agricultural Information in Sri Lanka

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Even though television is a powerful medium which is appealing to mass audiences, the usage of television to deliver timely information to agricultural communities still remains low. At present, over 79% of rural houses and 100% of urban houses have television sets. This research was conducted to develop and test an agriculture related "news segment" for a leading television channel which may be used as a model- format in telecasting agriculture news in future. A design and development research approach (Peffers etal., 2007) was adopted. Accordingly, the study was conducted following six stages namely; identifying the problem, describing the objective, designing and development, testing, evaluating test-results, and communicate the testing results. During the stage 2, data were collected using a content analysis and eight key informant discussions. An online questionnaire (n=15) and aself-administered questionnaire (n=24) were used during the evaluation stage to obtain the feedback of experts and farmers respectively. Data were analyzed manually as well as using SPSS and online report generating methods. Two news segments were produced and telecasted during the testing stage. Majority (86%) of experts believed that the particular news segment motivates people to explore further about the news topic and about 54.2% of the farmers confirmed that. Respondent farmers were interested in the news clip (79.2%), mentioned that they wish to share the news with others (45%), and stated that the news segment updated their knowledge on new practices (100%). The experts mentioned that it is possible to get sponsorship from commercial organizations (80%). The most suitable time belt to telecast agriculture news was between 7.00 p.m. -8.00 p.m. according to the farmers. Finally, it can be concluded that news space of the television media can be effectively utilized to communicate agricultural information to farmer communities.

Keywords: Agriculture News, Television, Mass Media, Design & Development Research

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Development and Use of Temperature Humidity Index for Cattle Types in North Western Province, Sri Lanka

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Though dairy production in North Western province has a considerable contribution to GDP in Sri Lanka, there is still potential to improve the dairy sector in the province. In this study the effect of heat stress on milk production of cattle reared in North Western Province was assessed by using temperature humidity index (THI). Effect of heat stress was measured on four commonly reared cattle types, namely Friesian × Sahiwal, Jersey × Sahiwal, Sahiwal × Local and Pure Sahiwal. Daily dry bulb temperature, maximum temperature and relative humidity data from year 2006 to 2015 were collected from five meteorological stations in the province. These data were used to identify and map (ArcGIS 9.3) the THI variation within the province. Milk yield data of different cattle types was collected from 40 farms. According to average THI values of meteorological stations, Batalagoda possessed the least THI value (79.12±0.26), and Wanathawilluwa possessed the highest THI value (82.45±0.68). The threshold maximum temperature values for milk production were estimated as 32°C, 33°C, 33.5°C and 34°C for Friesian × Sahiwal, Jersey × Sahiwal, Pure Sahiwal and Sahiwal × Local genotypes, respectively. According to the THI mapping and the threshold values, the most suitable areas for rearing the four commonly found cattle types were identified and suggested. Accordingly, Friesian × Sahiwal was suggested to Mid and Low Country Wet Zones, Jersey × Sahiwal to Mid and Low Country Wet Zone and Low Country Intermediate Zone areas, Sahiwal for almost all the areas except some Low Country Dry Zone and Sahiwal × Local to Low Country Dry Zone and Intermediate Zone areas. The study revealed that THI and the production parameters of the cattle type could be used in identifying the areas suitable for rearing different cattle types in the province

Keywords: North Western Province, heat stress, milk production, temperature humidity index

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Development of a Canned Fish Product Using Cured Indian Oil Sardine (*Sardinella longiceps*)

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Indian oil sardine (*Sardinella longiceps*) is one of the most abundant marine fishes found in Sri Lankan coastal fishing grounds. Though this nutritionally rich, inexpensive and fish is harvested throughout the year in large quantities, they have not been widely used in local processed seafood industry to develop value added products. There is a high demand for canned fish products among Sri Lankans and this study was aimed to develop a low cost canned fish product using Indian oil sardine with a high nutritional value and a longer shelf life. Whole Indian oil sardines were eviscerated, and their inedible parts were removed prior to processing. Then the fish was cured by dipping them in 12% brine and 2% *Garcinia indica* ("goraka") mixture (ratio, 1:1) at a ratio of 1:3 (fish: curing mixture) for 30 minutes. Then, the cured fish was canned in 2% brine solution with different herbs or condiments and retorted. Prototype was developed using three independent trials. Sensory test was performed for the developed canned fish products using an untrained set of panelists and statistical significance was determined using Kruskal-wallis test method. The canned fish prepared using cured Indian oil sardine with lemon grass was preferred significantly ($P<0.05$) compared to all the other canned fish types prepared adding other condiments. Proximate composition of the above most preferred canned fish product was; moisture 69.74%, ash 2.50%, fat 8.20% and protein 22.33%. Salt percentage and pH of the product were 2.25% and 5.97 respectively. The above product can be considered to further develop into a commercially viable, low cost product for Sri Lankan consumers.

Keywords: Curing, Lemon grass, Proximate composition, *Sardinella longiceps* (Indian oil sardine)

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Development of a Cordial from Tomato *(Lycopersicon esculentum)*

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Tomato *(Lycopersicon esculentum Mill.)* is produced in Sri Lanka in large quantities during season where post-harvest losses get increased. Tomato is a good source of energy and it consists of vitamins and minerals. Tomatoes are edible only for a very short time period unless properly preserved. Production of value added products such as cordial can prolong the shelf life of the perishable fruits and maintain the availability throughout the year. New technologies can be used to prepare cordial from tomatoes. Well-ripened fruits were selected to prepare the cordial and seeds were removed as they were known to incorporate a bitter taste to the product. Three cordial samples were developed according to Sri Lankan Standards by only changing the concentration of xanthan gum (stabilizer) i.e. 0.3%, 0.4% and 0.5% and labelled as 472, 321 and 845 respectively. Each sample consisted of 25% pulp, 20% sugar, 55% water, 0.035% sodium metabisulphite (SMS) and 0.45% citric acid. Prepared samples were subjected to sensory evaluation (5-point Hedonic scale test) using 20 semi-trained panelists, and the sample which contained 0.5% of xanthan gum was selected as the best sample. The selected sample had pH 3.4, brix 42 ^{o}, titratable acidity 1.2%, fruit content 25%, total solid 42.16%, total sugar 27.73%, polyphenol content 0.0025 mg/ml GAE, and ascorbic acid content 32.42 mg/100 ml. Shelf life evaluation was conducted by using microbiological tests, physico-chemical analysis and sensory evaluation. The product was found to be stable for a period of one month.

Keywords: Xanthan gum (stabilizer), Sodium metabisulphite, Citric acid, Polyphenol content, Sensory evaluation

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Development of a Cost effective Milk Replacer for Orphaned Puppies

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There is high demand for canine milk replacer in the Sri Lankan market though it is a very rare and expensive product. In this study, a cost effective canine milk replacer was formulated as an alternative to mother's milk for orphaned puppies before weaning by dam. Skim cow milk, cream, full cream milk powder and soy milk were used as ingredients. Soy milk was extracted from soybeans which were soaked in alkaline water. Soybeans were ground with water in 1:1, 2:1 and 3:4 ratios (v/w) and warmed at 80°C for 15 minutes. The feed was formulated to have the same nutritional composition of fresh canine milk (77.2% moisture, 8.1% protein, 9.8% fat, 3.5% lactose, 0.28% Ca and 0.22% P). The UHT treated (121°C for 15 minutes) product was stored under room temperature (27°C) and subjected to analysis of nutrients. The determined nutritional values were compared with those of canine milk. Keeping quality under storage at 27°C was determined weekly for 3 weeks. As indicators of keeping quality, total plate counts (TPC), Coliform and fungus or moulds were analysed. The palatability was evaluated by observing the feeding behavior of puppies (7 days old) and the cost of production of the feed was compared with the price of commercial canine milk replacer. Of the three combinations tested, the product mixed in 2:1 ratio was found to be the best which had no significant difference ($P<0.05$) in crude protein, crude fat, lactose, calcium and phosphorus contents when compared with canine milk. There was a decreasing trend in pH during the storage period, but there was no significant increase in microbial counts during the storage periods. The present study revealed that the soy milk incorporated product mixed in 2:1 ratio is a palatable, low cost, good alternative to mother's milk for orphaned puppies.

Keywords: Canine milk replacer, Low cost, Orphaned puppies, Palatable

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Development of a Functional Pasteurized Dairy Beverage with Higher Antioxidant Activity by Incorporating Native Nelli (*Phyllanthus embilica* L.) Fruit Extract

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The objective of this study was to determine the total antioxidant activity (TAA) and total phenolic content (TPC) in selected indigenous underutilized fruits extract under room temperature (RT) and pasteurizing (PT) & sterilizing (ST) temperature treatments, and to develop a functional pasteurized milk beverage with higher antioxidant activity by incorporating the most suitable fruit extract. Samples of five selected underutilized fruits; Nelli (*Phyllanthus embilica* L.) (Matale selection), Pomegranate (*Punica granatum* L.) (Nimali), Guava (*Psidium guajava* L.) (Horana red), Katu anoda (*Annona muricata* L.), Woodapple (*Limonia acidissima* L.) collected from the Fruit Research and Development Institute, Department of Agriculture, Gannoruwa and home gardens in Central Province were analyzed for TAA and TPC using 2, 2-diphenyl-1-picrylhydrazyl (DPPH) and Folin-Ciocalteu method, respectively. The fruits had a wide range of TAA in terms of DPPH value at three different temperature treatments. It was revealed that except for pasteurized temperature (0.9221±0.003), Nelli extract scored the highest DPPH value in mg GAE/L at room temperature (0.9285±0.03) and sterilizing treatment (0.8952±0.002) while the highest TPC at all three temperature treatments (RT-26854±363.26, PT-35591±492.43, ST-30720±451.99 mg GAE/L). TAA of Nelli, Guava, Pomegranate extracts significantly were affected ($P<0.05$) by the temperature treatments while that of Katu anoda and Woodapple extracts were not significantly affected ($P>0.05$) by temperature treatments. TPC of Nelli, Guava, Woodapple, Pomegranate extract significantly were affected ($P<0.05$) by all temperature treatments except that of Katu anoda extract. In addition, pasteurized milk incorporated 5% nelli extract showed highest scores for all five organoleptic attributes at the sensory evaluation, qualifying as the best functional beverage. Based on the TAA &TPC related and the sensory evaluation data, it can be concluded that the pasteurized dairy beverage incorporated with 5% native Nelli extract is the most suitable functional dairy beverage to be introduced for Sri Lankan market.

Keywords: Functional pasteurized milk beverage, underutilized fruits, total antioxidant activity, total phenolic content, heat treatments

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Development of a Green Colour Chicken Sausage

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At present consumers willing to buy sausages which are free from curing salts, artificial colorings and flavoring agents. This study was done to develop a green colour chicken sausage by incorporating green colour fresh spices without adding curing salts, artificial colorings and flavoring agents. Five different recipes were developed by trial and error method and most preferred recipe was selected from a sensory evaluation test. Sensory evaluation test revealed that panelists preference for odor, texture, overall acceptability and overall preference of second recipe (1% of each curry leave, parsley, green chili and 0.5% of each coriander leave, clove leave, onion leave integrated) was significantly higher ($P<0.05$) than others. Further study was conducted to evaluate keeping quality, microbial properties and proximate composition of green sausage. Total plate count (TPC), shear value, pH, color, water holding capacity (WHC) and 2-thiobarbituric acid reactive substances (TBARs) were measured during the storage period at -18^{o}C for 4 weeks. Crude protein and crude fiber contents were significantly higher ($P<0.05$) in green sausages when compared to that of control samples. There was no significant difference ($P>0.05$) in pH and WHC between green sausages and control samples. TBARs values and TPC were significantly higher ($P<0.05$) in green sausage than the control. pH value of green sausages and control samples were significantly reduced ($P<0.05$) during the storage. WHC and shear values were not significantly changed ($P>0.05$) during storage in both samples. TBARs and TPC values were significantly increased ($P<0.05$) during storage in both green sausages and control samples.

Keywords: Green colored chicken sausage, curing salt, artificial coloring agents

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Development of a Healthy Noodle by Incorporating the Low-fat Residue of Virgin Coconut Oil

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Virgin coconut oil (VCO) is a value-added coconut product having a high demand all over the world. The residue after the extraction of VCO is rich in nutrients and dietary fiber, which can be used to produce coconut flour. There is a huge potential to substitute some proportion of coconut flour for wheat flour in food production. The objective of this research was to develop a healthy noodle by incorporating the low-fat residue of VCO. The proximate analysis of the flour made from VCO residue indicated 4.83±0.4% moisture, 1.71±0.77% ash, 9.2±0.61% crude protein, 19.78±1.67% crude fat, 44.15±0.84% crude fiber and 64.2±1.57% total carbohydrate content. Three sensory evaluations were conducted by changing the type of binders (CMC, xanthan gum, guar gum), amounts of binder (0.2%, 0.4%, 0.6%) and coconut: wheat flour ratios (30:70, 40:60, 50:50). By analyzing the results of sensory evaluations, the formula having 0.4% guar gum and 40% coconut flour was selected as the best combination. Physico-chemical characters, cooking characters and textural characters of developed noodles were evaluated and compared with a control (100% wheat flour noodles). Coconut flour (40%) noodle had 10.08±1.5% moisture, 3.32±0.1% ash, 10.25±0.1% crude protein, 5.4±0.1% crude fat, 6.05±0.5% crude fiber and 70.95±3.0% total carbohydrates. Storage study was conducted in noodle samples prepared with and without an antioxidant (vitamin E), packed in low density polyethylene and triple laminated aluminiumfoil packages. The moisture and free fatty acid contents during 4 weeks of storage were within the Sri Lankan standards and the microbial analysis assured the safety of the product. The noodles made with vitamin E and packed in aluminium package showed the least compositional changes during storage. It can be concluded that 40% of wheat flour can be replaced by coconut flour made from VCO residue in developing a health-beneficial noodle.

Keywords: Antioxidant, Binders, Coconut flour, Noodles, Virgin coconut oil

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Development of a Naturally Flavoured Coconut and King Coconut Water Beverage

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Coconut (*Cocos nusifera*) water is a natural beverage obtainable in sterile condition. It has less fat and sugar, more minerals and vitamins. Other than a beverage it is used as a raw material for the production of wine and vinegar, for medicinal applications, as a dietary supplement and as a plant growing medium. Thermal treatments such as pasteurization, sterilization and chilling, and non-thermal treatments such as membrane filtration and high pressure treatments are applied for preserving coconut water as well as king coconut water. Main problems of coconut water are enzymatic browning due to polyphenol oxidase, peroxidase enzymes and rapid deterioration. This research was applied to develop a naturally flavoured coconut and king coconut water beverage. The selected flavours were ginger and mint.The main problems of this product development were the precipitation of the coconut and king coconut water mixture after thermal processing and pinkish brown discoloration. Those were reduced by centrifuging coconut and king coconut water mix followed by filtering. However, centrifugation and heat treatments affected the K and Na concentrations.The products were analyzed for pH, total soluble solids, Na and K levels. Sensory preference for the product made with different concentrations based on overall acceptability was evaluated by ranking tests. Analysis of sensory data showed that there is a significant difference ($p<0.05$) among the 4 different concentrations.

Keywords: Beverage, Coconut, Ginger, King coconut, Mint

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Development of a Non-Dairy Condensed Milk Using Creamed Coconut and Soy Milk

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This study was aimed at developing a non-dairy, sweetened condensed milk for the vegans. Three different ratios of creamed coconut and unflavoured soy milk (100:0; 75:25; 50:50 w/w) were trialed initially. Sucrose concentration and moisture content of the products were kept constant at 43.3±2.5% and 36.8±1.8% w/w, respectively. For this purpose, heating time was prolonged with the increase of soy milk content, without varying the temperature (64±2°C). The fat content of creamed coconut was reduced from 65.6±0.8% to 29.6±6.8% w/w by centrifugation before mixing with soy milk to increase the oxidative stability of the final product. Among the trialed ratios, product made with 75:25 creamed coconut:soy milk was preferred for its taste over the others, and had the highest overall acceptability ($p<0.05$). This product was selected and assessed for its proximate composition and shelf-life stability. Crude protein, crude fat and ash contents of the product were 7.3±0.8%, 1.2±0.2% and 0.6±0.4%, respectively. Fat content of the product was comparable to the local standard level (SLS) set for the sweetened condensed milk made with skimmed cow's milk. Crude protein and ash content were lower than the set standards, and it was expected due to the compositional differences in creamed coconut and soy milk in comparison to cow's milk. Stability of pH and viscosity of the product was monitored over a period of 10 days. pH of the product dropped from 6.6 to 5.8 within that period, whilst the viscosity remained stable at 5600±440 cP (days 4-10). Microbial safety and its usability as an ingredient in selected food products will be assessed during the next step of this study.

Keywords: Condensed milk, Creamed coconut, Physicochemical parameters, Sensory analysis, Soy milk

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Development of A Wellness Drink Using Tamarind (*Tamarindus indica* L.) and other Locally Available Health-Beneficial Plant Extracts

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This study was conducted to develop a non-carbonated soft drink with tamarind (*Tamarindus indica* L.) and other ingredients which possess medicinal and therapeutic properties, while maintaining optimum physico-chemical, microbiological and sensory properties without the addition of any artificial flavourings, colourants and preservatives. Some spices, cumin (*Cuminum cyminum* L.), black pepper (*Piper nigrum)* and ginger (*Zingiber officinale)* were used as other major constituents. Tamarind has been commonly used in traditional indigenous medicine for many ailments. It is known as an effective remedy for digestion problems, blood pressure and considered as a carminative, expectorant and laxative fruit. Tamarind pulp was extracted with water at ambient temperature (Tamarind: water =1:2) while cumin, pepper and ginger were extracted using hot water (80 °C, 10 minutes). The pulp, spice extract, steviol glycosides (sweetener) and salt were mixed with water and after bottling, the product was pasteurized at 85 °C for 20 minutes. According to the sensory analysis, the drink with 5.5% tamarind pulp, 4% spice extract and 150ppm steviol glycosides concentration acquired the highest preference. Titratable acidity 1.2%, pH 3.2, total soluble solids 4.5%, proteins 0.28%, total fats 0.0% and minerals 7.6% were resulted in the final product by the physico-chemical analysis. The IC_{50} value for the product was 1.83 µl/ ml. The physico-chemical analysis proved that the drink can be marketed within the green label for both sugar and salt levels described by the Ministry of Health in Sri Lanka. The storage study conducted for 12 days revealed that total plate count and yeast & mold counts remained under acceptable levels set by the SLSI until 10th day of storage. Prepared wellness drink possesses acceptable quality characteristics and sensory properties that fulfill the required standards.

Keywords: Tamarind, Cumin, Black pepper, Ginger, Steviol glycosides

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Development of an Instant Herbal Extract

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Herbal extracts commonly consumed in Sri Lanka contain bael flower, black pepper, cardamom, ginger, *Gotukola*, cinnamon, clove, licorice, coriander, *Ranawara* and *Venival*. Main objective of this study was to develop an instant natural herbal powder with a considerable shelf life. The herbal blend weight was calculated according to the volume of standard tea cup. Preliminary trials were conducted to select the blend weight per standard cup and three weights (35 g, 55 g and 75 g) were selected. The herbal blends were brewed for five minutes in 100°C water and three extracts were spray dried separately under similar conditions. Three spray dried powders were assessed for color, viscosity, moisture content, particle size and particle density. Sensory evaluation carried out using 30 untrained panelists for the selection of best concentration. Chemical parameters were analyzed for the spray dried powder which was selected from the sensory analysis as comparison with dried fine cut of herbal extract and a selected commercial sample. Chemical parameters were measured were Total phenolic content and DPPH free radical scavenging capacity.Statistical analysis was done by SAS University edition and from the IBM SPSS statistics 20. Viscosity, moisture and particle density increased in the spray dried powder with the increasing concentration. Particle sizes of the spray dried powders were decreased with the increment of concentration and the color was not significantly different ($p<0.05$) among three powders. The most preferred sample was 35 g/cup according to the results of sensory analysis. Total phenolic content was comparatively high (17.92±0.01GAE mg/dry weight) in spray dried powder and the free radical scavenging capacity was comparatively high (12.77±0.02mg/ml) in spray dried powder. Addition of 10% maltodextrin to the extract increased the product recovery up to 51.3%.

Keywords: Free radicals, Instant, Maltodextrin, Spray drying, Total phenolic content

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Development of Coconut Milk Incorporated Yoghurt: A Possible Value Addition to Coconut Milk

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This research was aimed at developing a coconut milk incorporated yoghurt as a novel product for the local consumers. Coconut milk contains a higher amount of fat (~25-30%) and a lower amount of proteins (~2-3%), thus cannot be used directly or alone for the manufacturing of yoghurts. During this study, efforts were taken to identify the maximum level of coconut milk that can be incorporated into skim milk for the production of yoghurts with acceptable sensory properties and shelf-life stability. Fat content of coconut milk was reduced by centrifugation to 5% and 10%, and trials were carried out using both levels. Reduced-fat coconut milk was mixed with skim milk at three different ratios (25:75; 50:50 and 75:25) and set yoghurts were made using a standard procedure. A sensory analysis conducted using 30 untrained panellists revealed that the yoghurts made with the lowest ratio of coconut milk had the highest overall acceptability for both fat contents. However, the yoghurts made with 5% fat coconut milk had a firmer texture in comparison to those made with 10% fat coconut milk. Yoghurts made with 5% fat coconut milk were chosen for proximate and microbial analyses. Crude fat content, ash content and total solids of the yoghurts increased with the increase of coconut milk ratio, while crude protein content was reduced. This was attributed to the higher fat content and lower protein content of coconut milk in comparison to those of skim milk. Yeast and mould count was obtained at weekly intervals for the assessment of microbial safety of the yoghurts. Yoghurts made with 25% and 50% coconut milk had counts less than 1000 CFU/g, falling below the maximum level set by local standards (SLS). However, the yoghurt made with 75% coconut milk had 1030 CFU/g after the second week.

Keywords: Yoghurt, Coconut milk, Skim milk, Physicochemical analysis, Sensory evaluation

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Development of Dietary Coconut (*Cocos nucifera*) Fibre and Yeast Extract Incorporated Chicken Sausages

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Incorporation of dietary fibre into sausages can make it healthy. The present study was conducted to investigate the use of dietary coconut (*Cocos nucifera*) fibre as a vegetable oil replacer in oil emulsion used in chicken sausages. Thirty% (T1) and 50% (T2) of vegetable oil in the oil emulsion was replaced with coconut fibre and sausages were manufactured, and compared with the control. Sensory evaluation results revealed that the appearance, colour, aroma, taste, texture, saltiness and overall acceptability of T2 were lower ($P<0.05$) than that of T1 and the control. The taste and overall acceptability of T1 was lower ($P<0.05$) than those of control indicating negative effects of fibre enrichment. Treatment 1 (30% fibre) was selected for further developments with yeast extract as a flavor enhancer. The second study was conducted with T1, 30% coconut fibre in oil emulsion+0.2% yeast extract (T3), 30% coconut fibre in oil emulsion+0.4% yeast extract (T4) and the control. The proximate composition, color, shear value, pH, water holding capacity (WHC) and 2-thiobarbituric acid reactive substances (TBARs) were measured for 4-week storage at -18 °C. Sensory evaluation results revealed that the taste and aroma were higher ($P<0.05$) in T4, compared to T1, T3 and the control. Crude fat content is lower ($P<0.05$) in T1 (12.21±0.6%), T3 (12.82±0.4 %) and T4 (12.75±0.7%) compared to the control (14.18±0.7%). Though, the lightness and shear values were higher ($P<0.05$) in T4 than all other samples, the sensory evaluation did not reveal that. The pH, WHC and TBARs values were not different ($P>0.05$) among 4 treatments. Overall results revealed that T4 is the best product with incorporated coconut fibre. Thus 30% vegetable oil replacement in oil emulsion with coconut fibre and addition of 0.4% yeast extract can be used to produce consumer acceptable coconut fibre incorporated chicken sausage.

Keywords: Dietary coconut fibre, chicken sausages, fat replacement, yeast extract

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Development of Dietary Fiber Rich Biscuits Using Selected Sri Lankan Banana Varieties

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Unripe banana flour (UBF) is gaining a growing recognition in food industry as a gluten free replacement to wheat flour and as a good source of dietary fiber. This study was focused on identifying the potential of incorporating UBF, prepared from three selected Sri Lankan banana varieties namely; *Ambul*, *Embun* and *Kolikuttu*, in developing dietary fiber rich biscuits with better sensory and nutritional properties. Considering the reported similar studies, biscuit samples were formulated incorporating 50% and 60% UBF of each variety. According to the results of sensory analysis data conducted involving trained panelists, the preference for 50% flour incorporated biscuits developed with UBF of all three varieties were higher compared to those of 60% UBF. However, a significant difference ($p<0.05$) was found only between the preferences for the 50% and 60% of *Ambul* flour incorporated biscuits. Considering this significant difference and comparatively higher preference for biscuits developed incorporating 50% flour of other two varieties, biscuits prepared by incorporating 50% of UBF of all three varieties were selected as most preferable biscuits among the tested samples. According to the consumer test, there were no significant differences ($p>0.05$) among consumer preferences for the biscuits developed incorporating 50% UBF of all three varieties which indicates that the varietal difference does not greatly account for the preference of biscuits incorporated with UBF. Protein percentages of the biscuits developed incorporating *Kolikuttu*, *Embun* and *Ambul* flour were 7.8 ± 0.10, 8.1 ± 0.4 and 8.2 ± 0.1 while fat percentages were 10.0 ± 0.0, 11.1 ± 0.1 and 10.2 ± 0.1 and total dietary fiber percentages were 3.3 ± 0.4, 5.6 ± 1.3 and 5.3 ± 0.9 respectively. This study confirms the potential of incorporating UBF of *Ambul*, *Embun* and *Kolikuttu* varieties in developing dietary fiber rich biscuits with desirable sensory properties

Keywords: Biscuits, Dietary fiber, Unripe banana flour

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Development of Functional Yoghurt with Lunuwila (*Bacopa monneiri*) and Lecithin

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Functional foods improve the health and wellbeing by positively affecting one or more targeted functions of the body. Lunuwila (*Bacopa monneiri*) is a herb used in Ayurvedic medicine with numerous health benefits. Lunuwila and lecithin are reported to have cognition enhancement effect. This study was conducted to develop a functional yoghurt by incorporating lecithin and Lunuwila extract. The treatments of the first experiment were the incorporation of 100, 125 and 175 mg of lecithin per cup of set yoghurt. The three samples of yoghurt were evaluated based on preference for aroma, texture and flavour using 31untrained panelists and ranking tests. Results revealed that the amount of lecithin significantly ($P<0.05$) affected the preference for aroma and flavor but not texture. The sample containing 100 mg of lecithin per cup was selected and used for the second experiment which included 100, 125 or 175 mg of Lunuwila extract added set yoghurts per cup. The three samples of yoghurt were evaluated based on the preference for color, aroma, flavour and overall acceptability using 36 untrained panelists. Results revealed that the amount of Lunuwila extract significantly ($P<0.05$) affected the preference for aroma, flavour and overall acceptability but not colour. The sample containing 125 mg of Lunuwila extract per cup was selected as the final product. The final product and the control (plain yoghurt) were analyzed for pH, titratable acidity, synersis and water holding capacity for 28 days of storage. There was a significant difference ($P<0.05$) between them in synersis and water holding capacity, but not pH and titratable acidity. Yeast and mold counts were within acceptable levels in both samples over the storage period. Shelf-life assessment using physicochemical and microbiological parameters revealed that the lecithin and Lunuwila extract incorporated set yoghurt was acceptable for 28 days at 4 °C.

Keywords: Functional foods, Yoghurt, Lecithin, Lunuwila (*Bacopa monneiri*), Physicochemical characteristics

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Development of Mango (*Mangifera indica* L.) Pulp Incorporated Drinking Yoghurt

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Drinking yoghurt is categorized under stirred yoghurt. Market demand of drinking yoghurt can be improved by developing novel forms with different flavours. Mango (*Mangifera indica* L.) is one of the seasonal fruit. The consumer preference for mango based product is higher due to nutritional value and unique taste. Mango pulp possesses stabilizing ability, therefore without adding gelatin drinking yoghurt can be produced. Physicochemical analysis was conducted for raw milk, mango pulp and final product to confirm the suitability. Mango pulp: drinking yoghurt ratio of 8:92 was the best preferred combination and above mean score 5 (like) out of three treatments (4, 8 and 12 % w/w mango pulp) based on sensory evaluation performed using 7-points Hedonic scale. With regard to sensory attributes (aroma, colour, sweetness, sourness, texture and overall acceptability), there were no significant difference ($P>0.05$) among three treatments. There were significant difference ($P<0.05$) for overall acceptability based on ranking test among three treatments. Physicochemical parameters pH, acidity, total soluble solids and viscosity were determined during storage. Physicochemical parameters were within the acceptable range during the storage. Microbiological analysis revealed that up to 21 days this product safe for consumption. In final product, fat and protein percentages were 2.7 % and 2.3 % respectively.

Keywords: Drinking yoghurt, Mango pulp, Physico-chemical parameters, Sensory attributes

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Development of Palmyra (*Borassus flabellifer*) Pulp Incorporated Ceylon Moss (*Gracilaria edulis*) Jam

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Ceylon moss (*Gracilaria*) is rich in nutrients and contains a high amount of agar-agar. This study was to formulate and to develop jam incorporating Ceylon moss. In addition, palmyra pulp was used to improve the sensory properties of jam. The palmyra pulp is a good source of Vitamins A and C. Dried *Gracilaria edulis* was collected from Kalipiya area. Sun dried Ceylon moss was soaked in water for 15 min, drained and steamed for 10 min, followed by blending (10 min) to obtain the pulp. Formulation was done with ingredients: Ceylon moss pulp, palmyra pulp, citric acid and sugar. Pectin was not added because of jelling properly of the Ceylon moss pulp. Optimum Ceylon moss pulp content was determined based on four treatments (30, 40 , 50 and 60 %) without using palmyra pulp and the sensory evaluation based on flavor, colour, aroma, spreadability, sourness and overall acceptability (7 points Hedonic scale). The best Ceylon moss pulp content was 40 %. The Ceylon moss pulp content was replaced by incorporating different contents of palmyra pulp to enhance the color, aroma and flavor. It was found that the product with 24% of Ceylon moss pulp and 16% of palmyra pulp was the best combination. The pH, titratable acidity and total soluble solids in final product were 3.07, 1.04% and 65%. The developed *Gracilaria edulis* pulp and palmyra pulp incorporated jam consists of moisture 13.8 %, protein 0.59%, fat 5.23%, total ash 0.42% and total dietary fiber 4.89 % (w/w). The technologies developed in this research were applicable to use Ceylon moss economically and to develop commercial products of jam. Further animal based gelatin can be replaced by plant based ingredients, *Gracilaria edulis* pulp.

Keywords: Jam, Ceylon moss pulp, palmyra pulp, *Gracilaria edulis*

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Development of Quality Pig Manure Compost by Incorporation of Effective Microorganisms (EM) in Sri Lanka

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The objective of the present study was to find out the effect of Effective Microorganisms (EM) on the odor and quality of pig manure composting. Pig manure was composted with and without EM (2 treatments; 4 replicates/treatments) for a period of 60 days. Pig manure and sawdust were mixed (3:1); each 1kg of the above mixture was mixed with 10 mL of EM for composting. Physicochemical parameters were measured daily whereas carbon, nitrogen, volatile dissolved solids and minerals were measured every 10 days. In addition, a seed germination bioassay was conducted for a period of 6 days to assess the maturity of produced compost. Statistical analysis of physicochemical properties was carried out using Two-Sample T-Test whereas seed germination and particle size distribution data were analyzed using ANOVA in SAS package using Completely Randomized Design. According to the results, compost incorporated with EM had more ($P<0.05$) nitrogen (2.7%), phosphorus (0.9%), potassium (0.6%) and lower ($P<0.05$) zinc (0.07%) content compared to the compost without EM (nitrogen 2.1%, phosphorus 0.8%, potassium 0.5% and zinc 0.08%). Temperature of the compost with EM was stabilized on day 20 and reached a temperature of 27°C whereas compost without EM took more time (28d) to stabilize and reached a temperature of 26°C indicating less microbial activity in the control. Furthermore, pH (7.2), carbon (38.5%), volatile solids (59.5%) and C/N ratio (16.5) of compost with EM were lower ($P<0.05$) than the compost without EM. There was no odour in both composts, probably due to the small quantity of wastes in containers as well as due to frequent mixing. No significant difference ($P>0.05$) in particle size or seed germination bioassay was observed between two treatments. It can be concluded that Effective Microorganisms can be used efficiently to increase the quality of compost within 60 days of composting.

Keywords: Composting effective microorganisms, pig manure

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Development of Silica Gel Using Rice Husk and Evaluation of Its Application

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Rice husk was used to extract silicon, since it has very high silicon content. Therefore, this research was conducted to convert rice husk into silica gel by developing a process. Cleaned rice husk was burned in muffle furnace at 600°C for 6 hours to get ash. Ash was dissolved by potassium hydroxide (1.425 M, 150 mL) and heated for 20 minutes at 100°C. The solution was filtered and 5 mL of phosphoric acid was added to the filtrate to get the silica gel. Rice husk ash and the silica gel were analyzed for the parameters of pH, electrical conductivity, salinity, TDS, TSS and VS. Bio assay studies with different silica gel percentages were conducted to check the phytotoxicity of the silica gel. Prepared silica gel showed an alkaline pH of 9.59. First bio assay was failed and germination percentage of control treatment and treatment with 1% silica gel was 68% and 43%, respectively in second bio assay. Organic solution was prepared using CO-3 grass and analyzed for listed parameters. It was used to adjust the parameters of the silica gel. A mixture of silica gel and the organic solution was analyzed for different parameters for 7 days. The initial parameters of the mixture changed and reached static values. After 7 days, pH, electrical conductivity, salinity and TDS of the mixture were 9.59 to 8.56, 14.68 to 5.28 mS, 8.4 to 2.7 ‰ and 8,230 to 2,710 mg/L, respectively. Adsorption kinetics was applied to the mixture and 12.97 times transformation of TDS took place in the mixture. A huge portion of TDS transformed to available form. Different organic solutions can be used to check the TDS transformations and concentrated organic acid could replace phosphoric acid.

Keywords: Adsorption kinetics, rice husk, rice husk ash, silica gel, TDS

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Development of Sodium and Fat Reduced Chicken Bockwurst Sausages to Meet Food Regulatory Guidelines

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This study was conducted to develop low fat low sodium chicken Bockwurst sausages using citrus fibre, potassium chloride and sodium gluconate to match amber category of World Health Organization colour coding system for salt and fat. Initially, Sodium chloride was reduced in chicken Bockwurst to a level that is not affecting sensory attributes adversely. Secondly, the selected low salt level was totally replaced with comparable amount of commercial salt blend (1.19% to match with saltiness) containing NaCl and sodium gluconate and potassium chloride. Low fat emulsions were prepared by replacing 25% (T1), 37.5% (T2) and 50% (T3) vegetable oil with citrus fibre, and Bockwursts sausages were manufactured with commercial salt blend (1.19%). Sensory evaluation was performed using 10 trained panelists at week-1 using 5-point hedonic scale. Water holding capacity (WHC), 2-thiobarbituric acid reactive substances (TBARs), pH, texture, inner and outer colour were analyzed in one-week intervals for one-month of storage at -18 °C. The minimum level of NaCl that could be added to Bockwurst sausage was 1%. Added 1.19% commercial salt blend reduced the Na content of sausages by 48.26% compared to the original recipe. According to the sensory evaluation results appearance, color, aroma, taste, saltiness and overall acceptability of T2 were significantly higher ($P<0.05$) than T1, T3 and control. No significant differences ($P>0.05$) were observed in T2, with regards to WHC, TBARs, inner & outer lightness and outer redness. However, pH, outer yellowness and shear value of T2 were significantly differed ($P<0.05$) with time. T2 reported significantly low fat content and high fibre & moisture contents ($P<0.05$). Ash and protein contents were not significantly different ($P>0.05$). Thus 1.19% of commercial salt blend and 37.5% replacement of vegetable oil in emulsion with citrus fibre produce low salt, low fat Bockwursts sausages without hindering sensory attributes.

Keywords: Sodium, potassium chloride, citrus fibre, chicken Bockwurst sausage

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Development of Spice Cubes for Chicken and Fish Curries

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Production of Ready-to-use (RTU) spice cubes that provide all requirements of spices to make instant chicken and fish curries are potentially high demanded products among the consumers. The objective of this study was to develop RTU spice cubes using ground spices,(19 and 14 spices for chicken and fish cubes respectively), dehydrated vegetables (tomato, capsicum, garlic etc.) and other ingredients (vegetable oil and corn starch).The spice cubes were prepared with different levels of ingredients. Sensory evaluation was conducted to select the most acceptable formulations. Aroma, colour, taste, spiciness and overall acceptability of chicken and fish curries were evaluated subjectively using 30 untrained panelists. The formulations with the highest acceptance ($p<0.05$) were selected for further development. Developed RTU cubes were subjected to storage study. The spice cubes were packed in polyethylene terephthalate (PET) and cast polypropylene (CPP) laminated pouches. Hermetically sealed samples were stored at room temperature (28 ±2 °C).Free fatty acid (FFA) value, pH, moisture content, sensory properties and microbial quality were determined during the storage of one month. There were no significant changes ($p>0.05$) in pH, moisture and FFA value during the storage of one month. Total Plate (TPC) and yeast & mold counts of chicken and fish spice cubes were below the acceptable level. Therefore, the products are safe for consumption. The proximate composition of spice cube developed for chicken curry exhibited to have carbohydrates 64.02%, fat 24.22%, crude protein 7.44%, moisture 2.88%, ash 0.67% and crude fiber 0.59%. For the spice cube for fish curry; carbohydrates 59.47%, fat 23.94%, crude protein 7.5%, moisture 2.88%, ash 4.37% and crude fiber 1.84%. The shelf life was one month without quality changes. The RTU spice cubes save time and develop unique flavor in chicken and fish curries with the developed formulations.

Keywords: Proximate composition, Ready to use, Sensory properties, Spice cube

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Different Feeding Regimes and Production Performance of Village Chicken in Trincomalee District

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Village chickens contribute only to 15% of the national egg production as they are poor egg producers. The low egg production corresponds to the variability in feeding under backyard system of rearing. This study was conducted to evaluate the effect of different feeding regimes on production of village chicken in *Kinniya* and *Muthur* veterinary division in *Trincomalee* district. A sample of 76 farmers who follow five types of feeding regimes, representing two villages was selected through a preliminary survey of the area. The five supplementary feeding regimes included rice polish only, commercial feed, paddy with rice polish, commercial feed with broken rice, and broken rice only. A detailed survey was carried out using a pretested questionnaire, and data were analysed using Analysis of variance procedure. The mean separation was done using Duncan's Multiple Range test. The survey revealed that the contribution of village chicken to the household is mainly determined by eggs and meat produced under traditional management practices. Almost all farmers provided household wastes along with scavenging system. The feeding regime varied due to different supplementary feeding practices among which rice polish was the most common supplementary feed. Night shelter (97%) and day time scavenging were the characteristic features of the system. There was no significant difference ($P>0.05$) in number of birds among feeding regimes, and also the five feeding regimes had almost similar ($P>0.05$) egg production levels ranging 11.6 - 18.2 eggs/layer/month. However, the commercial feed with broken rice category showed significantly high number of layers (12.385) and egg production (18.2 eggs/ layer/ month) compared to the other categories except for rice polish with paddy feeding ($P<0.05$). The feeding regime consisted of rice polish with paddy had a high egg production/layer/month (14.6) with low expenditure on feed (Rs. 87.88/layer/month).

Keywords: Village chicken, supplementary feeds, feeding regime, egg production

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Effect of Different Packaging Materials of Sausages and Meatballs on the Reduction of Market Returns

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Meat based processed food products are highly perishable due to high levels of nutrients. Thermoform vacuum packaging is widely used by processors to increase the shelf life of meat products. Nevertheless, non-vacuuming of vacuum packed products is a huge problem in this industry due to low resistance of packaging materials to stress conditions during handling, transportation and storage. Thus the objective of this study was to investigate the effect of different packaging materials on the reduction of non-vacuuming during the market channel. The quality and the packaging orientation of commercially available four different packaging materials of both meatballs and sausages were investigated. Polyethylene (PE) and Nylon are the main ingredients co-extruded in different thicknesses to prepare the bottom multilayer films. The initial thickness of the packaging materials varies from 125 µm to 150 µm. The tensile strengths of the packaging materials were measured according to Active Standard Test Method D882. The packages were prepared by using thermoform vacuum packaging machines. The non-vacuum percentage during storage in factory cool room (-18 °C) and at the retail market were measured. The gauge meter was used to measure the formed punnet thickness and the highly affected point for non-vacuuming was identified by bubbling test method. General Linear model was used for statistical analyses. Non-vacuum percentage of meatballs packages were significantly ($p<0.05$) lower in the retail market. The packaging material with lower tensile strength (120 MPa) and the thickness of 125 µm showed significantly ($p<0.05$) lower non-vacuum percentage than other packaging materials. Non-vacuum percentage due to package orientation did not change significantly ($p>0.05$) for both meatballs and sausages.

Keywords: Non-vacuum, Thermoform vacuum packaging, Tensile strength, Sausages, Meatballs

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Effect of Organic and Inorganic Fertilizers on Growth and Nutritional Value of Cabbage

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The effect of organic (Phospho Compost tea +*Gliricedia* leaf extract and Compost Tea + *Gliricedia* leaf extract) and inorganic fertilizer (Albert's mixture) on growth and nutritional value of cabbage was investigated. Vegetative parameter such as plant height, leaf area, number of visible leaves and fresh weight of organically and inorganically grown cabbage under hydroponic system were measured. Vegetative parameter analysis showed significant differences ($P< 0.05$) between plants treated with different fertilizer application. Inorganic fertilizer treated plants had higher vegetative growth. At the 3 month stage fresh weight of inorganically grown cabbage was 572 g, while the fresh weight of organically grown cabbage was 260 g. Ascorbic acid (AA) content was higher in organically grown plants while chlorophyll content (CC) was significantly higher in inorganically grown plants. At the three month stage organically treated cabbage contained 2 g of Ascorbic Acid per 100 g of cabbage while, inorganically treated cabbage contained 1.5g/100g.Total antioxidant activity (TAA) was measured using DPPH (1,1-diphenyl-2-picryl-hydrazyl) assay and both organically and inorganically grown cabbage 164.5-164.8 mg/g. The available nitrogen content in the leaf samples was determined through the micro Kjeldhal method. At three month stage inorganically grown cabbage showed higher nitrogen content 35 mg Ng^{-1} while, N content of organically grown cabbage nitrogen was 29 mg Ng^{-1}. Total phosphorous content and potassium content were determined by Dry ash technique. At the three month stage organically grown cabbage showed higher P and K content 6430 μgPg^{-1} and 17556 $mgKg^{-1}$ while inorganically grown cabbage showed lower P, K content 4860 $\mu g\ Pg^{-1}$, 16000 mg Kkg^{-1}. The results of present study imply that cabbage organically grown had high nutritional quality even though the yield is low.

Keywords: Organic and inorganic fertilizer, cabbage, nutritional

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Effect of Pinching and Paclobutrazol on Growth and Flowering of Binara (*Exacum trinervium*)

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Exacum trinervium is a slender herbaceous annual flowering plant which is an endemic species to Sri Lanka. Pale to dark blue color flower which is rare in nature with striking bottle shaped anthers has added value to *E. trinervium* to be introduced as a potted plant to the floriculture industry. The growth of plant up to 0.5-1.0 m height without branching is the major problem when it is used as a potted plant. Therefore, this study was conducted with the aim of developing *E. trinervium* as a dwarf attractive plant with more flowers to be an ideal potted or bedding plant. Rooted *in vitro* grown *E. trinervium* was potted after the acclimatization. Two weeks after transferring to pots, plants were divided in to 2 groups. Then the apical buds of the plants were removed by pinching in the first group while in the other group plants were left without pinching. Then both group of plants were treated with 3 concentrations (0, 10 and 20 mg/L) of 25 ml of paclobutrazol at 2 weeks after pinching or 8 weeks after pinching. According to results, pinching, time of application of paclobutrazol and the concentration of paclobutrazol significantly affected ($P<0.05$) the plant height, canopy diameter and number of flower buds/plant. Plants treated with paclobutrazol at early stages (2 weeks after pinching) showed deformation. Pinched plants that were treated with paclobutrazol at nineth week produced compact plants as well as early floral initiation, compared to non-pinched plants applied with paclobutrazol at the age of 9 weeks. Therefore, pinching of plants, followed by application of 25 ml of 20 mg/L paclobutrazol 8 weeks after pinching can be recommended as the best method for controlling height of *E. trinervium* to transform it into a potted plant.

Keywords: *Exacum trinervium*, potted plant, paclobutrazol, pinching

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Egg Production Performances and Quality of Shaver Brown Layers Fed on Scavenger (*Plecostomus* spp.)Fish Meal Supplemented Diet

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The present study was conducted to investigate the effectiveness of feeding, Scavenger (*Plecostomus* spp.) fish meal supplemented diet to Shaver Brown layerson egg production performances and egg quality parameters. Two hundred Shaver Brown laying hens at 58-week of age were divided in to two groups. Each group consisted of 4 replicates of 25 laying birds. Hens were fed with isonitrogenous and isocaloric diets formulated with triple nine fish meal and Scavenger fish meal. The experiment lasted for seven-week. Feed intake and egg production were measured daily and feed conversion ratio was calculated for the whole period. Analysis for fatty acids in egg yolk was done on 7th week of the experimental period. Egg quality parameters including Haugh unit, shape index, yolk index, yolk colour, egg weight, weight of egg yolk, weight of egg white and shell thickness were measured weekly and, a sensory evaluation of hard boiled eggs was carried out at the end of the experimental period. Scavenger fish meal supplemented diet increased Omega-3 fatty acid content in egg yolk by 1.41% ($P<0.05$) and numerically increased ($P>0.05$) Omega-6 content by 0.12%. Feed intake/hen/day (112.16±1.23 g), egg production/hen/week (5.61±0.02), and feed conversion ratio (2.53±0.21 kg/12 eggs) were not significantly different among treatments ($P>0.05$). Except yolk color, all other quality characteristics of egg showed no significant difference ($P>0.05$) between two treatments. The results of sensory evaluation showed no significant difference ($P>0.05$) on aroma, appearance and texture of eggs from two treatments. The highest preference on yolk color was reported with triple nine fish meal supplemented group ($P<0.05$). It can be concluded that Scavenger fish meal can be effectively used to replace triple nine fish meal without adversely affecting egg production performances and egg quality.

Keywords: Scavenger fish meal, laying hens, fatty acid, egg quality, performances

This work was funded by Biodiversity Secretariat of the Ministry of Mahaweli Development & Environment, Sri Lanka

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Estimation of Productivity and Technical Efficiency for Contract Dairy Farming in Kurunegala District

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Dairy industry is one of the prioritized industries in livestock sector in Sri Lanka. Most of the dairy farmers involved in the dairy industry are smallholders and most of the small holdings are under-productive. Therefore Sri Lanka cannot be self sufficient milk production as a country. Understanding this condition there are various development programs implemented by government to increase the production level of the smallholders targeting the ultimate purpose of self sufficient in milk production. National Agribusiness Development Program's project is one of that kinds of program. It is implemented by the government and the private sector in the country jointly as a private public people partnership (PPPP) project. However the impacts of PPPP project achieving the intended benefits in dairy farming are not assessed. Against this background this study was aimed to at evaluating ,the technical efficiency of contract dairy farmers in Hettipola area in Kurunegala district. A Primary survey was carried out using structured questionnaire. In collecting data the sample was identified using stratified random sampling technique. A maximum likelihood estimation of the stochastic frontier model was carried out for milk production as a function of fodder amount, concentrate amount, mineral amount, family hours, and veterinary cost as input using Cobb-Douglas specification. The determinants of technical efficiency such as education level of farmers, age, experience in dairy farming, number of training and project input were investigated, following the Battese and Coelli (1995) specification. According to the Cobb-Douglas specification, the coefficient for family hours was the coefficient is significant at 90% probability level. Mean technical efficiency of farms is 75.01%. Government input has the coefficient of 0.09 significant at 90% probability level.

Keywords: Technical efficiency, Stochastic frontier mode, Public-private-people partnership

The study was funded by National Agribusiness Development Program, Presidential Secretariat.

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Identifying Relatively Drought-Tolerant Breeding Lines/Inbred Lines in Sri Lanka Produced from *C. annuum* and *C. frutescens/C. chinense* Crosses

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Drought is a critical abiotic stress affecting tropical crops. Chilli (*Capsicum spp*.) is highly sensitive to drought. Therefore, development of drought-tolerant (DT) varieties is essential. The objectives of this work were to: (a) screen parental lines produced from *C. annuum* and *C. frutescens/C. chinense* crosses and identify DT genotypes; (b) determine relationships between DT and selected physiological traits. Fifteen parental lines and MI-Hybrid (sub-plot factor) were grown under a rain-shelter at Mahailluppallama, Sri Lanka under two water regimes (main-plot factor) in a Split-Plot Design. Drip irrigation was provided at 6- and 12-day intervals in well-watered (WW) and water-stressed (WS) treatments, respectively. Water *x* genotype interaction was significant ($p<0.05$) in the majority of measured traits. Water-stress reduced yield by 0.6%-94% in 13 genotypes while increasing yield by 4-15% in 3 genotypes. A strong positive correlation was observed between yields under WW and WS conditions, thus indicating that in chilli, higher yield potential contributes to higher yield under drought. Stomatal conductance (g_s) showed strong positive correlations with yield under both water regimes. Furthermore, % reduction of conductance was positively correlated with % yield reduction. Canopy temperature (T_c) showed significant negative correlations with yield in both water regimes. Greater increases of T_c caused greater yield reductions across the genotypes. Shoot water potential (WP) and relative water content (RWC) decreased with WS and significant positive correlations were observed between WP and yield, and RWC and yield, across the two water regimes. Yet, within each water regime, these correlations were not significant among genotypes ($p<0.05$). Greater conversion of flowers to pods, a trait indicating the DT of reproductive processes, was positively correlated with yield under drought (Yd). Based on Yd and DT, as indicated by minimum yield change, the parental lines MICHPL38, MICHPL3, MICHPL22 and MICHPL4 are selected to be advanced in breeding programmes.

Keywords: Chilli, stomatal conductance, water-stress, genotypic variation, canopy temperature

Financial assistance from the National Research Council, Sri Lanka (Target-Oriented Grant No. 14-24) is acknowledged.

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Impact of Different Fertilizers of Nitrate and Ammonium Forms and Slow Releasing, on Growth, Yield and Nutrient Use Efficiency of Rice (*Oryza sativa* L.)

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Two separate experiments were conducted at the University Experimental Station, Dodangolla, Sri Lanka, as field and pot experiments with the objectives of assessing growth, yield and agronomic nitrogen use efficiency (AE_N) of irrigated rice with different nitrogen fertilizer sources and rates compared to the Department of Agriculture (DOA) Urea recommendation. As nitrogen fertilizers; Urea, Ammonium Nitrate (AN), Urease inhibitor treated Urea (U+UI) and Osmocote were used in different rates based on DOA recommended nitrogen (DOAN) levels. Field experiment consisted of 8 treatments. They were; no N applied, 100% DOAN provided as Urea (Control), 75% of DOAN provided as AN, U+UI, Osmocote, and 50% of DOAN provided as AN, U+UI, Osmocote. In the pot experiment, 11 treatments were applied. They were, no N applied, 100% DOAN provided as Urea (Control), 100% DOAN provides as AN, U+UI and as Osmocote; and 75% of DOAN provided as AN, U+UI and Osmocote; and 50% DOAN provided as AN, U+UI and Osmocote. Results of the field experiment showed that there was no significant ($p<0.05$) yield difference between 75% U+UI treatment and control. The highest AE_N was reported with 50% U+UI and 75% U+UI treatments respectively and it was 34.0% and 26.8% increments compared to the control. Results of the pot experiment showed that yield obtained from 100% U+UI was significantly higher ($p<0.05$) than the control and there was no significance difference ($p<0.05$) between 75% U+UI treatment and control. The highest AE_N was reported with the 75% U+UI which was a 26.3% increment compared to the control. Results showed that there could be a considerable yield loss due to Ammonia volatilization in Urea under field conditions and it can be recovered significantly by using Urease inhibitors. Further, Urea performed well on rice under flooded condition compared to the AN in the pot experiment.

Keywords: Ammonium nitrate, nitrogen use efficiency, rice, urea, urease inhibitors

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Increasing the Recovery Percentage of a Commercial Sliced Gherkin Production Line by Proper Grade Selection and Optimization of Pre-Processing Steps

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This study was aimed at increasing the recovery percentage of a commercial sliced gherkin process line. The complete process consists of 7 steps: receiving of fresh gherkins, brining/fermentation, curing, de-brining, slicing, screening of end cuts and small cuts and filling into pouches. Each step was carefully assessed for the identification of possible causes for raw material/ semi-finished product losses. Trials were designed to quantify and reduce the losses at selected steps. During the brining process, gherkins lost their weight by ~18%. Fermentation takes place during this step and it is essential for the shelf-life stability of the product. Hence, brining conditions (salt concentration and period of brining) were not altered. However, different curing conditions were trialed during this study, and it was found that curing in 11-13% w/w brine solutions for a period of 3 weeks or in 8% w/w brine solution for a period of 4 weeks facilitate the maximum weight regain (~9%), which is caused by salt migration into fermented gherkins. Effect of de-brining on the weight of cured gherkins was not assessed due to the limitation of time, but it generally leads to reduce the weight of cured gherkins. Thus, a final value for the increase in recovery percentage during the pre-processing steps (i.e. from receiving of fresh gherkins to de-brining) was not calculated. During the processing of de-brined gherkins, replacement of the sieve used for the screening of end cuts and small cuts with a new mesh size (19 mm×19 mm) led to increase the recovery percentage for the de-brined gherkins. In addition, use of de-brined gherkins with a diameter of 30-36 mm led to reduce the wastage as small cuts, again increasing their recovery percentage. Application of these modifications resulted in a total increase of recovery percentage of de-brined gherkins from 86 to 91%.

Keywords: Gherkin, fermentation, processing, recovery percentage

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Introduction of a New Bacterial Starter Culture to Improve the Flavor and Aroma of CIC Buffalo Curd

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Buffalo curd is a fermented milk product famous among many South Asian populations. The demand for buffalo curd is being increased over the past and, the local producers of buffalo curd are trying to improve the quality of their products to compete the challenges in the market. This study was designed to improve the flavor and aroma of CIC buffalo curd, produce by a Sri Lankan food processor.For the purpose, a new commercial bacterial starter culture (Lyofast MW 036 R) consist of undefined strains of *Lactococcus* spp and *Leuconostoc* spp. was introduced to the current formulation (KDI starter culture) at different ratios. This starter culture is capable of fermenting citratein todiacetyls, at a higher rate improving the flavor and aroma of the curd. Flavor and aroma of the new buffalo curds prepared by adding Lyofast MW 036 R at different levels (5%,10%,20%,25% and30%) with KDI starter culture were assed using a sensory test.The curd prepared with 30% MW 036 R starter culture was significantly ($p<0.05$) preferred by the sensory panelists for flavor, aroma and overall acceptability compared to the all other curd formulations tested. The assessed sensory properties of the preferred curd formulation did not change significantly ($p<0.05$) within the 14 days shelf life study period at 4˚C. Therefore, this new formulation has a potential to develop in to a better buffalo curd with improved flavor and aroma profiles.

Keywords: Starter culture, Sensory evaluation, Buffalo curd, Fermentation

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Investigation of Microbial Quality, Somatic Cell Count and Lipolytic Activity of Raw Milk Collected from Galaha and Thalathuoya Veterinary Ranges

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The objective of this study was to investigate the quality of raw milk by aerobic plate count (APC), psychrotrophic bacterial count (PBC), free fatty acids (FFA), somatic cell count (SCC) and occurrence of antibiotic residues in raw milk collected from Galaha and Thalathuoya Veterinary Ranges (VR). The values of APC and PBC were determined according to the standard culture methods. FFA was determined by extraction–titration method and SCC was determined by using a DeLaval cell counter. Occurrence of antibiotic residues in milk was detected by Beta Star Combo Rapid Test. The above mentioned parameters were determined in bulk milk samples (n=50) collected from Farmer Managed Societies (FMS). SCC were determined in all individual farmer milk samples (n=176). The data were evaluated by regression methods to identify relationships between studied parameters. Mean APC and psychrotropic bacterial counts in both VR exceeded the acceptable levels of 1×10^5 CFU/mL and 5×10^4 CFU/mL, respectively. Strong correlation was warranted between APC and PBC ($P<0.05$; $r = 0.77$) while the correlation was medium between SCC and FFA ($P<0.05$; $r = 0.31$). The APC correlated with FFA more weakly ($P>0.05$; $r = 0.09$), whereas FFA was more closely correlated with PBC ($P<0.05$; $r = 0.34$). The acceptable FFA content (0.5-1.2 mmol/100 g) was exceeded in 48% and 52% of raw milk in Thalathuoya and Galaha VR, respectively. Except for milk collected from three FMS, milk collected from all other selected FMS exceeded the limit of SCC (200,000 SCC/mL) for good quality milk. Furthermore 18% of samples exceeded the hygienic limit of 400,000 SCC/mL in both VR. Fifteen percent of samples showed positive results for antibiotic residues whereas five percent was strongly positive. Results from the current study suggest that microbiological quality of raw milk collected from two VR is below the standard acceptable levels.

Keywords: Free fatty acids, psychrotrophic, microbes, somatic cell count, milk

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Investigation of Nutritional and Antioxidant Properties of Selected Sri Lankan Marine Macro-algae

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Fresh and dried seaweeds are consumed directly or indirectly as a dietary supplement since ancient times. The present study aimed at elucidating the proximate composition and antioxidant properties of elevan selected Sri Lankan seaweed species collected from four coastal sites (Erukkalampiddy, Madiha, South Bar and Wellamadama). Total phenolic content, ferric reducing antioxidant activity (FRAP), DPPH (1,1-Diphenyl-2-picryl-hydrazyl) scavenging activity and ABTS+ (2,2'-azino-bis (3-ethylbenzothiazoline-6-sulphonic acid) radical scavenging activity in crude ethanol extracts of sea weeds were measured. The nutritional and antioxidant properties of the seaweeds vary significantly among the species ($p<0.05$). The *Ulva rigida* (green algae) showed the highest crude protein content (23.67+0.73% DM). The *Cladaphora herpestica* (green algae) and *Turbinaria ornate* (brown algae) were significantly ($p<0.05$) high in crude fat content. Crude fiber level was highest in *Sargassum cinereum* and *Gracilaria corticata*. Among crude ethanol extracts of samples, two species of brown algae showed significantly ($p<0.05$) high total phenolic content (51.32+0.61 and 49.92+2.68 mg/GAE g). The DPPH radical scavenging activity was high in *Sargassum crassifolium* (brown algae). *Caulerpa racemose* (green algae) showed the highest inhibitory activity on Fe^{3+}(420.19+6.78 mM Fe^{2+}/ g of crude ethanol extract) while *Gracilaria corticata* was highest in $ABTS^{+}$ radical scavenging activity (1016.50+2.74 mM TE/g of crude ethanol extract). Present results suggest that the selected Sri Lankan seaweeds contain high nutritional and antioxidant properties.

Keywords: Seaweeds, Proximate composition, Antioxidant activity, Crude ethanol extract

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Length Weight Relationships and Condition Factor of Major Freshwater Fish Species in Some Perennial Reservoirs in Sri Lanka

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Objective of this study was to determine the relationships among length, weight and condition factor of major freshwater fish species in Victoria, Sorabora and Ulhitiya reservoirs. The major fish species studied were Tilapia (*Oreochromis niloticus*), Catla (*Catla catla*), Rohu (*Labeo rohita*), Mrigal (*Cirrhinus mrigala*), Common carp (*Cyprinus carpio*), Freshwater prawn (*Macrobrachium rosenbergii*) and Snakehead (*Channa* spp.). Standard length (cm) and weight (g) of the above species were recorded from random catches of nets of different mesh sizes twice a month from January, 2014 to December, 2015. The total sample sizes of the respective species were 342, 133, 116, 74, 141, 105 and 77. Condition factor was calculated as Weight*100/Length^3. Analysis of variance procedure was used to determine the effects of tank, mesh size and calendar month on length, weight and condition factor of each species and Duncan's Multiple Range Test was used for mean separation. Significant differences were found among tanks, mesh sizes and months of catch for all three traits ($P<0.05$) depending on the species. Significantly the highest mean condition factor values were recorded by Victoria and Sorabora for Tilapia, Victoria and Ulhitiya for Catla, Sorabora for Common carp, Victoria for Fresh Water Prawn, and Ulhitiya for Mrigal and Snakehead ($P<0.05$). Nonlinear regression analysis was carried out to obtain '*a*' and '*b*' parameter estimates for the weight-length relationship (Weight = *a**Length^b), where values equal to, greater than or less than 3.0 for parameter *b* indicated isometric, positive allometric or negative allometric growth patterns, respectively. The results showed that Catla (3.95) and Common carp (4.87) in general exhibited positive allometric growth patterns while Tilapia (0.88), Rohu (2.71), Mrigal (2.52), Prawn (0.87) and Snakehead (0.42) showed negative allometric growth across tanks. Thus, management strategies formulated must be specific to individual reservoirs as well as each fish species.

Keywords: Allometric growth, condition factor, freshwater fish, length, weight

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Mechanization of Paddy Farming: Potentials and Constraints

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Due to labour scarcity and escalating wages, the farm mechanization in Sri Lanka happens in a rapid phase. However there is no clear view about the level of mechanization and the potentials and constraints of mechanization.In this background, this study aims to determine the status of mechanization and its potentials, and constraints in paddy farming. The specific objectives of this study was to get insight into the status of mechanization of paddy farming, find out the factors which affect mechanization, investigate the role of mechanization in the paddy production process, find out whether intended benefits are met by using machines and to find the costs and consequences of mechanization.A field survey based on a structured questionnaire was conducted among 46 farmers in major irrigated paddy farming system in North Western Province. Descriptive analysis indicates that management practices like land preparation, harvesting are mostly mechanized, whereas bund cleaning and plastering, transplanting and drying are mostly done with manual labour. Labour, farm and income related factors mostly motivate farmers to use machinery. Weighted average mechanization index for the area is 0.714. If machinery usage is concerned, results show that more than 80% of the farmers uses two wheel tractor and combine harvester. The ordinary least square results revealed that farm income, education and productivity significantly ($p \leq 0.05$) influence machinery usage.The estimated production function revealed that seed, labour, mechanization index significantly ($p \leq 0.1$) contribute to paddy production. Timeliness of operation and reduction in drudgery are the main benefits of mechanization and increased input usage, spoilage and wastage of harvest are the costs and consequences of mechanization.The results indicate level of mechanization is substantial and mechanization has a significant impact on production, and with the labour issues and people's attitude toward mechanization, future of agriculture is fairly dependent on machines.

Keywords: Mechanization index, Production function, Motivation, Ordinary least square method, Benefits and costs.

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Morphological and Molecular Characterization of Selected *Dioscorea* Accessions for Analyzing Diversity and Determining Duplicates

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Dioscorea is a tuber crop belonging to the family Dioscoreacea having high species and genetic diversity with more than 360 species recorded in the world. The present study was conducted to analyze genetic diversity and to identify duplicates among 20 *Dioscorea* accessions of three different species, namely (*Dioscoreaalata, D. esculenta* and *D. bulbifera*) conserved in the Plant Genetic Resources Center (PGRC) at Gannoruwa by using 57 morphological characters and 15 SSR markers. Morphological data were collected according to the PGRC descriptors of yam with 21 stem characters, 31 leaf characters and 5 flower characters, and was analyzed using Minitab 17 software. The dendrogram revealed 5 clusters without a duplicate. Accession 53 (Kiriala cultivar) was isolated from other accessions while five accessions (Accessions: 21, 36, 127, 113 and 92) were clustered into non-related clusters. The 15 SSR primers produced polymorphism among all 20 *Dioscorea* accessionsresulting in an average 3.8667 alleles per primer and genetic distance based on SSR analysis through PowerMarker V3.25 ranged from 0.1333 (among accessions 101, 102, 103 and 109) to 0.7529 (between accessions 83 and 133), and the phylogenetic tree resulted in three major clusters. These three clusters were almost in agreement with the existing classification demarcating them to the above three species. However, accessions 36 and 127 recorded previously as *D. alata*and *D. bulbifera*, respectively, was clustered with *D. esculenta.*

Keywords: *Dioscorea*accessions, Morphological analysis, Simple Sequence Repeats

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Oyster Mushroom (Pleurotus osteratus) Spent Substrate as a Ruminant Feed

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The objective of the present study was to evaluate the feeding value of Oyster Mushroom Spent Substrate (OMSS) as a ruminant feed. Six Saanen growing goats, aged 4-5 months with mean body weight of 15.2±2.4 kg were selected and divided into two groups in order to get similar cumulative body weights in both groups. Two diets namely, control and the treatment was formulated according to the NRC recommendations for growing goats except that 6 % OMSS was added to the treatment. A feeding trial consisted of a 7-day preliminary period followed by a 30-day collection period was conducted to measure the dry matter intake of goats. In addition, *in vivo* dry matter digestibility of the two diets was measured during the last week of the feeding trial. Animals were weighed weekly. Data were statistically analyzed using Minitab (Version 17) and Two sample t-test. According to the chemical analysis, OMSS had 7.16 g/kg crude protein, 3.63±0.01 Mcal/kg gross energy,17.5±0.5 g/kg Calcium and 52.1±0.2 g/kg Phosphorus, whereas *in vitro* dry matter digestibility was 14.2% on dry matter basis. Results revealed that feed intake of goats fed with OMSS was higher ($P<0.05$) compared with the control during the period from 16-30 days however, no difference ($P>0.05$) was observed between 1-30 days. Furthermore, no difference ($P>0.05$) in weight gain (3.1±0.8 % vs 2.4±1.0 %) or *in vivo* dry matter digestibility was observed between the treatment and control respectively. But there was a tendency to observe a higher value with the OMSS diet compared to the control. Cost of feeding was lower ($P>0.05$) with OMSS diet compared to the control. According to the results, it is possible to include 6 % of OMSS in ruminant diets without affecting the weight gain of animals.

Keywords: Digestibility, feeding value, Oyster mushroom spent substrate, weight gain

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Performance and Meat Quality of Broiler Chicken Fed on Scavenger Fish Meal (*Hypostomus plecostomus*) Supplemented Diets

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The aim of the present study was to find out the effect of feeding Scavenger fish meal on growth performance and meat quality of broiler chickens. Two isonitrogenous and isocaloric diets were formulated using imported fish meal or scavenger fish meal as the control feed and the test feed, respectively. Imported fish meal was totally replaced by scavenger fish meal in the test feed. A feeding trail was conducted using 80 day-old male broiler chicks (Cobb 500) according to a Complete Randomized Design. Chicks were brooded in floor brooders for two weeks and then transferred to 8 battery cages. Each experimental diet was fed *ad libitum* to 4 groups of 10 birds for 32 days. Birds were fed on starter feeds for initial 3 weeks and thereafter on finisher feeds. The average body weight and feed intake were recorded weekly. During the slaughter study, weight after bleeding, weight after de-feathering and dressed weight were recorded. Meat quality parameters were measured using breast meat samples. The average final body weight, body weight gain, feed intake and feed conversion ratio of birds fed with scavenger fish meal diet were 1285 g, 41 g, 87 g/bird/day and 2.12, respectively, which were similar to those fed with imported fish meal diets ($P<0.05$). Carcass quality parameters (weight after bleeding, weight after de-feathering, dressed weight and dressing percentage) and meat quality parameters (pH, water holding capacity, cooking loss, drip loss, color) were also not affected ($P>0.05$) by dietary treatments. It was concluded that imported fish meal could be totally replaced by scavenger fish meal in broiler feeds without affecting their growth performance and carcass and meat quality.

Keywords: Scavenger fish (*Hypostomus plecostomus*), broiler performance, meat quality

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Possibility of Using *Cyclea peltata* Plant Extract as a Substitute for Gelatin in Set Yoghurt

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Gelatin is an animal origin stabilizer commonly used in dairy products in Sri Lanka. Some lacto-vegetarians are reluctant to consume gelatin incorporated products due to several cultural and religious reasons. Therefore, this study was conducted to find-out the possibility of using *Cyclea peltata* plant extract as a substitute for gelatin in set yoghurt. After several initial trials, the maximum level of plant extract that can achieve the maximum gelation effect was found to be as 10% (w/v). A series of set yoghurts were made using three levels (1.5, 3 and 4.5%) of plant extract from the initially made extraction (10%). Fat and SNF contents were balanced as 3.5 and 8.5%, 3.15 and 8.57% and, 4.2 and 11.43%, respectively. Then a sensory evaluation was carried out with ten untrained panelists. The sensory evaluation revealed that 1.5% plant extract incorporated yoghurt is the most acceptable yoghurt. Whey syneresis (%) and pH of yoghurt was significantly higher ($P<0.05$) than those of the control, while titratable acidity of both were not significantly different ($P>0.05$) throughout the storage at refrigerated temperature. Proximate analysis showed that herbal set yoghurt has 76.26±0.4% moisture, 85.57±2.53% dry matter, 4.24±0.026% Fat, 6.83±0.39% Protein and 4.11±0.19% which were similar to levels of gelatin incorporated yoghurts. There was no coliform, yeast & mould growth during storage at refrigerated temperature for two weeks. Further, physical and organoleptic properties can be improved by incorporating Carrageenan, Kelco-gel or Pectin from lovi fruits.

Keywords: *Cyclea peltata gel*, Herbal set yoghurt, Gelatin Replacer

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Production of Silage from Fish Waste Using Whey as the Inoculum

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The fisheries industry plays an important role in the economy of Sri Lanka by providing livelihood for coastal communities as well as providing more than 50% of animal protein requirement of people in the country. The industry is growing and the fisheries sector in Sri Lanka has been considered a potential area to expand seeking development in the country's economy. With increasing fish production, fish waste management has become one of the problems having the greatest impact on the environment. One potential way of minimizing these problems is its transformation in to a product to be incorporated as an ingredient in animal rations. Fish silage,which is frequently added into animal feedis a liquid or semi-solid product made from whole fish or parts of fish that are liquefied by the action of enzymes in the fish in the presence of an added acid. This research study was carried out to produce fish silage from fish waste through a biological process involving microbiological fermentation which replaces the function of fish enzymes by microorganisms. The whole experiment concentrated on developing an ensilation formula and determining a time frame to get a physically, biologically and nutritionally better quality final product, where whey is used as the lactic acid bacterial inoculum and molasses as the fermentable carbohydrate source. The combination of 6% of whey, 15% of molasses and 79% of fish viscera waste was the best formula and 5-day time period was selected as the best fermentation period. The results of the analysis of proximate composition indicated 14.52±0.05% of protein in the final silage product and respective N amount is appropriate to be used as a supplement for animal feed production.

Keywords: Fisheries sector, fish silage, biodegradable waste, animal husbandry, microbial fermentation

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Production of Virgin Coconut Oil by Fermentation Method and Comparison of its Physico-chemical Properties with Virgin Coconut Oil Produced by Other Methods

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Virgin coconut oil (VCO) can be extracted using different methods, of which fermentation method is considered the best method to obtain VCO of high quality at low cost of production. Currently, however,the physical extraction method is used as the main method of extracting VCO in Sri Lanka. The efficiency of fermentation can be enhanced by introducing a fermentative bacteria to coconut milk. In this study *Lactobacillus bulgaricus* was used as the starter culture. The oil obtained was assessed for the physicochemical parameters and microbiological requirements were studied using standard methods. Fatty acid composition was determined using Gas Chromatography. The optimum yield with best quality was obtained after 24 hours at 37^0C of fermentation. The Free Fatty Acid Content, moisture, specific gravity and iodine value of VCO produced were 0.089% as lauric acid equivalent, 0.124%, 0.915, 7.075, respectively. The saponification value of the oil was 258.75mg of OH/g and all these were within acceptable limits based on SLS 32:2002. The Total Plate Count was 18.75which was significantly ($p<0.05$) lower than the oils produced by other methods. The yield of oil on wet weight basis was 19.13% and this is higher than natural fermentation, however, lower than the yield obtainable from high pressure expeller method which was about 25.33%. The fatty acid composition of fermented VCO was acceptable with standard levels. A consumer preference test was conducted to evaluate the flavor, aroma and color of VCO produced by induced fermentation and conventional methods. There was no significant difference for flavor and color and there was a high consumer preference for odor of conventional VCO. All the physicochemical parameters, microbiological parameters and fatty acid composition were acceptable to quality standard values.

Keywords: Fatty acid composition, Fermentation method, Free Fatty Acid, Virgin Coconut oil (VCO)

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Reduction of Microbial Contamination of Dehydrated Moringa (*Moringa oleifera* L.) Leaf Powder

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The objective of this study was to reduce the microbial contamination of dehydrated Moringa leaf powder to improve its marketability. An experiment was designed with 16 treatments to find the best preservation technique that can reduce the contamination of dehydrated Moringa leaf powder. In eight treatments fresh Moringa leaves were washed either with 200 mg/L sodium hypochlorite (NaOCl) or 20000 mg/L hydrogen peroxide (H_2O_2) as a method of sanitation. In the other eight treatmentsMoringa leaves were washed with sterilized water or tap water. All the washed leaves in each treatment were divided into two portions and one portion was blanched using hot water at 60 °C for 2 minutes whilst the other portion left unblanched. Thereafter, all the leaves were sundried until their moisture content dropped down to 10% (d.b) and milled manually to obtain a particle size of 0.5-1.0 mm. Leaf powders were packed insterilized high density polyethylene (HDPE) packages to prevent recontamination and absorption of moisture. Packages containing either blanched leaf powder or non-blanched leaf powder were divided into two groups and one group was subjected to Gamma irradiation at 5 kGy dose. Leaf powder samples received each treatment were subjected to microbial analysis and results showed that Gamma irradiated samples had significantly lower ($p<0.05$) Total plate count (TPC), Yeast and Mold (Y & M) count, Coliforms and *Escherichia coli* (*E. coli*) counts in comparison to non-irradiated samples.

Keywords: Moringa, Gamma irradiation, TPC, *E. coli*, Coliforms

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Replacement of Imported Fish Meal with Scavenger Fish (*Pterygoplichthys multiradiatus*) Meal to Determine the Growth Performance of Swordtail (*Xiphophorus helleri*)

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Swordtail (*Xiphophorous helleri*) is a dominant ornamental fish species in the export market of Sri Lanka. Feeding of well nutritious diet is crucial for the ornamental fish species to achieve required marketable size during nursery stage. This experiment was conducted at the Ornamental Fish Breeding Center, National Aquaculture Development Authority, Ginigathhena to investigate the effects of replacing imported fish meal (IFM) by scavenger fish meal (SFM) in swardtail diet. The experiment was done with three isonitrogenous and isocaloric experimental feeds: Feed 1 (IFM 40% + 0% SFM), Feed 2 (IFM 30% + SFM 15%) and Feed 3 (IFM 26% + SFM 20%) with three replicates per treatment. Each replicate contained 10 Red Swordtail day old fry. Feeding was done five times a day for 35 days according to 10% of the body weight. The fish growth parameters such as body weight gain (BWG) and body length gain (BLG) and survival rate were measured. Water quality parameters such as ammonia concentration and temperature were measured daily and maintained at optimum levels. Analysis of variance was carried out under Completely Randomized Design and the three treatment means were compared using Least Significant Difference test. All three treatments were significantly different from one another with respect to BWG and BLG ($P<0.05$). The means of BWG (g) were 1.38±0.03, 1.71±0.02, and 1.48±0.02 while those for BLG (cm) were 1.34±0.12, 2.00±0.33 and 1.53±0.04, respectively. Survival rate was not significantly different ($P>0.05$) among the three treatments as no mortalities occurred during study period. Since Feed 2 has produced the highest BWG and BLG, it can be concluded that one third of imported fish meal could be replaced by scavenger fish meal to reduce the cost in sward tail diet at nursery stage.

Keywords: Fish nutrition, Scavenger fish meal, Swordtail (*Xiphophorus helleri*)

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Root Cause Analysis for the Fungal Growth in Tomato Sauce during Storage: A Case Study

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Fungal growth is one of the primary causes for the spoilage of food with high sugar content. A tomato sauce processing company in Sri Lanka experiences a sporadic growth of fungus in some of the sauce bottles during storage, and this study was designed to analyze the root cause for the saidfungal growth. Total plate count, and yeast & mold counts were determinedfollowing the SLSI standard procedures. Acidity level, pH and preservative level of contaminated and control sauce samples were analyzed. Empty bottles and their lids ready for packagingof freshly prepared tomato sauce and indoor air were tested for microbial contamination, using a swab test and anopen culture plate test, respectively. The hygienic practices of the production process were carefully observed without informing the employees. Improper handling and delay in closing the lids were observed to be potential contamination roots. Species of *Aspergillus*, *Penicillium*, and *Mucor* were observed as the three major molds in the contaminated tomato sauce. Yeast and mold counts in non-contaminatedsauce were significantly ($p<0.05$) lower than that in contaminated sauce. There was a gradual reduction of yeast and mold growth in the sauce from top to bottom of the bottle, confirming the contamination through headspace. Further, sterilized lids ready for capping were positive for yeast and mold confirming secondary contamination due to improper handling. Yeast and mold count in indoor air, exceeded the limits (500 cfu/m^3) of World Health Organization. Acidity level of the contaminated samples were significantly ($p<0.05$) lower compared to control sauce samples, indicating the microbial action. According to the findings of the study, it can be concluded that fungal growth in tomato sauce was due to improper hygienic practices of the production process.

Keywords: Fungus, Root cause analysis, Total plate count, Yeast and mold

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Root Cause Analysis of Mold Growth in Virgin Coconut Oil

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This study was carried out to analyze the root cause for the mold growth in virgin coconut oil (VCO), which is indicated by the development of pale yellowish color sedimentation at the bottom of VCO containers during storage.Total plate count, yeast & mold count, moisture content and free fatty acid (FFA) content of the sediment and the clear oil layers of the contaminated VCO were separately determined.Separate experiments were performed to analyze microbial quality of the lids of the containers, empty containers, indoor air and VCO samples from different steps at the production process. A mold was found in all oil samples having a sediment at the bottom (<10 cfu/mL), which was within the product specification. Packaging containers and the lids were negative for yeast & mold, while each sample from different processing steps was positive. It was concluded that microbial contamination of VCO was due to contaminated raw coconuts, those missed during raw material inspection.The mold counts of the VCO samples close to 24 months of shelf-life were within the specification. It can be suspected that the retardation of mold growth is due to the antifungal activity of VCO over time. Tests were designed to analyze the distribution of mold in VCO and found that it was present only at middle and bottom of the container. Further, the FFA content was higher in the sediment compared to the clear oil. It can be assumed that the mold growth may be favored by the moisture accumulated at the bottom sediment layer during storage. It can be concluded that the contamination and growth of molds can be minimized by proper inspection of raw materials to avoid mixing of contaminated raw coconut with coconut used for processing

Keywords: Virgin coconut oil (VCO), Molds, Contamination, Moisture

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Screening of Zearalenone Contamination of Formulated Feeds and Feed Raw Materials of Cattle in Sri Lanka

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Zearalenone (ZEN) is an estrogenic mycotoxin mainly produced by the *Fusarium* spp. Because of its estrogenic ability ZEN results in reproductive problems such as abnormal estrous cycle, irregular heat, swollen vulva, vaginitis and reduction in milk yield in farm animals. South Asian countries are reported to be contaminated with ZEN. Therefore, the present study was conducted to screen the presence of ZEN in formulated feeds and feed raw materials from selected areas in Sri Lanka. Samples were collected from 18 districts covering nine provinces. Collected samples were ground and sieved using 0.85 mm mesh. Two grams of prepared sample was added with 10 ml of 70% methanol and vortexed for 3 min, centrifuged at 3500 g for 10 minutes at room temperature and supernatant was separated and stored at -20 ºC. Zearalenone concentrations of the extracted samples were detected using commercial ELISA kits (Affinitech Pvt Ltd). Highest ZEN concentrations in broken rice (0.016 ppm), coconut poonac (0.026 ppm), imported soybean meal (0.071 ppm), local soybean meal (0.049 ppm), dhal dust (0.021 ppm), dhal husk (0.037 ppm), wheat bran (0.048 ppm), rice polish (0.042 ppm), maize (0.042 ppm), groundnut meal (0.018m ppm) and cattle feed brand B (0.083 ppm) were detected from samples collected in Colombo, Vavuniya, Colombo, Polonnaruwa, Puttlam, Gampaha, Gampaha, Matale, Gampaha, Trincomalee and Galle districts, respectively. Zearalenone limits for animal feeds according to European Union (EU) recommendations are 2 ppm for cereal/cereal byproducts, 3 ppm for corn/corn byproducts and 0.5 ppm for complete feeds and complementary feeds. All ZEN concentrations detected in the present study were below the EU limits. Thus, the results of the present study suggest that the formulated feeds and feed raw materials available in Sri Lanka are not contaminated to the risk levels with ZEN.

Keywords: Zearalenone, ELISA, concentration, formulated feeds, feed raw materials

This study was funded by National Research Council of Sri Lanka (NRC TO 14-10)

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Starter Culture Composition and Draining pH Influence the Quality Characteristics of Mozzarella Cheese

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The objective of this study was to develop a low cost Mozzarella type cheese using buffalo milk under Sri Lankan conditions. This investigation was carried out at Dairy Product Processing Plant and Dairy Technology Laboratory of the Faculty of Agriculture, University of Peradeniya. Sri Lanka has a good market for mozzarella type cheese, especially in hotel and bakery industry. Mozzarella cheese was manufactured by using two different starter cultures (Chr Hanson ST-M5 and RST-776) using buffalo milk as main raw material. Each starter culture added (0.5g/10 L milk) buffalo milk samples were treated with three different pH values at the draining (pH 5.3, 5.2, 5.1). The effect of added starter culture and draining pH on the physico-chemical, microbiological and organoleptic properties of Mozzarella cheese were studied. It was found that protein content was not affected ($P>0.05$) by the starter culture or draining pH. Added starter culture and the draining pH value significantly affected ($P<0.05$) the fat content of the cheese. Dry matter content, ash, moisture content and titratable acidity were affected by the added starter culture but not affected ($P>0.05$) by the draining pH. Further, texture and meltability were only affected ($P<0.05$) by added starter culture. Total plate count and Coliform count were not affected by the culture and draining pH. Organoleptic properties such as odour, colour, taste and texture were better in RST-776 treated cheese sample. Colour of the cheese was affected ($P<0.05$) by the type of starter culture. Organoleptic properties were better in cheese treated with pH 5.2. Texture and overall acceptability of cheese were affected ($P<0.05$) by the draining pH. This study concluded that buffalo mozzarella cheese made out of RST-776 culture with the draining pH 5.2 is better in organoleptic properties and physico-chemical properties when compared to rest of the mozzarella cheese samples.

Keywords: Mozzarella cheese, buffalo milk, starter culture, draining pH

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Study on Generation of *trans* Fatty Acids and Oxidation Stability of Palm Oil and Coconut Oil during Repeated Frying

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The objective of this study was to evaluate the quantity of*trans* fatty acids (TFA) generated and oxidation stability of palm and coconut oils in repeated deep frying. In the frying system, French fries (1:6 w/v) were fried in branded and bulk palm and coconut oil at 160°C. Four frying cycles were performed using same oil and after each frying cycle, a sample was drawn from each oil and saved for the chemical analysis. Content of TFA was measured by Gas Liquid Chromotography. The oxidation stability of oils was assessed by determining Thiobarbaturic Acid Reactive Substances (TBARS). The change of colour of oils were determined based on CIE-LAB method by chromameter. Development of TFA with the frying cycle didn't show a significant increase in both palm and coconut oil. The content of TFA observed in fresh and four times used coconut oil was significantly low ($P < 0.05$) than that of both bulk and branded palm oil. Significant increase of TBARS value with the frying cycle was only observed in bulk coconut oil.TBA values of fresh oil as well as four times used oil were significantly high ($P < 0.05$) in both branded and bulk coconut oil than that of palm oil. Lightness of the colour of both palm oil and coconut oil was linearly reduced with the increasing frying cycle. These results suggested that coconut oil has low *trans* fat development compared to palm oil and low oxidation stability compared to palm oil.

Keywords: Coconut oil, lightness, palm oil, TBA value, *trans* fatty acid development

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Technology Development for Making Crispy Roasted Jackfruit Seeds and Coconut Chunks

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This study was carried out to develop a compatible technology for making crispy roasted Jack fruit seeds and coconut chunks as value added snacks targeting the export market. Although the jack fruit seed is known as a healthy food, a major fraction is wasted in Sri Lanka due to less attraction as a value added food. Similarly a recently introduced value added coconut product called coconut chunk also has growing demand in the international market as a high energy snack. Therefore, development of processing technology for making crispy roasted jack fruit seeds and coconut chunks may open up new avenues for the local food processing sector to expand their product range. Freeze drying, vacuum drying and a chemical treatment were selected as the pre-processing techniques to prepare crispy roasted Jack seeds and coconut chunks. The product quality was evaluated based on the physical characteristics such as texture, volume shrinkage, porous structure of the internal tissues & residual moisture content. Sensory analysis was done with 40 untrained panelists using a seven point hedonic scale. The crispiness, texture, taste, color and overall acceptability of the crispy roasted products were assessed by the panelists. The two pre-treatments; freeze drying and pre-soaking in 1.0 moldm^3 $NaHCO_3$ for 12 hours are found to be the most appropriate pre-treatments for getting crispy Jack fruit seeds after roasting. However, $NaHCO_3$ was not suitable for coconut chunks as it produced a soapy taste when soaked. Therefore, freeze drying is found to be the best pre-treatment for making crispy roasted coconut chunks in comparable with the sensory qualities of the commercial product.

Keywords: Crispiness, jack seeds, coconut chunks, freeze drying, vacuum drying

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Use of Beetroot (*Beta vulgaris* L.) Powder as a Nitrite Replacer in Chicken Sausages

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The purpose of this study was to assess the suitability of red beetroot as a nitrite replacer in chicken sausages and to investigate the effect of red beetroot on quality characteristics of chicken sausage during cold storage at -18^{0}C. Red beetroot was prepared as a powder and substituted sodium nitrite in sausage by 0.3%(T1), 0.5%(T2) and 0.7%(T3) levels. Treatment which prepared using 0.5% level of beetroot powder was selected as the best treatment. Initial residual nitrite was significantly ($P<0.05$) high in control sample and residual nitrite reduction was not significantly ($P>0.05$) different during the storage period in both control and treatment. TBARS values and sheer force values were not significantly ($P>0.05$) different between control and treatment throughout the storage period. TBARS and sheer force were significantly reduced in both control and treatment during the storage. pH value of control and treatment was reduced during the storage. pH of T2 was significantly higher than the control throughout the storage. Lightness was not significantly ($P>0.05$) different between control and T2 throughout the storage. Lightness was significantly increased in control but not in T2 during the storage. Redness and yellowness significantly ($P<0.05$) high in control throughout the storage. However, redness and yellowness were not significantly change in both control and treatment during the storage. Water holding capacity was not significantly different between control and treatment throughout the storage. However, WHC was significantly reduced in both control & T2 during the storage. According to sensory evaluation and residual nitrite level, optimum level of beetroot powder which can be added in to sausages was 0.5%. Addition of beetroot in to sausages was not affected to the proximate composition and microbiological properties of sausages.

Keywords: Beetroot powder, nitrite replacer, chicken sausages

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A Case Study on the Influence of Thermal Environmental Parameters on the Performance of Dairy Cattle

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This study was conducted at the National Livestock Development Board farm, Siringapatha to assess the relationship of environmental factors with production and reproduction performance of dairy animals in the farm and identify the factors that limit animal performance. Records of 2201 milking cows, 2996 dry cows, 318 heifers, 160 bulls and 306 calves from 2013 August to 2016 August were used to obtain data on individual milk yield (MY), age at first calving (AFC), calving interval (CI), number of conceptions (NC) and growth rate (GR). Data on daily ambient temperature (AT) and relative humidity (RH) were obtained from nearby Makandura Meteorological Station. Temperature Humidity Index (THI) values were computed, descriptive statistics were estimated and correlation regression analysis was performed. Ambient temperature and RH varied among days and months to assume mean values of 30.67±1.9°C and 86.42±3.6 %, respectively. Mean number of milking cows, dry cows, heifers, calves and bulls in the herd at a given day were 59.0±11.9, 80.0±11.0, 8.0±8.0, 8.0±4.3 and 4.0±1.1, respectively. Mean daily MY, AFC, NC, CI and parity of cows were 4.69±1.0 L, 47±14 mo., 2±1, 214±204 d and 4±2, respectively. Daily and monthly MY decreased ($P<0.05$) as daily AT ($r=-0.38$) and monthly AT ($r=0.60$) increased from 22°C to 39°C and assumed mean MY values at 28°C. Daily MY increased ($P<0.05$) with increasing daily RH ($r=0.39$), but decreased with increasing THI ($r=-0.30$). Number of conceptions decreased ($P<0.05$) as the AT on the day of insemination increased ($r=-0.44$). Other relationships were not significant. The results suggest AT as the most influential environmental factor and MY and NC as the most responsive performance indicators. To increase NC and MYof cows in the farm it is suggested to employ cooling strategies to reduce AT surrounding the cows on the day of insemination and when AT increases above 28°C.

Keywords: Ambient temperature, THI, milk yield, conception

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Acclimatization of In Vitro Cultured Ornamental Aquatic Plant (*Anubias nana*)in Trough Culture Under Different Shade Levels and Fertilizer Solutions in Intermediate Zone Sri Lanka

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The ultimate success of *in-vitro* cultured *Anubias nana* (a highly popular aquatic plant in Sri Lanka) on commercial scale depends on the ability to transfer plants out of the culture on large scale basis with high survival. This study was conducted at National Aquaculture Development Authority, Rambadagalla to determine the combined effects of shade and fertilizer concentration on growth and survival of *in vitro* cultured *Anubias nana* at acclimatization stage. Twelve plants were grown in troughs under three shade conditions (30%, 50% and 80%). Within each shade condition, four fertilizer dosages (0.5g/L, 1g/L, 1.5g/L and 2g/L) of Albert's solution were compared. Water was used as the control. Average day time temperature, pH and electrical conductivity were monitored periodically during experimental period. Data of the two-factor factorial experiment were analyzed using Analysis of variance and mean comparison was done using Duncan's multiple range test. There was a significant shade and fertilizer interaction effect on leaf width, leaf length and survival percentage of plantlets ($P<0.05$). The highest leaf width (10.45±1.2 mm), leaf length (21.3±1.1 mm) and survival percentage (100%) were obtained at 1 g/L Albert solution with 80% shade after 8 weeks of planting. However, the interaction effect was not significant for the other morphological features such as leaf formation (leaf number) and root length ($P> 0.05$). In contrast, uptake of Nitrogen, Phosphorous and Potassium significantly improved ($P<0.05$) with the increase in fertilizer concentration but that did not contribute to growth and plant survival percentage. There was no significant shade and fertilizer interaction on N, P and K uptake ($P>0.05$). Based on survival percentage and measured morphological characters, Albert's solution at 1 g/L with 80% shade level can be recommended as the best combination to acclimatize *in-vitro* cultured *Anubias nana* in intermediate zone of Sri Lanka.

Keywords: Acclimatization, Albert's solution, *Anubias nana*, *in-vitro* culture

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Analysis of Aflatoxin Contamination Levels during Different Stages of Parboiled and Raw Milled Rice Production Processes

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Aflatoxins are natural contaminants of cereals and other commodities frequently reported throughout the world.They are produced by various strains of moulds, particularly in tropical countries mainly during storage of fresh commodities. Due to significant trade and affected cereals are the food staples, humans in tropical countries have a higher chance of getting exposed to aflatoxins. Chronic dietary exposure even in low doses of aflatoxins is a known risk factor for liver cancer and affects protein metabolism and immunity. Rice as the staple food in Sri Lanka and is stored for long periods under conditions that promote mould growth, it is important to assess the risk associated with aflatoxin contamination during different processing stages.This study was carried out on Keeri Samba (BG 360) involving both paddy and rice and total aflatoxin contamination levels were assessed during different stages of parboiled and raw milled rice production processes. Samples representing different processing stages were collected from Rice Processing Unit, CIC Agri Export (Pvt) Ltd, Maho. Enzyme-linked immunosorbent assay (ELISA) and Lateral flow test strip (Smart Strip) methodswere used to quantify aflatoxin contaminationin paddy and rice. Out of 22 rice and paddy analytical samples, aflatoxinconcentrations more than 2 ppb were detected in 3 samples (13.64%) and in 19 samples (86.36%) aflatoxin concentrations were below 2 ppb. It became evident that after parboiling of paddy, aflatoxinlevels increase. Even though, aflatoxinconcentration can be high in the husk, after removing of the husk it can be reduced down to less than 2 ppb. The final rice products of both parboiled and raw milled rice production processes contained aflatoxin concentrations less than 2 ppb which is much lower than the specifications given in many countries as well as in Sri Lankan regulations.

Keywords: Aflatoxin, Parboiled, ELISA, Lateral flow test strips

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Application of Polyphasic OJIP Chlorophyll Fluorescent Transient Analysis in Seed and Seedling Testing in Common Bean (*Phaseolusvulgaris* L.)

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The possibility of using non-invasive and rapid polyphasic OJIP chlorophyll fluorescent transientanalysis, which is relatively a new techniquein seed and seedling testing, was investigated to understand the performance of photosystem II (PSII) activity of common bean (*Phaseolus vulgaris* L.).Seeds were exposed to accelerated ageing test (60ºC) and germinated under both laboratory and field conditions. Fresh seeds and seeds stored for seven months were also used for testing. The chlorophyll fluorescence in imbibed seeds and 5-day old seedlings was measured using FlourPenFP-100 and the JIP-test was performed. Several functional and structural parameters, such as, specific fluxes (SFs) quantum efficiencies (QEs), and performance index (PI) were derived from the OJIP transients to explain the PSII behavior. Germinationpercentage (GP), weak seedlingpercentage (WSP)and seedling dry weight (SDW) were recorded. Seed deterioration caused by accelerated ageing test was well explained by the OJIP parameters. The GP of seeds exposed to 60ºC for 6hrs and 24hrsdid not show a significant difference ($p>0.05$), however, SFs, QEs and PI measured in seedlings were significantly different ($p<0.05$). The GP, WSP and SDW were not significantly different between fresh seeds and those stored for seven months. However, the seedlings of stored seeds showed a decrease in SFs, QEs and PI compared to those of fresh seeds. Therefore, the polyphasic OJIP chlorophyll fluorescent transient analyses could successfully be used to determine the seed and seedling quality at early stages.

Keywords: Germination test, polyphasic OJIP chlorophyll fluorescent transient, accelerated ageing, quantum efficiencies, specific fluxes and performance index

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Assessing Nutrient Use Efficiency of Different Fertilizer Types and Weed Control Systems of Tea Fields in Hapugastenne Estate in Maskeliya Plantations PLC

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Ways to improve Nutrient Use Efficiency (NUE) and control weeds by reducing the complete dependency on chemical control is essential to enhance sustainability in the tea sector. This study was initiated to investigate the impact of different weed and fertilizer management measures on soil nutrient status, NUE and green leaf production of tea. A Field experiment was conducted in VP tea fields of TRI 2025 (*Camellia sinenses* L.) to assess the NUE of Slow Releasing Fertilizers (SRF) in already established Herbicide Free Integrated Weed Management (HFIWM) and chemically weed controlled mature tea fields in Hapugastenne Estate in Maskeliya. The experiment was a Split-Plot Design with weed control as the main plot factor with two levels (HFIWM and chemically weeding). Sub plot factor was fertilizer with six treatment combinations of TRI recommended 100% U709 (200 kg/ha/3months), 75%U709+25%SLF, 50% of U709 and SLF, 25%U709+75%SLF, 100%SLF (100 kg/ha/3months) and no fertilizer treatment. Green leaf yield and SPAD meter readings were taken at 12 day intervals and soil measurements were taken from 0-15 cm depth initially and three months after treatment application. Results showed a significant yield increment ($P < 0.05$) in HFIWM compared to chemical weeding fields. Among six treatments 100%SLF and 25%U709+75%SLF showed higher yields in both HFIWM and chemical weeding fields. Overall, the SPAD meter readings were greater in HFIWM compared to chemical weeding fields. In both fields, application of 100% SLF resulted a greater AE_N 30%) compared to 100%U709. There was no significant difference ($P > 0.05$) in soil properties of CEC, total N, exchangeable K, available P and organic matter content of initial and 3 months after treatment application. Addition of organic matter content in HFIWM fields was 1212 kg/ha/3months as dry weight. HFIWM improved NUE, soil properties and biodiversity in tea plantations exhibiting significant improvement many parameters over chemical weeding.

Keywords: Nutrient use efficiency, Herbicide free integrated weed management, Slow release fertilizer, Agronomic use efficiency of nitrogen

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Assessment of 3G Solution for the Control of Chilli Thrip (*Scirtothrips dorsalis* Hood) on Chilli

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Chilli (*Capsicum annuum* L.) is an important profitable cash crop cultivated in dry zone of Sri Lanka. However, the chilli production has been severely limited due to leaf curl complex. Chilli thrip is one of the major pests responsible for leaf curl complex. Application of insecticides for thrip has many limitations, mainly the possible contamination of the harvest and the environment; hence, alternative control measures are needed. Therefore, the present study was conducted with the objectives of evaluating the efficacy of a solution prepared with Garlic, Ginger and Green chilli (3G) extracts against the thrip (*Scirtothrips dorsalis* Hood) on chilli plants and selecting the effective concentration of the 3G solution. A field experiment was laid out as a randomized complete block design (RCBD) with three replicates and five treatments in Agricultural Research Station, Kilinochchi. The chilli crop was raised by following all agronomic practices recommended by the Department of Agriculture. The first application of 3G was done at two weeks after transplanting of chilli. When transplanting Abamectin (0.15 EC) was sprayed on all plants to maintain a uniform thrip population. The 3G solution with different concentrations was sprayed at weekly interval and the level of thrips control was assessed by counting the population of the chilli thrips. Abamactin (0.15 EC) was used as the standard control. Results of the experiments showed that the 3G solution significantly reduced the thrip population than the untreated control and chemical treatment. A ratio of 1:5 of 3G to water significantly reduced the population level of thrips than in 1:10 and 1:20 ratios of 3G to water. Abamactin treatment also reduced the population level of thrips. The 3G solution diluted at the ratio of 1:5 can be used as an alternative to synthetic chemical insecticides.

Keywords: 3G Solution, Chilli, Control, Eco-friendly, Thrips

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Circulatory Metal Concentrations in Cattle in Padaviya and Kandy

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The bioaccumulation of metals in the bodily systems can cause toxicities. Such possibility is suspected in the aetiology of Chronic Kidney Disease of unknown origin (CKDu) in Sri Lanka. This study was carried out to determine the bioaccumulation of metals in free grazing cattle in CKDu affected and non-affected areas. Total of 80 blood and serum samples (n=43 from CKDu affected Padaviya; n=37 from non-affected Kandy) were collected and processed for further analysis using microwave digestion. High throughput Inductively Coupled Plasma Mass Spectrophotometry (ICP-MS) approach was used to determine the metal concentration in blood and serum. Out of 70 spectra, nine trace metals (Al, Zn, Mn, Cu, Se, Co, V, Sr and Ca) and three heavy metals (As, Cd and Cr) were selected to assess the differential presence in cattle blood and serum in two sets of samples. Mean concentrations (ppm) of As, Cd and Cr in the blood samples from Padaviya vs Kandy were, 0.0106±0.0009 vs 0.0111±0.0009, 0.0017±0.0003 vs 0.0010±0.0002 and 0.6020±0.0470 vs 0.6080±0.0410, respectively. Mean concentrations (ppm) of As, Cr and Cd in the serum samples from Padaviya vs Kandy were 0.0271±0.0021 vs 0.0323±0.0067, 0.9910±0.0650 vs 0.8660±0.0790 and 0.0043±0.0006 vs 0.0030±0.0004, respectively. Concentration of Cd in cattle blood samples from Padaviya was significantly higher than that in Kandy Samples ($P<0.05$). Trace metals concentrations varied in the two sample sets while Co, Se, Sr were significantly ($P<0.05$) higher in Padaviya blood samples. Both blood and serum samples from Padaviya had significantly ($P<0.05$) higher V, while both blood and serum samples from Kandy contained significantly higher ($P<0.05$) Cu. Since serum Cd, Cu and Mn were in higher concentration than the permissible limits in both regions, further studies are warranted to examine their effects on physiological functions.

Keywords: Bioaccumulation, blood, serum, metal concentrations, permissible limit

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Comparative Analysis of Leaf Shape and Leaf Anatomy of Traditional Rice Varieties

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Rice (*Oryza sativa* L.) is the staple food for over half of the world's population. Rice follows a C_3 photosynthetic pathway, a less efficient pathway compared to the C_4 pathway that expresses a higher photosynthetic efficiency. Previous research has reported the possibilities of a conversation from C_3 to C_4 pathways in rice. Early indications of such a conversion are expected to be evident in the leaf anatomy, where the leaf-vein density would be increased and kranz anatomy would be developed with time. While research is underway to develop rice varieties with increased leaf-vein densities as an initial step towards developing a C_4 rice variety, it is possible that varieties with high leaf-vein densities could exist among the traditional germplasm. Leaf-vein density assessment of Sri Lankan traditional rice varieties has not been conducted before. Hence, in the present study leaf-vein density (average vein length between two large longitudinal veins (LLV) and two small longitudinal veins (SLV), and the vein length per unit area (TLV)) of 11 Sri Lankan traditional rice varieties were analyzed by performing a one-way ANOVA and mean separation with Duncan's multiple range test in SAS v9. Among the 11 traditional rice varieties the leaf vein-density parameters LLV, SLV, and TLV were found to be significantly (P<0.05) different. Based on the mean separation, the highest LLV was shown in the variety *Thanthiribalan* and the lowest was represented by seven varieties including *Mahasuduwee*. The highest SLV was reported in variety *Wannidehanala* and lowest was in *Mahasuduwee*. The highest TLV was reported in variety *Mahasuduwee* and the lowest in *Wannidehanala*. Hence, the variety *Mahasuduwee* generally carried a higher vein-density compared to the other varieties, and therefore, can be recommended as a potential variety for studying the C_3 to C_4 photosynthetic pathway conversion in rice.

Keywords: Kranz anatomy, Leaf anatomy, Leaf vein density, C_3/C_4 rice

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Comparison of Physicochemical Properties of Coconut from Different Locations

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Coconut based products such as desiccated coconut, coconut oil, virgin coconut oil (VCO) are used as ingredients for different food products such as confectionary items, cakes and biscuits. The demand for ready to serve foods prepared using coconut is increasing due to consumer preference. The objective of the study was to determine the best growing area of coconut to produce different coconut products. Coconut kernel and coconut water from six districts namely, Kurunegala, Matara, Gampaha, Kegalle and Jaffna were analyzed for physicochemical properties. Moisture, sugar, fat and crude fiber content of fresh coconut kernel were analyzed. pH, total soluble solids (TSS), sodium and potassium contents were also analyzed in coconut water. Vertical and horizontal diameters, nut weight, kernel weight, water volume and color of coconut kernel were analyzed in samples from these six districts, to check whether there is a significant difference ($p<0.05$). Moisture and sugar contents of coconut kernel and pH, TSS, Na, K contents of coconut water showed significant difference ($p<0.05$) among these six districts. Vertical and horizontal diameters, coconut nut weight, coconut kernel weight and nut water volume were somewhat higher in coconuts analyzed from Matara district.

Keywords: Coconut kernel, Coconut water, Physicochemical properties

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Design and Development of a Medium-size Commercial Scale Pyrolyser for Biochar Production

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Biochar is thermally decomposed solid pyrolysis product derived from solid biomass through heating in absence of oxygen or limited supply of air. Uses of biochar as a soil amendment and as an adsorbent in water and air purification are well known; therefore there is a growing demand in Sri Lanka for biochar. However many issues are highlighted in existing pyrolysis techniques adapted by farmers in Sri Lanka such as low capacity, low thermal efficiency, low char recovery, high smoke and particulate emission, and poor quality of produced biochar. Thus, a novel medium-size commercial scale biomass pyrolyser was designed and developed to manufacture quality biochar at farmer's fields. The design parameters were set to fulfil the specific needs of high capacity, higher thermal efficiency, minimum operational and maintenance requirements. The desktop design was first developed to a small scale laboratory pyrolyser and tested for performances by pyrolysing Gliricidia wood biomass. Laboratory prototype has an average thermal efficiency of 28±6% and 37±6% biochar recovery. Based on the design criteria and laboratory prototype evaluation, a medium-size commercial scale pyrolyser was developed to process 120 kg of dried firewood into 45 kg of biochar in a single batch operation. The medium-size pyrolyser attained 16% thermal efficiency and 34% biochar recovery. Pyrolyser can operate in batch that last for six hours during which the human intervention is minimal unlike the existing methods where continuous fuelling is essential throughout the process. The produced biochar satisfied the quality parameters of pH, EC, volatile solids, fixed carbon, ash and bulk density proposed by International Biochar Initiative. The medium-size pyrolyser was introduced to biochar farmers at Wariyapola Agricultural farm, and farmers positively received the technology and were in the opinion that the medium-size pyrolyser will increase the existing production rate and income by 400%.

Keywords: Biochar, pyrolyser, thermal efficiency, char-recovery

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Design and Development of an Automated Drip Irrigation System

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An automated irrigation system was developed facilitating farmer to get information on soil moisture, status of the irrigation system and providing accesses to control the irrigation system through a mobile phone. The system composed of an ATmega328 microcontroller and programmed to facilitate drip irrigation system via activators (solenoid valves) depending on the soil moisture level. Soil moisture sensors (LM393) were used in measuring the soil moisture level in the field. When the moisture level reaches to the minimum level set by the farmer a short message is automatically sent to the mobile phone through GSM (SIM 900) module. The activation or deactivation of irrigation system depend on the farmer's reply through Short Message Service (SMS). Further the developed drip irrigation system could be operated manually through SMS regardless of the moisture level in the soil. The field capacity measured using the gravimetric method was 28.95 % (d.b) and the relevant average sensor reading (20 readings) was 248.43. The moisture content at 50 % depletion level by gravimetric method was 21.71 % (d.b) and the relevant average sensor reading was 241.05. The moisture readings in between field capacity and the 50 % depletion was linear. The system was tested for its functionality in activation and receiving messages to the mobile phone and sending necessary messages for activation of the irrigation system. Manual operating system was included to the control panel for switch the solenoid valves if necessary. The system performed according the program written to the ATmega328 microcontroller and the developed system could be used in similar applications in irrigation.

Keywords: ATmega328 microcontroller, GSM (SIM900) modular, Solenoid valve

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Design and Development of Ultrasonic Application System in Wastewater Treatment

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Ultrasonic treatment of wastewater has been identified as a promising technology for wastewater treatment. This research was conducted to design and develop an environmentally friendly intensive wastewater treatment system. During this study, an ultrasonic humidifier was used as the ultrasonic source. Different tunes of the ultrasonic humidifier from 1 to 11 were applied on different types of wastewater samples (effluent from dairy sales center, PGIA canteen and Meda-Ela water) for different durations of 1, 2, 5, 10, 15, 20, 30 and 50 minutes to find the optimum condition of the humidifier. In order to increase the efficiency of the system, ultrasound treated wastewater was subjected to aeration for enhancing the microbial activity and wetland treatment. Different experiments were conducted to study the effect of ultrasonic application on microbial activity. The effect of ultrasound in wetland was evaluated with and without the introduction of microbes in the aeration system. The breakdown of particles was analyzed by the interpretation of parameters of TSS, TDS and EC values. According to the results, Tune 9 with 50 minutes was selected as optimum condition with the parameter values of EC-1281 µS, TDS- 614 mg/l, TS–11.86 g/l, TSS–2.925 g/l, VSS–2.79 g/l and salinity–0.5‰. Ultrasonic application perhaps did not have an effect on pH. The total efficiency of the system, namely; ultrasonic application, aeration with microbes and treatment in wetland was 35 %, 47%, 30%, and 62% for conductivity, TDS, TS and TSS, respectively. pH and temperature were 7-8 and <40^{o}C, respectively, which complied with CEA standards. The results indicate that ultrasonic application either batch or continuous flow can pre-treat wastewater. This cavitation (<1 MHz) process generated by ultrasound can treat wastewater in an efficient manner. Perhaps, high frequency ultrasound source can reduce the time consumption for the treatment process.

Keywords: Cavitation, Microbial activity, Ultrasonic application, Wetland

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Determination of a Total Volatile Basic Nitrogen Cut-Off Limit for Fresh Herrings (*Amblygaster sirm*) as a Spoilage Indicator

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Total volatile basic nitrogen (TVB-N) is a widely used chemical parameter to determine the microbial spoilage of fresh fish. The aim of this study was to determine a cut-off limit of TVB-N for fresh herrings (*Amblygaster sirm*) to confirm the consumer safety. Three independent storage trials for fresh herrings were conducted at 0 °C for 21 days. During the storage period, TVB-N content, Total Plate Count (TPC), pH, and sensory evaluation was performed at every two-day time intervals. A strong correlation ($R^2 > 0.9$) between TVB-N content and other parameters was observed. At the 12th day of storage, fish samples reached the sensory rejection level. According to the TPC values of the fish samples, fish were microbiologically unacceptable by the 12th day of storage. However, their pH levels were within the acceptable range. After considering the results of all the experiments, it was determined that 35.75±1.60 mg/100g of TVB-N was the safe cut-off limit for fresh herrings.

Keywords: Total volatile basic nitrogen (TVB-N), Quality index method, Sensory evaluation, Spoilage Indicator

This research was funded by National Aquatic Resources Research and Development Agency (NARA).

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Determination of the Genetic Diversity of Self-pollinating Coconut Forms in Sri Lanka

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Coconut in Sri Lanka are classified into three forms: Tall, Dwarf and Intermediate based on morphological traits and breeding behavior. The dwarf coconuts are naturally self-pollinated. Genetic diversity provides raw material for breeding programs, hence self-pollinating coconut forms are very important as parents in breeding programs. Hybrid coconuts involving a Dwarf parent display precocity, high nut number and tolerance to certain diseases. The current research was conducted to characterize a sample of 43 Dwarf and Intermediate coconut genotypes at 14 SSR marker loci and to determine the genetic diversity within and between the forms. Genomic DNA was extracted and PCR amplification was performed followed by 6% denaturing polyacrylamide gel electrophoresis to visualize the bands. Genotypic data were analyzed using PowerMarker software. Out of 14 marker loci, 10 were polymorphic while the rest were monomorphic. Among them highly informative microsatellite loci for tested sample population were identified. A total of 36 alleles were scored in the 43 individuals ranging from a minimum of one to a maximum of four alleles. A total of 21 heterozygous loci were identified across the 14 marker loci. The results indicated that the Sri Lankan Yellow Dwarf share bands more frequently with Intermediate coconut forms than other Dwarf coconut forms. The dendrogram displayed two main clusters with one cluster including Dwarf forms and Sri Lankan Yellow Semi Tall and the other including Intermediate King Coconuts. The observed genetic and allelic diversity and the heterozygosity give evidence of a certain percentage of out crossing which had taken place even among the naturally self-pollinating Dwarf and Intermediate forms. The information generated from this study can be utilized in identifying genetically diverse parents for future coconut breeding programmes.

Keywords: Coconut, Genetic diversity, Self-pollinating, SSR markers, Sri Lanka

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Determination of the Potential Use of Some Selected Biotic and Abiotic Inducers (Salicylic Acid and *Burkholderia spinosa*) to Manage Anthracnose of Banana

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Anthracnose caused by *Colletrotrichum musae* is a prevalent postharvest diseases of banana. Application of fungicides is not preferred to manage postharvest diseases. However, biotic and abiotic inducers are eco-friendly and is a safer alternative to fungicides. The objective of the present study was to determine the potential of using biotic and abiotic inducers, namely salicylic acid (SA) and *Burkholderia spinosa* (BS) to manage anthracnose in banana. An *in vitro* study was conducted to determine the most effective concentrations of SA and BS based on the reduction of sporulation, spore germination, germtube length and mycelial weight of *C. musae*. The most effective concentrations determined by the above studies were applied as dip treatments before and after the inoculation of *C. musae* on banana and the effect of dip treatment on lesion development, Ripening Index (RI) and Disease Index (DI) were determined. Moreover, β-1,3 glucanase and chitinase activity on the peel tissues were quantified spectrophotometrically ten days after treating the fruits with SA and BS. Sporulation, spore germination percentage, germtube length and mycelial weight were significantly (P<0.05) reduced by the two treatments in comparison to the control (untreated) and 2 mM of SA and 1x10^8CFU/mL of BS were the most effective concentrations. Treating with SA and BS showed no significant difference (P<0.05) on RI and DI in comparison to the control. At the 10th day after treatment, anthracnose lesion development was significantly (P<0.05) reduced by SA and BS in *C. musae* inoculated banana, irrespective of the time of treatment (i.e. before or after the inoculation). However, the post inoculation dip treatment was more effective than treating banana prior to inoculation. Chitinase and β-1,3 glucanase activity was higher in SA and BS treated banana than in the untreated control, though there was no significant difference (P <0.05) between SA and BS treatments.

Keywords: Anthracnose, banana, β 1,3 glucanase, *Burkholderia spinosa*, Salicylic acid

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Development of a Food Ingredient Using the Soy Waste from Soy Sauce Industry

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A trend exists in the food industry to use waste/ by-products generated during food processing operations to develop new food products/ ingredients to make processing operations economical and as a mean to manage waste. Soy waste was analyzed to determine its suitability for reprocessing. Proximate composition of soy waste resulted in, 53.6 ± 0.32% moisture, 10.15 ± 0.04% crude protein, 9.45 ± 0.13% crude fat, 03.83 ± 0.92% crude fiber, 17.89 ± 0.82% ash and 5.10% of carbohydrates. Sodium content was found to be 57.75 ± 0.03 g per 1 kg of soy waste. The desalted soy waste by stirring with water (250 mL of water per 100 g) was selected to develop a soup seasoning cube. Level of spices and other ingredients were determined through preliminary trials. Three formulations prepared using fresh soy waste without heat treatment, dry soy waste of 4.6% moisture content and roasted soy waste were evaluated for preference against control sample for color, aroma, taste and overall acceptability through sensory analysis. Selected best formulation which was prepared from fresh soy waste was adjusted for four moisture levels. Those four formulations were evaluated for the same sensory attributes using a 7- point hedonic scale. The soup seasoning cube which was prepared from desalted soy waste with 51.5% moisture content was found to be significantly preferred ($p<0.05$) over other treatments. Proximate composition of the most preferred soup seasoning cube was, 55.84 ± 0.61 moisture, 7.48 ± 0.27% crude protein, 11.30 ± 0.54 % crude fat, 4.50 ± 0.30% crude fiber, 9.84 ± 0.11% ash and 11.04% carbohydrates. During four weeks of storage at 28 ± 2 °C, there were significant changes ($p<0.05$) in moisture content, pH and acid value.

Keywords: Soup seasoning cube, Soy sauce, Soy waste

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Development of a Robotic Arm Feeding Mechanism for a Chilli Milling Process

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A robotic arm feeding mechanism was developed for feeding chilli to a chilli grinding mill with a feeding rate required by the mill. The rate of feeding is important in achieving the efficiency and the required particle size in micro-pulvarizer type chilli mills. The bucket or auger feeding methods cannot be used since chilli is not free flowing due to its physical nature (long narrow conical shape with wrinkled and glossy surface). At present manual feeding is practiced in chilli mills and it would be drudgeries to feed manually for mills with larger capacities. Further manual feeding leads to several problems including quality and efficiency of milling due to change in feeding rates. A robotic arm feeding mechanism with a finger grabber was fabricated and automated by using PIC16F684 micro controller and an ATmega328 microcontroller, micro switches, DC motors, stepper motors, for this purpose. The robotic arm grabber was placed on top of the chilli containing trough (2.5m wide, 10.5m long, 1.25m high) and the finger grabber could grab 1.640 ±0.128 kg of chilli from the bulk in a single operation. The average time taken for one complete cycle of grabbing chilli, lifting the grabber, turning the arm on to the conveyer and releasing chilli on to the belt conveyer, varies from 13 s and 27 s respectively depending on the height of chilli in the trough. The feeding rate varies from 440.6 kg/h and 218.66 kg/h when chilli is grabbed from the top and the bottom layers respectively. The feeding rate is automatically controlled according to the power consumption of the chilli mill measured using a hall effect sensor and communicating with the robotic arm with bluetooth technology.

Keywords: Robotic arm, stepper motor, chilli feeding, microcontroller

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Development of Callus Induction Technology for Anther Culture of Selected *Capsicum* Varieties

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Plant breeding programmes can be accelerated through double haploid plant production. One of the easier ways to produce double haploid plants is anther culture. This experiment was carried out to initiate anther culture technology for *Capsicum annuum* L. with three varieties of *Capsicum*: Lanka Yellow Wax(LYW), Hungarian Yellow Wax (HYW), 1782 and, three growth media, using RCBD. Anthers were selected based on microscopic observation. The three callus induction media included MS basal medium and different concentrations of hormones 2,4-D (1 mg/L), 2,4-D (2 mg/L) and NAA (1 mg/L) + BAP (1 mg/L). Cultured anthers were incubated under dark for 14 days at 25^{o}C for anther callus induction. Data were collected on number of anthers plated and number of calli produced by anthers. After the callus induction, selected calli were transferred into a regeneration medium, which included MS basal medium and 0.1 mg/L kinetin. Regenerating cultures were incubated under 16 h light and 8 h dark conditions at 25 ^{o}C. Observations were taken for callus growth, appearance and greening of callus. A significant effect on anther callus induction (P<0.05) among the three media could not be observed. In the variety comparison, a significant difference (P<0.05) could be observed between LYW and 1782 and between LYW and HYW. The highest callus induction percentage was observed with LYW (53%). In the regeneration medium, calli behaved in different ways. White crystalline calli responded well to the regeneration medium. Callus enlargement and greening at later stage were observed. Light brown colored calli did not show enlargement and greening like in white crystalline-form calli. Varieties responded differently for the anther callus induction. Variety LYW showed better anther culture ability than other varieties significantly (P<0.05). Further refinement of regeneration medium is needed.

Keywords: 2,4-D, Anther culture, Callus induction, *Capsicum*, MS medium

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Development of Good Manufacturing Practices Guidelines for Nestle Lanka Sampling Operations

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Quality and safety are first priorities in the food industry. Good Manufacturing Practices (GMP) are the procedures applied by the food industry to ensure the safety and quality of their finished products. Food manufacturing organizations are obliged to follow the GMP and maintain hygienic standards. Nestle Lanka PLC is one of the leading multinational food and beverage producers in Sri Lanka. However, the GMP guidelines are not adequately developed for their sampling operations. Thus the objective of the present study was to develop GMP guidelines for sampling operations of Nestle Lanka PLC to obtain a GMP certificate. During the study, existing conditions and working procedures of the mobile vehicles were observed. Mobile vehicle layout and design, process flow, raw material handling, mobile vehicle hygiene, personal hygiene, storage and transportation, record keeping, pest control and waste management practices were studied. This was performed by interviewing mobile vehicle employees using GMP gap analysis checklist, observing the current sampling procedures and studying vehicle audits conducted by Sri Lanka Standards (SLS) Institute. Furthermore, the current hygiene and street food manufacturing practices were compared with the code of practices for general principles of food hygiene (SLS 143:1999). The gap between the standards and the present situation of the sampling operations was then identified. Sanitary problem was found as the main reason for the quality reduction of the sampling operations. Thus proper hygienic and sanitary practices were developed as GMP guidelines for Nestle street foods to ensure the product quality and safety to obtain GMP certification.

Keywords: Good Manufacturing Practices (GMP), sampling operations, food hygiene, personal hygiene, street foods

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Development of Low Salt Chicken Sausages by Incorporating Potassium Chloride and Yeast Extract

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Present study was conducted to develop low salt chicken sausages by incorporating potassium chloride (KCl) and yeast extract. First experiment was designed to identify the best replacement level of salt by KCl. Control sausage sample was prepared adding 1.8% of sodium chloride (NaCl) and treatments were prepared by replacing NaCl by 40% (T2) and 60% (T3) with KCl. Results of sensory evaluation revealed that the saltiness, taste, odour, colour, texture and acceptability of control sample and T2 were not significantly different ($P>0.05$). Sensory quality of T3 treatment was significantly lower ($P<0.05$) than other two treatments. Therefore, T2 treatment was selected and yeast extract was incorporated for further development of flavour of the sausages. Second experiment was conducted with four treatments (T1-1.80% NaCl, T2-1.08% Nacl + 0.72% KCl, T3-1.08% NaCl + 0.72% KCl + 0.40% Yeast extract, T4-1.08% NaCl + 0.72% KCl + 0.60% Yeast extract). According to the results of sensory evaluation, values for taste, saltiness and acceptability were significantly higher ($P<0.05$) in T3 treatment compared to other treatments. The pH, water holding capacity, shear value and 2-thiobarbituric acid reactive substance values were not significantly different ($P>0.05$) between four treatments. Dry matter and crude protein content of T4 treatment sausages were significantly higher ($P<0.05$) than other treatments. Sausages from T1 treatment had the lowest crude protein content. Dry matter and crude fat contents were significantly lower ($P<0.05$) in T2 treatment compared to other treatments. T1 treatment had the highest crude fat content. Ash and crude fiber contents were not significantly different ($P>0.05$) between treatments. Therefore, present results showed that salt content of sausages can be reduced up to 1.08% by incorporation of KCl (0.72%) and adding yeast extract (0.4%).

Keywords: Salt, potassium chloride, yeast extract, sausages

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Development of Spice Incorporated Vinegar from Pineapple Waste

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A large amount of pineapple waste is generated in fruit processing industry and this can be utilized to produce vinegar as a mean of waste handling. The outermost portion of the pineapple rind (first pineapple peel) was cleaned with potable water and then water was added at 1:2 ratio and heated for 30 min. Then extract was taken by filtering and sugar was added to make the juice 20º brix. The mixture was fermented for 10 days after adding 0.5% (w/w) *Saccharomyces cerevisiae* (baker's yeast). The fermentation process was carried out until the ethanol content reached 11.8% (v/v) and pH was about 3.8 in glass bottles. Then the mixture was inoculated with *Acetobacter aceti* and acetic fermentation was carried out until the total acidity measured as acetic acid reached 6.07% over 15days using aerobic conditions. Then the mixture was clarified by passing through active carbon and centrifugation. Cardamom, mace and black pepper were incorporated at 2% (w/w), 2% (w/w) and 1% (w/w), respectively after several preliminary trials. Then pasteurization was performed at 72 ºC for 3 min to obtain the final product. Vinegar contained 2.10% of total solids, 6% of titratable acidity, 3039 of permanganate oxidation value, 325 of alkaline oxidation value and 639of iodine value. There were no detection of pathogenic microorganisms like *Salmonella*, *E. coli*. The color, aroma, flavor and overall acceptability of spice incorporated vinegar were significantly different ($p<0.05$) from those of vinegar with no spices

Keywords: *Acetobacter aceti*, Brix value, Fermentation, Titratable acidity, Vinegar

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Effect of Dietary Probiotics Compared to Antibiotics on Production, Intestinal Health and Meat Quality in Broiler Chickens

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Excessive use of prophylactic antibiotics in poultry diets contributed to the antimicrobial resistance (AMR) for antibiotics. Finding an alternative is an urgent need to prevent further collaboration to AMR which is a serious public health issue. Therefore, an experiment was conducted to investigate the effect of dietary probiotics compared to antibiotics, on growth performances, intestinal health and meat quality in broiler chickens. Experimental diets were based on maize and soya bean meal. Five dietary treatments were prepared by adding: 1. Antibiotic, Zinc Bacitracin (Positive control), 2. No growth promoters (Negative control), 3. *Bacillus subtilis* isolated from healthy poultry (>10^{10}CFU/g), 4. Commercial probiotic preparation containing *Bacillus* species (>10^{10}CFU/g), 5. A combination of *Bacillus subtilis*, commercial probiotic, *Lactobacillus* species (>10^{8}CFU/g) and *Saccharomyces* species (10^{5}CFU/mL) into basal diet. The inclusion rate of growth promoters were 0.1 g/kg of basal diet. In fifth treatment all four probiotics combined at equal level: each at 0.025/0.1 g of the combination. Proximate nutrient composition was constant in experimental diets. Each treatment diet, fed from day one, replicated in 6 pens of each allocated with 14 birds. A total of 420 day old Cobb-500 broiler chicks were randomly allocated into the experimental design. The body weights, feed intakes, serum samples, intestinal health and meat quality were taken during the experimental period. Statistical analysis revealed that the commercial probiotic in diet improved body weight gain and reduced the feed conversion ratio ($P<0.05$) when compared with the negative control diet fed birds. A comparatively higher *Clostrdium perfringens* infection was identified with higher serum antibody development against *C.perfringens* α-toxin, ($P<0.05$) in negative control fed birds compared to antibiotic and commercial probiotic fed bird at fifth week of age. In conclusion, *Bacillus* species containing probiotics can be used as an alternative to antibiotic growth promoters in broiler industry.

Keywords: Antibiotics, probiotics, *Bacillus subtilis*, growth performances

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Effect of Floor Space and Type on Dairy Cattle Welfare in Central Province of Sri Lanka

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Dairy farming is a growing industry in Sri Lanka and milk production can be increased by improving dairy cattle welfare. However, there is limited research conducted on dairy cattle welfare and behavior related to floor space in Sri Lanka. The goals of this study were to investigate the effect of floor space and type on dairy cattle welfare and to compare the cow length and width measures with actual floor length and width of dairy farms in central province. Cattle welfare was assessed using cow behavior and cleanliness scores. Friesian milking cows in 2nd, 3 rd or 4th parity from 81 farms were selected to measure the cleanliness and cow dimensions (n=230). Of the 230 cows, 37 cows were selected to measure the standing and lying times and bouts (n=37). Data loggers were used to assess the standing and lying behavior. Ideal animals were selected within 37 animals to measure the eating and drinking behavior using video cameras (n=14). Animals used for assessing the behavior were fed by green grasses, poonac, cattle feed and vitamin under similar management systems with non-slippery and non-damaged floors. Results revealed that the floor length provided to dairy cattle in central province is significantly higher than the cow length ($P<0.05$). However, no significant difference was observed between cow width and given width. Dirtiness of cows were significantly increased with increasing actual length ($P<0.05$). There was no significant effect of space on cattle behavior. Standing bouts on rubber floor was significantly higher than the concrete floor ($P<0.05$). Average lying time was 12.6h and average lying bout was 12.9. Average standing time was 11.4h and average standing bout was 9.5. Average eating time was recorded as 5.4h and drinking time was 26.9 min in central province, Sri Lanka. Overall, floor space and type influenced dairy cattle welfare.

Keywords: Dairy cattle welfare, floor space, behavior, cleanliness score

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Effect of Flooring on Hock Lesions and Lameness in Dairy Cattle in the Central Province, Sri Lanka

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This study was conducted to estimate the prevalence of hock lesions and the relationship of hock lesions with flooring characteristics such as length, width and cleanliness of the cow lying area in cattle sheds of the Central province of Sri Lanka. Due to lack of studies on hock lesions and lack of awareness regarding the importance of lameness in cattle in Sri Lanka, occurrence of high economic loss and welfare concerns are evident. Hock lesions are the major cause of lameness other than sole ulcers, white line disease and foot rot. This study was conducted using milking cows, dry cows and heifers from 81 tie stall farms in the Central province, Sri Lanka. Hock lesions counts were obtained using a FLIR T420 Infrared Thermography camera and analyzed by using FLIR tools plus software. Length, width and cleanliness of cow lying area were taken as flooring parameters. Lameness ranking was done using standing gait attributes for 39 cows to determine the relationship between hock lesions and lameness. Statistical analysis was performed using SPSS 16.0 software. Prevalence of hock lesions in the Central province was 74.9%. A significant positive correlation ($P<0.05$) was revealed between the number of hock lesions and flooring characters of cow lying area. Among 87.5% hock wounded cows, 60.7% were lame and all lame cows had at least one hock lesion. In contrast, non-lame cows had no hock lesions. There existed a significant difference ($P<0.05$) between the temperature hock lesions and that of skin. Information originated from this study on the effect of flooring on hook lesions and lameness will be useful to provide suitable flooring requirements when designing cattle sheds to maximize production while protecting welfare aspects of dairy cows in Sri Lanka.

Keywords: Hock lesions, lameness, flooring, infrared thermography

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Effect of Hydro Climatic Factors on Size and Diversity of Catch of Fish in Some Major Perennial Reservoirs

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Objective of this study was to determine the effect of hydro climatic factors such as rainfall (RF) and water level (WL) on size and diversity of the catch in Victoria(23.80 km^2), Sorabora (4.21 km^2) and Ulhitiya (13.0 km^2) reservoirs. Data were collected two times per week from a random sample ofactive fishermen of each reservoir fromJanuary, 2014 to December, 2015. Total fish catch (all species) was divided by the no. of boats and no. of nets used to obtain catch per unit effort (CPUE) per boat and per net, respectively. Shannon index was used to measure diversity of fish species in the catch. Differences in CPUE and diversity among tanks and months of the year were compared using Analysis of Variance and Duncan's Multiple Range Test. Sorabora, Victoria and Ulhitiyatanks were significantly different ($P<0.05$) in mean CPUE per boat (22.2, 19.9 and 9.2 kg day^{-1} , respectively) as well as per net (1.2, 3.7 and 1.3 kg day^{-1}, respectively). The CPUE fluctuated significantly with month of the year in all reservoirs ($P<0.05$). Mean CPUE reached the peak in Victoria, Sorabora and Ulhityaas 4.9 kg $net^{-1}day^{-1}$ (29.0 kg $boat^{-1}$ day^{-1})in May, 2.9 kg net^{-1} day^{-1} (58.0 kg $boat^{-1}$ day^{-1}) in September, and 1.8 kg net^{-1} day^{-1} (19.1 kg $boat^{-1}$ day^{-1}) in January, respectively. Multiple linear regression analyses showed that CPUE (kg $boat^{-1}$ day^{-1}) in Victoriaand Ulhitiya tanks increased significantly by 0.13 and 0.08, respectively with increase in daily RF of 1mm ($P<0.05$). In Sorabora, CPUE increased by 10.9 kg $boat^{-1}$ day^{-1} with reduction of WL by 1m ($P<0.05$). Sorabora tank had significantly the lowest diversity compared with the other two reservoirs ($P<0.05$). No significant effect of RF, WL or month of the year was found on diversity of the catch in any reservoir ($P>0.05$).

Keywords: Biodiversity, catch per unit effort, Sorabora, Ulhitiya, Victoria

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Effect of processing on Antioxidant Activity, Total Phenolic Content and Ascorbic Acid Content of Pomegranate (Punica garantum L.)

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The present study was carried out to determine the effect of processing (pasteurization, dehydration) on Antioxidant Activity (AA), Total Phenolic Content (TPC) and Ascorbic Acid Content (AAC) of Fresh whole arils and arils without seed, pasteurized juice of whole arils and arils without seed and dehydrated whole arils of threeSri Lankan and one Indian pomegranate cultivars. Healthy matured pomegranatefruits of Nimali,Daya, and Nayana were obtained from Kalpitiya Regional Research Station while the Indian cultivar was purchased from the local market.The whole aril and arils without seed were separately macerated to prepare juice. In another experiment, the arils were separated and dehydrated. The products obtained and evaluated for their AA, TPC, and AAC.Ascorbic acid content was determined using 2, 6-Dichlorophenol-Indophenol titration method and expressed as mg per 100 g of extract. Total phenolic content was determined using Folin-Ciocalteau's colorimetric method and expressed as mg (GAE) per g of extract.Antioxidant activity of the sample extracts were measured using DPPH radical scavenging assay and expressed as IC_{50} values of mg/ml.Nayana cultivar (without seed) showed the highest AAC with a value of 64.44mg/100g while the Indian cultivar showed the lowest. The reduction of AAC ranged between processed samples, 91.75% to 1.26% with the highest reduction observed in pasteurized juiceof Daya while the lowest reduction was observed in dehydrated arils of Nayana. Nayana cultivar (with seeds) showed the highest TPC with a value of 32.47 mg (GAE)/g. The reduction of TPC ranged between 61.02% and 3.7% for pasteurized juice. TPC showed a positive relationship with dehydration. Nayana showed the highest increment after dehydration (221.65%).Fresh with seed extract ofNayana showed the highest antioxidant potential (IC_{50}value of 0.188±0.001mg/ml).AA in all cultivars drastically decreased after pasteurization and increased after dehydration. AAC and TPC of pomegranate showed positive relationships with AA.

Keywords: Antioxidant activity, AAC, IC_{50} , Pomegranate (*Punica granatum L.*), TPC

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Effect of Seasonal Variation on the Physicochemical Characteristics of Carrageenan Extracted from *Kappaphycus alvarezii* Species Grown in the Northwestern Seas of Sri Lanka

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Carrageenan is a sulfated polysaccharide commonly used as a thickening, stabilizing and gel forming agent in food industry. At the present, global carrageenan requirement is mainly fulfilled by carrageenan extracted from commercially grown *Kappaphycus alvarezii* species. During this study, effect of seasonal variation on the physicochemical properties of carrageenan derived from *Kappaphycus alvarezii* species grown in the Northeastern seas of Sri Lanka was investigated. Seaweeds were collected in different months of Southwest monsoon and first inter-monsoon, and they were sun-dried at harvesting location. The sun-dried seaweeds were washed to remove sand and dried at 70°C for 16 h in a cabinet dryer. Next, they were treated with 3% wt. KOH, and carrageenan was extracted using hot water (90-95°C). The carrageenan dissolved in hot water was precipitated using a 2% wt. KCl solution. The optimum concentrations of KOH and KCl were determined using a set of preliminary trials. The yield of carrageenan obtained from the samples varied from ~50-70% wt. Fourier transform infrared spectroscopy showed that the mixtures mainly consist of κ- and ι-type carrageenan. Gels were prepared from these extracts and they were assessed for gel strength, gelling and melting temperatures and syneresis index. Deviations were observed for the above parameters among the samples and they were generally attributable to the purity of the carrageenan extracts (total sugar content) and/or sulfate content (types of carrageenan present and their relative amounts). According to the results, highest quality carrageenan in terms gel strength can be obtained from *Kappaphycus alvarezii* harvested during May-June period of Southwest monsoon.

Keywords: Carrageenan, *Kappaphycus alvarezii*, Seasonal variation, Physicochemical characteristics

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Effect of Soaking and Steaming Time on Quality of Parboiled Rice of BG 360 and BG 358 Varieties

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This study was aimed at investigating the optimum soaking and steaming time of BG 360 and BG 358 rice varieties. BG 360 samples were either fully or partially parboiled, BG 358 samples were fully parboiled prior to milling. Fully parboiled samples were soaked at 60, 70 and 80 ^{o}C for 1.5/2/3.5 h, 2/2.5/3 h and 45 min. Then as a second soaking treatment, all the samples were soaked in ambient temperature (30 ^{o}C) for 2/4 h, 2/3 h and 60 min, respectively. Partially parboiled rice samples were soaked at 40 ^{o}C and 50 ^{o}C for 2/3 h and 1/2 h, and then samples were further soaked in ambient water for 3 and 5 h respectively. Fully parboiled rice separately steamed for 3.5, 5 and 7.5 min, partially parboiled rice steamed for 1, 2 and 3 minutes. Altogether 30 parboiled treatment combinations were tested either as fully or partially parboiled process. Head rice yield (HRY %), broken rice percentage (broken %) and whiteness value of milled samples were determined. Fully parboiled BG 358 rice, soaked at 70 ^{o} C for 3 h, steamed for 7.5 min gave the highest HRY of 75.9±2.7 % and the lowest broken percentage of 3.7±0.9 %. However, fully parboiled BG 360 at 60 ^{o} C for 3.5 h, steamed for 5 min, showed the highest HRY of 66.2±2.3 % and the lowest broken percentage of 4.5±1.1 %. Partially parboiled BG 360 rice soaked at 40 ^{o}C for 3 h, ambient temperature for 3 h and 3 min steaming showed highest HRY and lowest broken percentage of 67.7±4.5% and 14.3±3.1% respectively .Highest whiteness value (L) of 33.2±2.14, showed by partially parboiled BG 360 rice soaked at 40 ^{o} C for 2 h, ambient temperature for 5 h and steamed for one min.

Keywords: Broken rice percentage, HRY, Parboiling, Rice, Whiteness

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Effect of Storage Time and Added Antioxidants on Rancidity and Nutritive Value of Rice Polish

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Rancidity is a major problem in rice polish which reduces its full feeding value and limits its use in animal feeds. The main purpose of this study was to understand how rancidity develops during storage, the effect of antioxidant on rancidity and to determine the effect of rancidity on the nutrient levels of rice polish. Samples of fresh rice polish were stored at room environment with or without antioxidant (Hatox at 0.25kg/ton) in triplicate for 30 days. Free fatty acid (FFA) levels of samples were analyzed twice a day during the storage as a measurement of rancidity. The major nutrient contents of rice polish were analyzed on 1st, 10th, 20th and 30th day of storage. A practical diet replacement assay was conducted using 25 days old broiler chickens to estimate the metabolizable energy (ME) values of rice polish when it is fresh and after 18 days of storage under room conditions. Production of FFAs was increased throughout the storage period irrespective of addition of antioxidants but the rate of FFA production was lower with antioxidants. Though antioxidants did not control the FFA production significantly ($P>0.05$) up to the 23rd day of storage, the FFA production was significantly ($P<0.05$) lower in antioxidant added rice polish after the 23rd day of storage. Results indicated that hydrolytic rancidity, which was not controlled by the antioxidant, occurred mainly during the initial 23 days of storage and the oxidative rancidity became dominant thereafter and was reduced by the antioxidant. However, the storage time or the added antioxidant did not influence crude protein, ether extract, crude fibre, ash, acid detergent fibre, neutral detergent fibre and metabolizable energy contents of rice polish.

Keywords: Oxidative rancidity, energy, storage time, rice polish

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Effect of Supplemental Carbohydrase Enzyme on the Feeding Value of Palm Kernel Cake for Broiler Chicken

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β-mannan is one of the main Anti Nutritive Fibers (ANF) present in Palm Kernel Cake (PKC). The usage of PKC is limited in poultry diets due to the absence of required endogenous enzymes which can hydrolyze β-mannan, hence β-mannanase is introduced as an exogenous carbohydrase enzyme. A feeding trial was conducted using 300, day-old Cobb 500 chicks. A Complete Randomized Design was adopted when assigning birds to five different treatments with four replicates per treatment and 15 chicks per replicate. The five diets contained 0% (control), 10%, 15%, 20% and 25% PKC with β-mannanase at 0.04%. Average feed intake and body weight was measured weekly and at the end of the fourth week five randomly selected birds from each replicate were introduced to metabolic cages for a metabolism study. On the sixth week, five birds, randomly selected from each replicate were slaughtered. Live and dressed weights, fat deposition, gizzard and liver weights were measured. Feed Conversion Ratio (FCR), Dressing percentage (DP %) Protein Digestibility% (PD %), Fat Digestibility% (FD %) and Metabolizable Energy (ME) were calculated. Data were subjected to Analysis of Variance (ANOVA). The birds fed on 15% PKC diet had significantly ($p<0.05$) higher body weight gain. Feed intake of birds were not significantly different ($p<0.05$). 15% PKC diet fed birds had significantly ($p<0.05$) lower FCR. Birds fed the control diet had significantly ($p<0.05$) higher ME, PD and total fat deposition. Birds fed 25% PKC had significantly ($p<0.05$) higher FD and DP. There were no significant ($p<0.05$) difference in gizzard and liver weights of birds fed with five different diets. The study concluded that diets containing 15% PKC and supplemented with 0.04% β-mannanase can be fed to broiler chicken without any adverse effect.

Keywords: Palm kernel cake, β-mannan, Carbohydrase enzyme, β-mannanase, Broiler performance

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Effects of Lattice Structure Reduced Water on Extractability of Food Constituents Contributing to Colour, Flavour, Aroma and Antioxidant Properties

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Lattice structure reduced water (LSRW) possessing reduced molecular cluster structure was produced using a water electrolyzer and compared with normal potable water (NPW). Significant differences ($p<0.05$) in oxidation reduction potential (-350 to -450 mV and 75 to -150 mV), pH (10.20±0.08 and 6.82±0.19) and nuclear magnetic resonance frequency (55 and 120 Hz) of LSRW and NPW, respectively, were evident. LSRW and NPW were mixed with different quantities of mango pulp (1:4, 1:8, 1:10- w/v), green tea (1:75, 1:100, 1:125- w/v), cinnamon powder (1:75, 1:100, 1:125-w/v), fresh ginger extract (1:75, 1:100, 1:125- w/v), turmeric powder (1:300, 1:400, 1:500-w/v) and chili powder (1:75, 1:100, 1:125-w/v) to investigate their effects on antioxidant and sensory properties. Regardless of the dilution level, antioxidant properties, analyzed using 2, 2-diphenyl-1-picrylhydrazyl method,of all the samples prepared using LSRW were significantly higher ($p<0.05$) than that of NPW. Colour intensity of mango RTS, green tea, turmeric powder and chili powder samples, analyzed according to directional paired comparison test by thirty panellists, pre-screened for colour, revealedsignificantly higher ($p<0.05$) colour intensity of samples prepared using LSRW than that of NPW, regardless of the dilution level. Preference for flavour and aroma was evaluated using paired preference tests and thirty consumer panellists. Preference for flavour of mango RTS, green tea, cinnamon tea and ginger tea diluted with LSRW, except for the initial dilution ratios, was significantly higher ($p<0.05$)than that of NPW. Preference for aroma of all the samples prepared using LSRW were significantly higher ($p<0.05$) than that of NPW, regardless of the dilution level. Use of LSRW instead of NPW for food manufacturing could possibly contribute to better antioxidant and sensory properties of the finished products due to better extractability of food constituents by the former than the latter.

Keywords: Lattice structure reduced water, Water electrolyzer, Antioxidant and sensory properties

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Evaluating the Antioxidant Properties of Traditional and Improved Rice Varieties – Rice Bran Analysis

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Rice is the staple food of more than half of the world's population which provides most of their calorie requirement. Rice contains a unique complex of naturally occurring antioxidant compounds. This study was carried out to evaluate antioxidant properties (AP) of eleven rice varieties (RV) and to determine the effect of heating, parboiling and polishing on AP. This study was carried out using the rice bran (RB). The AP was evaluated using total phenolic content (TPC), 1,1-diphenyl-2-picryl-hydrazyl (DPPH) radical scavenging and ferric reducing antioxidant power (FRAP) *in vitro* antioxidant assays. RB was extracted using 80% methanol. All RB samples were autoclaved (121^0C, 15psi, 20 min) to determine the effect of heating. The variety "CIC White Basmati" (whole grain)was used to determine the effect of polishing (0%, 40%) and parboiling ($65\pm2\ ^0$C for 300 min). Significant differences ($P<0.05$) were observed among bran extracts of selected RV for investigated antioxidant properties ($P<0.05$).The TPC (Mean ± SD) of selected rice varieties ranged from 286.77 ± 9.23 to 1623.54 ± 3.75 mg GAE/100 g. The RV of dark color pericarps (DCP) recorded higher TPC than light color pericarps (LCP). Both DPPH and FRAP assays recorded higher antioxidant activity values in RV having DCP than LCP.Significant difference ($P<0.05$) in AP was observed between raw and heat-treated samples. The AP of selected RV decreased with heating but the change of TPC was not significant on varieties "Suwandel" and "Bg 352". Polishing significantly ($P<0.05$) reduced the TPC and AP in the variety CIC White Basmati, but the parboiling did not affect. According to the results"Kaluheenati", "Madathawalu", "CIC 300" and "At 353" recorded higher AP while "Bg 352", "CIC White Basmati" and "Suwandel" recorded lower values.

Keywords: Antioxidant properties, Pericarp, Rice varieties, Total phenolic content

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Evaluation of Antioxidant Activity along the Processing Steps of Instant Tea Cordial Manufacture and during Shelf Life

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Instant tea cordial is a concentrated form of tea extract which is used to make ready- to- drink beverages. The manufacturing process comprisesseven major steps; extraction, de-leafing (1stcentrifugation), evaporation, seeding, de-creaming (2nd centrifugation), blending and aseptic packaging. Ascorbic acid (AA) is added at blending as a food ingredient.The study was carried out to determine degradation of antioxidant activity (AOA) and total polyphenol content (TPC) along the processing steps and during the shelflife of tea cordial. AOA was measured using DPPH (1, 1-diphenyl-2-picryl-hydrazyl) freeradical scavenging assay and TPC was determined using Folin-ciocalteu's method. Both AOA and TPC were expressed as gallic acid equivalent (GAE). To compare changes occurring during processing, AOA% and TP%of tea solids were calculated. Comparisonbetween each processing step indicated that, de-leafing reduced both AOA% and TP% of tea solids. During blending,AOA% decreased significantly ($p<0.05$) but TP% remained unchanged. During seeding, TP% decreased significantlywithout affecting the AOA%. Other individual steps showed nosignificanteffect on AOA% and TP%but the combined effect of all steps was significant. Supplementary AA increased both TP and AOA concentrations significantly. Overall manufacturing process reduced the AOA% and TP% by 45% and 40%, respectively. The ratio between AOA% and TP% was approximately 0.52 at each step. During the storage period of 10 weeks, both AOA and TPconcentrations of tea cordial did not change significantly. AOA and TP concentrations (mean±SE) were 4.96±0.03 gl^{-1} and 9.77±0.24 gl^{-1}, respectively. Analysis of AOA and TP during processing steps in 3 batches indicated that the standard error of measurement was small indicating good uniformity among batches. The study helps for process optimization to preserve AOA and TP.

Keywords: Antioxidant activity, Polyphenol content, Processing steps, Shelf life, Tea cordial

This work was funded by the Ceylon Tea Services PLC, Peliyagoda, Sri Lanka.

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Evaluation of Clean Milk Production Practices and the Microbiological Quality of Raw Milk at Different Links of Commercial Dairy Value Chain in Galaha Area of Central Province

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The objective of this study was to evaluate the clean milk production practices and microbiological quality of raw milk at different links of a dairy value chain in Galaha milk chilling center area in Central Province of Sri Lanka. A total of 20 dairy farms were selected randomly with regard to the 8 milk collecting points. All these farmers were interviewed for the survey based study using a semi structured questionnaire. Then, raw milk samples were collected aseptically from udder, milk can at farms, collecting points and chilling centers before chilling for the microbial analysis through determination of Total Plate Count (TPC) and Coliform Count (CC). The milk contaminating bacteria species were identified by further characterization. Average values of TPC for samples collected from udder, milk can at farms, 40 L-transport cans at collecting points and chilling centers were 3.364±0.019, 4.844±0.022, 5.809±0.019, 6.839± 0.024 $\log_{10}$cfu/mL, respectively. The CC of milk samples obtained at udder level, farm milk can, 40 L-milk transport can at collecting points and chilling centers were 1.296±0.015, 2.963±0.007, 3.898±0.018, 4.998±0.016 $\log_{10}$cfu/mL, respectively. Both TPC and CC values of milk samples obtained from udder, milk can at farm showed a significant difference ($P<0.05$). The dominant bacterial species identified from the raw milk samples from milking cans at farm level and collecting points were *Klebsiella*, *Pseudomonas, Proteus*, *Citrobacter and Aeromonas* species. All these species are most likely to contaminate milk through water. These results indicates that the milk produced within the study area can be considered as having substandard microbiological quality due to poor hygienic practices adopted by farmers during milking including handling and thus it may pose a risk to the consumer unless properly heat processed and quality assured before dispatch to the market.

Keywords: Raw milk, microbiological quality, total plate count, coliform count

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Evaluation of Closed Cycle Heat Pump Drying System for Industrial Drying of Selected Spices

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A closed cycle heat pump drying system established in Ruhunu Food Private Limited, Kundasale was evaluated for the efficiency and drying characteristics and air flow resistance of selected spices. The spices studied were onion, coriander, lemon grass, mustard and finger millet. Traditional drying system uses direct sunlight or indirect heat sources. It is difficult to control the drying conditions in sun drying and highly dependent on weather. Also in convective drying systems, hot air is used. But due to high temperature, volatile flavor compounds tend to remove from the product leading reduced the quality of spices. If dehumidified air can be used, the drying can be done at relatively lower temperatures while preserving the volatile compounds. In this study a heat pump drying system was evaluated as an alternate method of drying several spices. SMER value of the evaluated HPD system was 1.9 kg/ kWh. The moisture content of onion was reduced from 85% to 12% (wet basis) within 75 hours. It was able to reduce the moisture content of coriander from 10% to 7% w.b. within 60 hours. Lemon grass dried from 75% to 8% w.b. moisture content in 30 hours. The moisture content of mustard was reduced from 40% to 8% w.b. within 30 hours. Finger millet also get dried from 42% w.b. moisture content to 8% w.b. moisture content in 30 hours. The drying constant of onion, coriander, lemon grass, mustard and finger millet was calculated as 0.08, 0.018, 0.17, 0.21 and 0.19 h^{-1} respectively. According to the results the heat pump system established in Ruhunu Foods Pvt (Ltd) could be effectively used in drying spices at industrial scale.

Keywords: Heat pump drying, Spices, Air flow resistance

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Evaluation of Colorimetric Soil C and its Applicability in Predicting Total N and Available P for Sri Lankan Soils

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Managing soil organic matter (SOM) level is generally considered as an effective way to maintain and improve the productive capacity of soils. The availability of nutrients from SOM depends on the fraction of decomposable SOM and the activity of soil microorganisms. Large fraction of total N (98-99%), P and S (25-50 %) are stored in SOM. Most of the soils in Sri Lanka have less than 2% of SOM. Since high amount of N and P present in organic forms, SOM can be used in predicting total N and P levels in soil. This research aimed to evaluate the applicability of simplified colorimetric method over the laborious titrimetric method (W&B) in organic C determination for Sri Lankan soils, and also in predicting total N and available P contents using the colorimetric organic matter content (C-OM). Twenty nine soil samples (0-30cm depth) were used in this study covering a range of soils in Sri Lanka. All soil samples were analysed using W&B and colorimetric procedure. Total N and available P were determined by Kjeldahl and Olsen method, respectively. SOM contents obtained from W&B and colorimetric method were not significantly different ($p>0.05$) and showed a strong positive correlation ($r=0.99$). There was a positive correlation between C-OM and total N ($r=0.95$) and available P ($r=0.41$) contents. Total N content can be predicted through the model $y=0.05x+0.048$ (where; y = Total N, x = C–OM). Available P also can be predicted through the model$y=6.30x+7.25$ (y=Available P, x=C-OM). Therefore, simplified colorimetric C determination procedure can be practiced instead of laborious time consuming titrimetric method, and by using the above model total N and available P contents can be estimated in Sri Lankan soils.

Keywords: Titrimetric C, Colorimetric C, Total N, Available P, Organic Matter

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Evaluation of Methane Generation Potential of Anaerobic Digesters: Case Studies From Small and Medium Size Digesters

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Different sizes of anaerobic digesters are available at households and industries in Sri Lanka. Majority of anaerobic digesters are operated either using food waste or organic fraction of Municipal Solid Waste. In order to meet the goal of appropriate waste disposal requirements of the country, a variety of commercial anaerobic digesters are available for a range of sizes and waste input rates. However, there are no acceptable norms to design, upscale and develop anaerobic digester systems in the country. Development of a mathematical model to estimate the expected biogas production from a given digester is an important parameter in digester designing process. Although several models are available in textbooks to predict the biogas production, they cannot be used due to various differences in local conditions. In this study, an empirical model was developed by using locally available secondary data, field measurements and secondary data from other countries. Three commonly available digester types;SirilakUmaga, Floating Drum and Chinese type were extensively evaluated in this study. Data collected from 5 SirilakUmaga type digesters, 13 Chinese type digesters and 3 floating drum type digesters. Results of the study shows that the biogas conversion efficiency of local digesters are low compared to literature data. The biogas production rate decreases with the increasing loading rate for local digesters whereas the opposite happens in technologically advanced reactors. The developed model predicts the biogas production in local condition; however found that methane gas productions in local digesters are 2-5 times lower than that of literature data. This suggests that the technological improvements should be done to achieve the higher biogas production from local digesters.

Keywords: Anaerobic digesters, biogas, empirical model, scaling up

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Evaluation of Raw Rice Production Process for the Improvement of Head Rice Yield in CIC Rice Processing Plant at Maho

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This study was carried out to evaluate the existing rice processing line at CIC rice mill in Maho for improving the head rice yield. The poor pre-harvesting practices and improper processing techniques are the common reasons for low head rice yield. The effect of moisture content and temperature on head rice yield and degree of milling is well documented. This research examined every step of rice processing line with respect to the moisture and temperature variations of rice passing through the machines and the rice milling yield and the head rice yield. A short grain rice variety BG 360 was used for the study. Samples were collected at every step of rice processing line at three different times. The same paddy was subjected to a standard laboratory milling test. The observed head rice yield from the processing line was 50% while it was 58% from the laboratory milling test. Therefore, there is a potential for improving the head rice yield by 8% manipulating machine parameters in the existing rice processing line at Maho. The initial whitening step was the critical step responsible for 7.1% broken rice. The polishing degree was noted as 88.5% in the existing process which is 1.5% lower than the expected value of 90%. Use of two rice polishers in the process make over polishing of 1.5% and create considerable amount of broken rice and weight loss. There is a possibility of achieving the required polishing degree of 90% by reducing the weight in whitener 1 and using only one water jet polisher instead of two.

Keywords: Total rice yield, Head rice yield, Degree of milling, Whiteness

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Evaluation of Selected Cinnamon Accessions (*Cinnamomum zeylanicum* Blume), for Selected Morphological Characters, Yield and Chemical Parameters

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Cinnamon (*Cinnamomum zeylanicum*Blume) is an important endemic spice crop in Sri Lanka which produced unique Ceylon cinnamon or true cinnamon. Although variation has been detected for straightness, pest and disease attacks, peeling quality, high yielding and coumarine content of the bark, enhancement of germplasm or geneticimprovement of cinnamon crop has only partially been achieved to fulfill the requirements of the industry. Recently, the coumarine content of the bark has received attention as it is identified as carcinogenic. Based on different germplasm evaluations done through earlier research, several accessions have been selected for the yield and quality characters of cinnamon and field evaluations have been conducted at the National Cinnamon Research and Training Centre (NCRTC), Thihagoda, Palolpitiya. Subsequently the objective of this study was to identify suitable accessions for various quality characters for further improvement of cinnamon in Sri Lanka. Thirty four accessions, which have established in the NCRTC were screened with 3 replicates per accession. Scored and quantitative data were carried out to evaluate straightness, branching, resistance to major pest and disease problems, peeling ability, bark thickness and dry bark yield etc. Coumarine content in the bark wasdetermined through theHPLC standard method.According to cluster analysis, the overall best accession was CRS741 for the all characters while CRS585,CRS615, CRS603, CRS766, CRS317, CRS585were good for straightness, branching, pest and disease resistance, high bark thickness and yield.CRS603 was the best for all characters except for resistance to pest and diseases. The coumarine content of accessions significantly varied among accessions ($P<0.05$), ranging from 24.5 ppm (CRS741) up to 46.95 ppm (CRS40). These accessions can be used to develop new varieties and also in future breeding programs.

Keywords: Accession, cinnamon, coumarine, peeling quality, straightness

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Evaluation of Sugar Cane Solid Waste Composting under Elevated Oxygen Conditions

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Pressed mud is a form of organic solid waste residue generated fromsugar processing industries. Pressed mud contains high moisture (75%) and elevated volatile solid levels (95%) that can be biologically converted to end products. However, small particle sizes (< 2mm) and lack of sufficient amount of other nutrients hinder the rapid aerobic or anaerobic decomposition process, thus pressed mud waste are accumulated in large quantities in sugar processing industries. This study was done to develop an aerated pressed mud composting system with mineral nutrient amendments and elevated oxygen supplyto accelerate the composting process. Six laboratory scale (2 L) forced aerated bioreactor units were constructed and filled with pressed mud mixed with(5% w/w) Eppawala Rock Phosphate. Three reactor units were supplied with additional nitrogen as urea (5% w/w) and oxygen (52% v/v). The reactors were constantly aerated for 21 days while continuously monitoring the oxygen supply, volatile solid changes and chemical properties (pH, EC, TDS, and Salinity). After 21 days of aerated composting, final products were analyzed to compare with SLS compost quality standards. Results revealed that forced aeration reduces the heat accumulation in the system as indicated by mesophilic temperatures throughout the process. The volatile solid content was reduced to 65-70% during the composting, however achieved substantial moisture reduction in all treatments. Additional oxygen supply does not have a pronounced effect on decomposition. Urea addition increased total nitrogen content in the final products than composting without urea. Also, SLS standard of 1% nitrogen in final compost cannot be achieved without nitrogen addition. Addition 5% of rock phosphate increased the total and available phosphorus in final product.In perspective, forced aerated composting with mineral nutrient amendments is a feasible technique to convert pressed mud in to useful byproduct.

Keywords: Pressed mud, aerobic, bioreactor, compost, decomposition

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Factors Affecting the Texture of Fermented Gherkin

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Fermented gherkin is consumed mostly as a vegetable salad thus, texture is the key sensory attribute, which contributes to the quality of the finished product. The variety of gherkin and many other factors during the fermentation process affect the texture. Therefore, texture of fermented gherkin from three varieties (Ajex, Chandani and Eclipse; diameter of 32-38 mm) were measured using a fruit hardness tester. After thirty-day fermentation period, significant differences ($p<0.05$) in exocarp firmness (7.10±0.02, 6.96±0.04 and 7.00±0.02 kg/cm^2) and mesocarp firmness (1.44±0.02, 1.00±0.02 and 1.20±0.01 kg/cm^2) were evident for Ajex, Chandani and Eclipse, respectively. Ajex variety showed a significantly higher ($p<0.05$) exocarp (7.10±0.02 kg/cm^2) and mesocarp (1.44±0.02 kg/cm^2) firmness. Effect of calcium chloride concentration (0.33, 1.33, 2.33, 3.33 and 4.33%), pH level (2, 2.5, 3, 3.5 and 4), B-80 Pure Flo™ clay concentration (0.067, 0.20, 0.33, 0.46 and 0.60%), holding time period (24, 48 and 72 h) and three processing steps (brining, de- brining and final fermentation) on the texture of fermented Chandani, which is the most commonly used commercial variety, was studied. Significantly higher ($p<0.05$) exocarp and mesocarp firmness was evident with 2.33% calcium chloride (6.69±0.01 and 2.18±0.03 kg/cm^2), at pH of 3.00 (7.05±0.03 and 2.05±0.02 kg/cm^2) and 0.60% B-80 Pure Flo™ clay (6.92±0.02 and 2.01±0.02 kg/cm^2) respectively. Lengthening the holding time period (24, 48 and 72 h) significantly decreased ($p<0.05$) exocarp firmness (6.05±0.03, 5.13±0.15 and 4.09±0.10 kg/cm^2) and mesocarp firmness (1.63±0.02, 1.18±0.04 and 0.97±0.02kg/cm^2), respectively.The brined, the de-brined and the finished products were significantly different ($p<0.05$) in exocarp firmness (6.77±0.02, 4.91±0.03 and 5.17±0.02kg/cm^2) and mesocarp firmness (1.79±0.02, 1.11±0.02 and 1.31±0.02 kg/cm^2) respectively.

Keywords: Gherkin, Brine fermentation, Exocarp and mesocarp firmness

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Fecundity, Parasitism and Eclosion of *Acerophagus papayae* (Hymenoptera: Encyrtidae): A Biocontrol Agent of Papaya Mealybug

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Papaya mealybug (*Paracoccus marginatus)* attacks a wide range of crops. It was first reported in Sri Lanka in 2008. Chemical spraying is not effective because of the waxy cover on the body of the pest. Classical biocontrol has been successful in some countries and the same was proposed to Sri Lanka. In this endeavor, parasitoids *Acerophagus papaya*e, *Pseudleptomastix mexicana* and *Anagyrus loecki* were introduced in 2009. The parasitoids were established and population suppression was achieved. Among parasitoids, *A. papaya*e is the most efficient species. In order to release the parasitoids, mass rearing of *A. papayae* was initiated in 2010. However, the biology of the parasitoids is poorly known under local conditions. Therefore, the present study was conducted to assess the fecundity, parasitism and eclosion percentages of *A. papayae* under laboratory conditions in order to improve mass rearing. In addition, parasitism under local field conditions was evaluated. Findings revealed that one female produced 43.93±5.39 offsprings and adult lifespan was 13.20±0.40 days. Use of 5 mated females per rearing cup for 5 days produced significantly (P<0.05) higher progeny. As an approach of releasing the parasitoids in the field conditions, parasitoid pupae were pasted on a card and kept in the laboratory. Among the methods used, use of cellotape gave a higher eclosion percentage than the use of glue, double tape, potato as a substrate and use of pupal cases without having a glued surface. The highest percentage of eclosion was 84 when used the cellotape method. Reduction in parasitism level caused by *A. papayae* was quantified by a field survey and it was less than 25 % in both Anuradhapura and Gampaha districts. Level of parasitism in home gardens was higher than that under commercial cultivations. Parasitism level caused by *A. papayae* was higher than the parasitism caused by other parasitoids.

Keywords: *Acerophagus papayae*, Eclosion, Fecundity, Parasitism

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Gap Analysis of Existing FSSC 22000 FSMS at Marah to Assess the Effectiveness of Food Safety Procedures and to Improve the System to Achieve Compliance

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Modern consumers seek for greater diversity in food products and always demand for products with superior quality and safety. To cater these needs, new processing technologies and new knowledge related to food product development are emerging day by day making the food industry highly dynamic. Therefore, similar to other requirements, criteria identified in Food Safety Management Systems (FSMS) cannot be designed to be valid forever. With time gaps can arise between existing and expected levels of performance in different food safety management criteria and those provide opportunities for improvements to upgrade FSMS. Food Safety System Certification 22000 (FSSC 22000) FSMS itself mandates for continual improvement of the system. Marah Trading (Pvt) LTD; being a reputed exporter of tea and herbs, has recognized the importance of identifying gaps to assess the effectiveness of their FSMS and improving the system to meet the requirements. All the gaps in requirements of the FSSC 22000 were analysed including ISO 22000 standard requirements and technical specifications of prerequisite programs. During the study eight non conformities and twenty observations were uncovered. Required corrective actions were determined and implemented to fill the identified gaps. Employee awareness on food safetywhich is a crucial factor in an effective FSMS was analysed through an interviewing technique and training needs were determined. It enabled to conduct effective training programs related to food safety management to the staff of the company. Finally, recommendations for reviewing and updating food safety documents were provided to have a FSMS which complies with system requirements.

Keywords: Food safety management system (FSMS), Food safety system certification 22000 (FSSC 22000), Gap analysis, Tea and herbs, Continual improvement

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Gap Analysis Study to Implement ISO 17025:2005 Standard Requirements for a Microbiology Laboratory of a Food Processing Company

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According to the requirements of the international organization for standardization (ISO), any accredited laboratory should comply with its ISO 17025:2005 standard requirements, which include general requirements for the competency of testing and calibration of instruments. This study was focused on identifying the general requirements for a food microbiology laboratory of a food processing company, according to ISO 17025:2005 standards. After developing the general requirements, a gap analysis was done to identify the improvements for implementing the standard requirements. Gap analysis was performed using a checklist prepared as the tool of analysis according to the requirements of the standard, and the gaps between the standard requirements and the existing facilitieswere identified and documented. The major deviations were identified as managerial and technical requirements based on the standard. Finally, suggestions were made with respect to the gap analysis data. Currently, only the basic infrastructure is available for developing the proposed microbiology laboratory at the study location.Therefore, most of the gaps identified in the study need to be addressedat the beginning of developing the microbiology laboratory. Further, technical modifications to the existing building were also proposed. According to the survey data collected, accreditation is a new experience to the laboratory staff identified by the company. Therefore, training of the laboratory staff to comply with ISO 17025:2005 standard requirements was proposed in addition to the infrastructure requirements. Upon completion of the gaps identified, and with the provision of other infrastructure facilities and competency development for conducting proposed microbiological tests, it is expected to comply the proposed microbiology laboratory with the ISO 17025:2005 standard requirements needed for accreditation.

Keywords: Gap analysis, ISO 17025:2005 standard, Accreditation, Food microbiology laboratory

This study was conducted at the CBL Natural Foods (Pvt) Ltd, Minuwangoda.

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Growth Performance of Different Indigenous Chicken Types under Semi-Intensive and Intensive Management Conditions

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A study was conducted to compare the growth performance of Normal Feathered (NF) and Naked Neck (NN) indigenous chicken types under Semi-Intensive and Intensive management. Ten NN and 57 NF day old Chicks were included in the study. NF chicks were divided into three groups (small, medium and large) according to the back length at two weeks of age, and reared under semi-intensive and intensive systems of rearing after the brooding period. Performance of the groups were analyzed using Analysis of variance procedure and mean comparisons were done by Duncan's Multiple Range Test. The average body weights (g) of day-old chicks were not significantly different ($P>0.05$) between NF and NN phenotypic groups. The final body weight of Small (634.09±31.7) group was significantly lower than Medium (717.1±26.5), Large (796.9±51.8) and NN (796.9±51.8) groups at the end of the experimental period of 12 weeks under semi-intensive management conditions ($P<0.05$). The final body weight of Small (1115.0±117.2) group was significantly ($P<0.05$) lower than that of Large (1532.0±81.6) group under intensive management. Small group showed a significantly higher feed conversion ratio (4.03±0.4) than Medium (3.26±0.2) and Large (2.90±0.3) groups under intensive management. The mortality of NF and NN chickens were 17.9% and 10%, respectively. When the growth performance of NF chicken is considered as a group, NN showed a superior growth performance under Semi-Intensive system. The findings of the present study also revealed that back length at two weeks of age is a good criteria for selection of birds for high growth performance as chicks with longer back length exhibited better growth potential and feed conversion ratio throughout the experimental period under both systems.

Keywords: Indigenous chicken, normal feathered, naked neck, back length, growth performance

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Head-Rice Yield and Sensory Attributes of Raw Milled and Parboiled *Keeri Samba* Rice from New and Old Paddy Stocks

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Rice is one of the most popular staple foods, produced from raw or parboiled paddy, which is dried and stored for several months prior to de-husking and polishing. As storage period depends on many factors and requirements, the effect of length of storage period on head-rice yield (HRY) and sensory attributes of raw and parboiled *Keeri sambarice* was studied. Paddy samples (50 kg) stored for 1, 2, 3, 6 and 7-month periods were de-husked and polished using a laboratory mill. The HRYof the polished rice samples was determined. Preference for appearance, stickiness, chewiness, rice flavor, odor and overall acceptability of the polished rice samples were evaluated by conducting a 5-point hedonic test with 30 consumer panelists. The results revealed that storage period significantly ($p<0.05$) affected the HRY%, which was 61.5, 57.5, 50.8, 47.6 and 32.7 for 1, 2, 3, 6 and 7-month old raw rice respectively, and 64.7, 67.2, 56.1, 58.2 and 61.7 for 1, 2, 3, 6 and 7-month old parboiled rice respectively. The results of the sensory tests revealed non-significant ($p<0.05$) effect of storage period on all the sensory attributes of raw rice, except for appearance. Two-month old parboiled rice showed the highest preference for appearance while 6-month old sample showed the highest preference for stickiness. Therefore, the most suitable storage period for *Keeri samba* paddy was found to be two months as revealed by the highest HRY of polished rice produced from raw and parboiled paddy and highest preference for appearance of cooked raw and parboiled rice and most acceptable stickiness of parboiled rice.

Keywords: *Keeri samba* paddy, Parboiling, Head-Rice yield, Sensory attributes

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Heterosis in F1 Generations of Two Selected Rice (*Oryza sativa* L.) Crosses for Growth and Yield Characteristics

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Rice (*Oryza sativa* L.) is the major food crop for more than half of the world's population. Hybrid production is one of the greatest practical achievements to increase the rice productivity in order to fulfill the food demand of the increasing world population. Two single crosses, Bg 300 x IRDTN 7-56 (Cross 1) and Bg 251x IRDTN 7-11 (Cross 2) were chosen to study the hybrid vigor or heterosis for yield and yield related agronomic parameters of rice. The F1 hybrids along with their parents were evaluated in a Randomized Complete Block Design with three replicates. Cross 1 showed significant (P<0.05) heterobeltiosis for flag leaf length (FLL), flag leaf width (FLW), 100 grain weight, days to 50% flowering and plant height (PH) while Cross 2 showed significant (P<0.05) heterobeltiosis for FLL, FLW, PH, number of tillers/plant, number of panicles/plant, panicle length and grain yield. The Cross 2 (Bg 251 x IRDTN 7-11) has a higher potential than the Cross 1 (Bg 300 x IRDTN 7-56) for the development of hybrids to increase the rice productivity.

Keywords: Heterobeltiosis, Heterosis, Hybrid

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Histamine Formation and Quality Assessment of Herrings (*Amblygaster sirm*) during Storage at 0 °C

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Temperature abuse conditions and mishandling enhance the formation of histamine and quality deteriorationof fish. *Amblygaster sirm*is a fish,commonly consumed by Sri Lankans. This study was conducted to determine the histamine formation and quality deterioration in *Amblygaster sirm* during storage at 0 °C.Fresh *Amblygaster sirm* (1-day) were stored at 0 °C for 21-days and three storage trials were conducted. Histamine content of *Amblygaster sirm*was determined using High Performance Liquid Chromatography (HPLC) with a fluorescence detector. Freshness of fish was determined by the changes in dielectric properties of fish occurred during storage by using the Torry meter. pH meter was used to determine the pH variation during the storage of fish. Quality Index Method (QIM) was performed to evaluate sensory attributes of fish. Polynomial type of relationship($Y=67.25-4.972X+0.166X^2$) was observed between histamine formationof *Amblygaster sirm*with time. Furthermore, correlation analysis showed a moderate relationship between histamine content and time($r^2= 0.649$, $p<0.05$). Histamine development was found to be lower than the European Union safety level of 100 mg/kg fish during storage at 0°C for 21-day. According to QIM sensory evaluation,*Amblygaster sirm* were rejected at 12-day of storage at 0 °C. The Torry meter values indicated loss of freshness of fish at 15-day.The pH increased with the storage time and, it reached to 7 at 18-day indicating spoilage of fish. It can be concluded that *Amblygaster sirm* can be stored at 0 °C for maximum of 11 days without quality deterioration and without exceeding European Union safety level for histamine.

Keywords: Histamine, HPLC, storage temperature, QIM, *Amblygaster sirm*

This research was funded by National Aquatic Resources Research and Development Agency (NARA)

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Identification of Herbicidal and Insecticidal Properties of *Artemisia vulgaris* (L.):A Hedgerow-Plant in Tea Plantations

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Weeds and insect-pests reduce production of tea [*Camellia sinensis* (L) O. Kuntze] by 10-50%. Environmental concerns and ban imposed on several pesticides highlight the need for alternate weed/insect-pest control strategies.This research aimed at identifying the potential of using *Artemisia vulgaris* (L) (Asteraceae) to control major weeds/insect-pests in tea plantations. Stems, leaves and roots of mature *A. vulgaris* plants were collected from hedgerows of up-country tea plantations. Water extracts of different plant-parts were prepared separately at 50%, 100%,150% and 200% concentrations, assuming that total plant biomass would dissolve in soil water. Bioassays for herbicidal effects were conducted using lettuce [*Lactuca sativa* (L); standard test-plant] and *Alawangupillu* [*Erigeron sumatrensis* (Retz.); a major tea-weed] with tap water (0%) as the control. Crude extracts of aerial plant-parts (100% concentration) and a dilution series of 50%, 25%, 12.5% and 0% with tap water were assessed for insecticidal properties using mosquito larvae (standard test), tea aphids (*Taxoptera aurantii*), and avoidance/repellence of earthworms and leeches. Five months old tea-nursery plants were assessed for phytotoxicity of extraction. Bioassays were repeated twice in a CRD with three replicates. Chi-square tests and probit analysis were done. Chemical constituents of *A. vulgaris* were identified using Gas Chromatography-Mass Spectrometry (Agilent 7890B GC-5077 MS). *Artemisia vulgaris* extracts did not show negative effects on tea plants, but showed triple-action effect on weed/pest control; (1) 50% concentration of all extracts reduced germination and seedling growth ($p<0.05$) of *E. sumatrensis*, (2) effectively controlled tea aphids ($p<0.05$), and (3) controlled/repelled nuisance pests (mosquito larvae and leeches) and even beneficial organisms (earthworms) ($p<0.05$). Increasing concentrations of extracts enhanced toxicity on these test subjects ($p<0.05$). The GC-MS identified 6,9-Octadecadienoic and Heptanoic acids (herbicidal), Germacrene D (insecticidal) and Taraxasterol (pest-repellent) as major chemicals in extracts.

Keywords: *Artemisia vulgaris* (L), *Erigeron sumatrensis* (Retz.), *Taxoptera aurantii*, herbicidal and insecticidal effect, earthworms and leeches

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Identification of Plant Parasitic Nematodes Associated with Export Ornamental Plants and Plant Nurseries

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Ornamental plant industry is experiencing quarantine limitations in exporting ornamental plants, which are associated with plant parasitic nematodes. International Plant Quarantine and Certification Programmedemands the certification of ornamental plants and planting materials free from Plant Parasitic Nematodes (PPN). In this certification, identification of PPN is essential. However, no data is available on locally-existing PPN, their distribution or host range. The aim of this research was to identify plant parasitic nematodes associated with export ornamental plants. Soil and root samples were collected from 11 ornamental plant nurseries and nematodes were extracted usingBaermann funnel, modified-tray, sieving-centrifuging-floating and blending-sieving-centrifuging-floating techniques. Stylet-shapes, esophagus-intestine overlapping, vulva position, presence of the median bulb, tail shape and shape of the female body were used in identification. Thirteen genera of PPN: *Criconemella, Caloosia, Hemicriconemoides, Helicotelynchus, Meloidogyne, Heterodera, Haplolaimus, Longidorus*, *Paratylenchus*, *Pratylenchus, Radopholus, Trichodorus*and *Xiphinema*were identified in collected PPN samples. Host plant range wasdetermined for nematode genera. *Criconemella*and*Hemicriconemoides* were rare in selected nurseries. *Longidorus* and *Xiphinema* were present in all the media except steamed coir. *Pratylenchus*and*Helicotylenchus* were presentin all the mother plants. *Meloidogyne* and*Heterodera* were found in most of the ornamental plants including *Livistoniarotandifolia*,*Sandriana* spp. *Zamioculcuszamifolia*, *Fecusumbalata*, and *Cordiam* spp. PPN population was variable between treated and untreated area, may be associated with management practices.

Keywords: Ornamental plants, quarantine, Plant Parasitic Nematodes, Morphological identification

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Identification of Satellite DNA Present in Leaf Curl Complex-Infected Chilli in Sri Lanka

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Chilli (*Capsicum annuum* L.) is one of the major cash crops grown in Sri Lanka which belongs to the family Solanaceae. Chilli leaf curl complex (CLCC) is a major biotic threat in chilli cultivation of Sri Lanka and chilli leaf curl virus (CLCV) is among the causal agents of CLCC. Chilli leaf curl virus is a Begomovirus that belongs to the family Geminiviridae. Begomoviruses have monopartite or bipartite genomes. Monopartite Begomoviruses contain additional DNA molecules designated as DNA satellites. The satellite DNA are responsible to modulate the symptoms in infected plants. The objective of this study was to identify the presence of satellite DNA in CLCC infected chilli in Sri Lanka. In this study chilli plants with typical CLCC symptoms were collected from five different locations namely Gannoruwa, Marassana, Kekirawa, Kibissa and Kundasale. DNA was extracted and subjected to PCR using CLCV, beta satellite and alpha satellite specific primers. Ninety two percent of the tested chilli samples were positive for the presence of CLCV. However, the expected size of the PCR products was not found in any of the tested chilli samples when the satellite DNA was targeted. Instead of a single 1350 bp PCR product, all the tested samples produced two PCR products of 1500 bp and 1000 bp for beta satellite specific primers. Despite repeated attempts with modifications, the expected size of the PCR product for beta satellite was not obtained. A new primer pair was designed based on the available DNA sequence data of the beta satellites of Sri Lankan CLCV isolates (Accession no.s. JN638445 and JN638446). The newly-designed primer pair resulted the expected sized PCR product in some of the chilli samples with a length polymorphism. It indicates the presence of beta satellite in CLCC infected chilli and its possible molecular variants.

Keywords: Alphasatellite, begomovirus, betasatellite, *Capsicum annum*, chilli leaf curl virus

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Incidence of Bovine Mastitis and Microbial Quality of Milk in Three Large Dairy Cattle Herds in Kurunegala District of Sri Lanka

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Dairy sector is one of the main subsectors of the livestock sector in Sri Lanka. Krunegala District is a major contributor to the national dairy industry. Three farms in the Kurunegala District were selected to identify the incidence of mastitis, mastitis causative pathogens and their antibiotic resistance. Milking herds of the farms were screened with Californian Mastitis Test (CMT), and positive samples were collected aseptically. In addition, from each farm three samples were taken from healthy animals, milking buckets and storage tanks to investigate the contamination through the milk supply chain. The samples were cultured to isolate mastitis causative pathogens. Total plate counts (TPC) and coliform counts (CC) were measured. Antibiotic susceptibility test (ABST) was carried out with isolated pathogens. Out of the animals screened (n=208) the incidence of clinical and subclinical mastitis were 6% and 66%, respectively. From the 157 samples cultured, 4% showed no growth, and 96% showed bacterial growths of which 32% showed fungal growth as well. *Staphylococcus* was the prominent pathogen that causes mastitis in all three farms, and Coagulase Negative *Staphylococcus* (CNS) was in the highest percentage. Bacterial isolates were mostly resistant towards Neomycin. Total plate counts increased along the milk supply chain inside the farms and there were no significant differences in TPC counts among farms. In all three farms CC were recorded only from storage tanks. The incidence of mastitis was significantly ($P<0.05$) higher in the cows aged >8 years when compared with other age groups while the occurrence of mastitis was not associated with parity. Moreover, occurrence of subclinical mastitis was higher in the back quarter. An unusual higher incidence of mastitis was reported in this study. Therefore, improvement of management practices and hygienic conditions in the farms are recommended to overcome the problem.

Keywords: Mastitis, pathogens, antibiotics, risk factors

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Inhibition of Lipid Oxidation in Mechanically Deboned Chicken Meat by Adding Natural Antioxidants

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Mechanically deboned chicken meat (MDCM) is highly susceptible to lipid oxidation due to the high content of fat and heme pigments. Various synthetic or natural antioxidants can be used to prevent oxidative rancidity development in MDCM. Due to consumer concerns about the potential health hazards associated with dietary intake of synthetic antioxidants, the current study was focused to use herbs as natural antioxidants. The current study evaluated the effect of *Moringa oleifera* pod (2.5%), *Moringa oleifera* leaves (2.5%), *Sesbania grandiflora* flower (2.5%), *Sesbania grandiflora* leaves (2.5%), tomato fruit (2.5%), curry leaves (2.5%), *Moringa oleifera* pod (1.25%) & ascorbic acid (1.25%) combination, *Moringa oleifera* pod (1.25%) & tomato (1.25%) combination and ascorbic acid (2.5%) as antioxidants on inhibiting lipid oxidation in MDCM. The 2-thioarbituric acid reactive substances (TBARS), pH and color values of the samples were determined on the 3rd day of storage at 0-2 °C. TBARS, color and pH values of all treatments containing herbs, herbs + ascorbic acid and ascorbic acid alone were considerably lower ($P<0.05$) than the control. Treatment with ascorbic acid (1.25%) & *Moringa oleifera* pod (1.25%) combination and ascorbic acid (2.5%) had the lowest ($P<0.05$) values of TBARS, color and pH values.

Keywords: MDCM, lipid oxidation, antioxidants

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Investigation of Cold Storage Technology for Long Term Storage of a Local Big Onion Selection

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Significant losses of big onion during storage are a national issue with respect to satisfying the requirements for consumption as well as true seed production in Sri Lanka. The losses during 3-4 month storage under naturally ventilated farmer storage remains about 30 % while the long-term storage for 6 months it exceeds 50%. Therefore, this study was conducted to investigate the storability of the local variety (MI BO-1) for low temperature cold storage and to identify the optimum storage temperature for long term storage at 75 % ± 5 RH. Cold storage at two temperatures; 2 C +1 and 5 C + 1 in a fixed RH value of 75% + 5 was studied. Samples of 45 mm diameter onions (250 g) were kept in airtight containers and RH was controlled using NaCl saturated salt solutions. The control was kept on a flat plastic container with bottom perforations for natural ventilation. A complete Randomized Experimental Design (CRD) was used with six replicates. Percentage weight loss, percentage reduction of diameter (Shrinkage), brightness and redness of the skin and external visual quality parameters were studied for a period of two months during storage. The results revealed that storage temperature significantly affect on the percentage weight loss and percentage shrinkage ($\alpha = 0.05$). Hence, 2 C + 1 is found to be the best. However, temperature is not significantly affecting on the market qualities; brightness and redness of the skin. It was also found that the cold storage: 2 C + 1 and 5 C + 1 is better than natural ventilated storage (control) for MI BO-1 variety for the storage duration of two months.

Keywords: Big onion, cold temperature, long-term storage, natural ventilated

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Investigation on Soil Physical Properties of Induced Root Zone Aeration

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Induced soil aeration is an in-situ soil remediation technique used to remediate soil, which are contaminated by volatile organic carbon, compacted or having water logged conditions. Before applying different remediation techniques a pilot testing was required to prove the effectiveness of the process. This study focused on important physical characteristics with regard to induced soil aeration. During the study, physical characteristics of soil in the site, minimum pressure and minimum velocity required for the movement of air, radius of influence, density (ρ), air pressure losses of the flow in soil and reduction of soil moisture with time were investigated. Soil at the experimental site belongs to sandy loam with a particle density of 2.71 g $cm^{-3}$and bulk density of 1.32 g cm^{-3}. Air pressure difference was increasing with increasing air velocity at higher velocities but air pressure also increases with very low velocities. Mathematically, it can be deduced that there is a minimum pressure and minimum velocity required for the movement of air in top soil and increases with decreasing soil moisture content due to the increase of radius of influence. Both kinds of pressure losses namely, losses along the pathway and entry, exit losses, increases with increasing velocity and increasing soil moisture content. Radius of influence in induced soil aeration increases with decreasing soil moisture content. Generally radius of influence for sandy loam is 1 m for the tests. K_1, flow resistance coefficient, seem to be related to air density (ρ), which decreased with increasing soil moisture content. Moisture content in soil decreases with time due to induced soil aeration. Information obtained during the study on soil physical properties can be used in designing an effective soil aeration system.

Keywords: Induced soil aeration, air velocity, air pressure, radius of influence, air pressure losses

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Molecular Identification and Cloning of *Xanthomonas* spp. Specific Sequences to be used for Rapid Disease Diagnosis

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Rapid and reliable identification the causal agent at an early stage of the disease development is important as there are limited options available to manage plant pathogenic bacteria. The present study was aimed to identify the causal *Xanthomonas* spp. of leaf blight of rice and anthurium, and cabbage black rot along with the identification and cloning of specific DNA sequences for rapid identification of the pathogens. The causal agents of the leaf blight of rice and anthurium and black rot of cabbage were isolated using YDC medium and was selectively-isolated by a modified differential medium (Xan-D medium) on which colonies of xanthomonads, show wet and shiny yellow green appearance. The gene, *estA* was targeted to identify the xanthomonads using specific primers which amplifiesa 777 bp DNA fragment. To confirm *Xanthomonas oryzae* pv. *oryzae* (causing leaf blight of rice), *Xanthomonas axonopodis* pv. *dieffenbachiae,* (causing leaf blight of anthurium) and *Xanthomonas campestris* pv. *campestris* (causing black rot of cabbage)pathovar specific primers were used to amplify PCR products of 230 bp, 785 bp and 535 bp, respectively. The specificity of the PCR product to detect the *X. campestris* pv. *campestris* was done by a dot blot hybridization. The confirmed DNA sequence which is unique to *X. campestris* pv. *campestris* was cloned using pGEM-T Easy Vector System I and the recombinants were confirmed by colony PCR. The findings of the present study successfully cloned a *X. campestris* pv. *campestris* specific sequence that can be used for the diagnosis of black rot of cabbage.

Keywords: Cloning, Hybridization, PCR, *Xanthomonas* spp.

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Non-destructive Sweetness Determination of Watermelon Based on Physical Properties

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Unlike other fruits, watermelon does not show much variation in its apparent properties of maturity after harvest. A destructive testing of Total Soluble Solids (TSS) content is the commonly used maturity indicator and quality control tool of watermelon as it is a sweet fruit. The quality certification is done by using a core sample, which is a destructive test and done for all individual fruits. Therefore, this study was conducted to develop a non-destructive technique to predict watermelon sweetness based on its physical properties. Correlation analysis was done using continuously measured sweetness, moisture content, dynamic firmness, and sound peak frequency data during five days of storage period for a batch of fifteen watermelons. Sound frequency response resulted from the given constant pendulum impact and dynamic firmness measurements were correlated with fruit sweetness (TSS) continuously for consecutive five days. The correlation coefficients between peak frequency response and sweetness were statistically insignificant and the correlation decreased with storage time. Further, the positive correlation changed to negative and negative correlation increased with storage time. The statistically significant ($P<0.05$) highest correlation coefficient between dynamic firmness and TSS was 0.615 and it was observed between 1st and 2nd days after harvest. A mathematical model was developed to estimate the TSS value using dynamic firmness. Similar to the sound frequency response, the correlation coefficients between dynamic firmness and TSS decreased with storage time, positive correlation changed to negative and negative correlation increased with storage time. The prediction model developed could be used for testing the TSS within 1-2 days after harvest

Keywords: Frequency response, dynamic firmness, maturity, correlation coefficient, mathematical modeling

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Nutritional Evaluation of Commonly Available Feedstuffs in Sri Lanka

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The objective of the present study was to evaluate the nutritional quality of currently available feedstuffs in Sri Lanka. Thirty five feed samples including 10 energy supplements, 11 plant protein supplements, 3 animal protein supplements, 2 mineral supplements, 3 grasses and 6 tree species were collected and feeding value was measured using proximate analysis. In addition, Van Soest fiber content, *in vitro* digestibility, gross energy and mineral content of feedstuffs were measured using standard protocols. According to the results, Black gram husk and dhal husk contained more crude protein (24-25%), *in vitro* dry matter digestibility (IVDMD) (62-67%) and energy value (3.8-4.3 kcal/g) compared to other plant protein supplements. The crude protein content of fish meal and poultry offal meal ranged between 64-70%, whereas corn gluten meal (CGM), United State soybean meal (US SBM) and textured vegetable protein (TVP) powder were ranged between 49-61%. According to the analysis, bakery by-products and rice by-products (rice polish and broken rice) contained more energy (4.3-4.7 kcal/g) compared to other energy supplements. Among the grasses, sorghum had an IVDMD of 63.6% while the lowest value was observed in CO-3 grass (48.9%). Calcium and phosphorous contents of meat and bone meal were 91.1 g/kg and 31.0 g/kg, respectively. Among the tree species, *Thespesia populnea* (Portia) leaves had a higher content of CP (15.9%) and IVDMD (63.2%) compared to other tree species. Chemical composition and nutritive value of these feedstuffs together with cost of these ingredients can be used in formulation of total mixed rations (TMR).

Keywords: Chemical composition, feedstuffs, nutritive value

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Occurrence of Pest and Diseases and Survival Rate of Black Pepper (*Piper nigrum* L.) Plants in Humid Chambers and Shade Houses

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Black pepper (*Piper nigrum* L.) is one of the important and valuable crops in Sri Lanka. In nursery period the microclimatic factors affect root initiation, growth and vigour of pepper plants. High Relative Humidity (RH) and Temperature create favorable situation for pest and diseases. Therefore, it is important to know the effect of microclimate on pest and diseases of pepper. The present study was conducted to determine the effect of microclimatic conditions on occurrence of pest and diseases, resistance and survival rate of pepper plant in humid chambers. In addition, effect of shade level on leaf gall thrips (*Liothrips karnyi* Bagn.) damage were studied. The study included three experiments and conducted at the Central Research Station, Department of Export Agriculture, Matale. A higher survival rate of pepper plants was observed in humid chambers (100%) than without chambers (36.6%). Water volume applied for the plants did not have significant effect on RH levels. No pest and disease incidences were observed in the plants inside the humid chambers. The level of light was measured under different shade levels using Pyranometer.Thrips damage severity was also measured using a pictorial key and a rating of 0 to 4. Growth indicators such as number of newly emerging leaves and total number of leaves per plant were also measured. There was a moderately positive correlation ($r^2 = 0.508$) between shade level and the average number of newly emerged leaves per plant. A weak correlation ($r^2=0.08$) was found between the shade levels and the severity of thrips damage. The result indicate that the shade level affects the thrips damage on pepper plants in nursery stage.

Keywords: Humid chamber, Relative Humidity, Shade level, Leaf Gall Thrip, Damage severity

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Partial Replacement of Imported Fish Meal by Scavenger (*Pterygoplichthys multiradiatus*) Fish Meal during Nursery Rearing of Platy (*Xiphophorus maculatus*)

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Platy fish (*Xiphophorus maculatus*) is one of the most popular and commercially valuable ornamental fish species in the world. Feed is a major contributor to cost in ornamental fish industry. Fish meal acts as an important ingredient in feed formulation as a source of protein. This experiment was conducted at the Ornamental Fish Breeding Center, National Aquaculture Development Authority, Ginigathhena to investigate the effects of replacing imported fish meal (IFM) by scavenger fish meal (SFM) in Platy feed. Three isonitrogenous and isocaloric experimental feeds were prepared as Feed 1 (IFM 40% + 0% SFM), Feed 2 (IFM 30% + SFM 15%) and Feed 3 (IFM 26% + SFM 20%). There were three replicates for each treatment with 10 Red Platy fry per each. Feeding was done five times a day according to 10% of the body weight of the fry. Growth parameters such as weight (g) and length (cm) were measured once a week. Mortality and water quality parameters were monitored daily. Body Weight Gain (BWG), Body Length Gain (BLG) and Survival Rate (SR) were calculated at the end of the experiment. Analysis of variance was used under the Completely Randomized Design and mean comparison was done using Least Significant Difference test. The means of BWG for the three treatments were 1.09±0.01, 0.97±0.01, and 1.31±0.01 and, for BLG were 1.49±0.01, 1.34±0.03, and 2.29±0.17, respectively. The experimental feed 3 which incorporated scavenger fish meal and imported fish meal at 20% and 26% ratio respectively has given significantly the highest BWG and BLG ($P<0.05$). There was no significant difference ($P>0.05$) in SR among the three treatments as the mortality was zero during experimental period. Therefore, it was concluded that over 40% of imported fish meal could be replaced by scavenger fish meal in nursery stage Platy feed.

Keywords: Fish nutrition, Platy (*Xiphophorus maculatus*), scavenger fish meal

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Possibility of Application of TiO_2 Photocatalytic Technique to Reduce the Bacterial Count in Bovine milk

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The poor microbiological quality of raw milk is a common issue in Sri Lankan dairy sector. Therefore, there is a high demand for the improved milk quality, specially free from spoilage microorganisms. The main purpose of this study was to investigate the possibility of applying TiO_2 photocatalytic technique to reduce the bacterial count in raw cow milk. In the method 4×4cm^2 soda lime glass plates were coated using 10mL and 20mL of 52824 ppm TiO_2 colloidal solution and three light sources namely Sunlight, UV light and 30W CFL bulb's light were used. 20mL of milk samples with and without these glass plates were exposed to three light sources for one hour and samples were taken in 15 minutes time intervals (0, 15, 30, 45 and 60minutes) for microbiological analysis. Milk sample without glass plate was used as the control. All microbiological analysis was done according to the standard methods using nutrient agar. The total plate count revealed a significant decrease ($P<0.05$) in colony forming unit per ml when both 10mL TiO_2 (10%) and 20mL TiO_2 (16%) sprayed plates were used in milk samples exposed to sunlight. The survival bacterial count was reduced significantly ($P<0.05$) by 15% and 26% in milk samples with same TiO_2 plates when exposed to UV light. However there was no significant effect when it was exposed to 30W CFL bulb's light. These results support the conclusion that there is a possibility to apply TiO_2 photocatalytic technique to reduce bacterial count in raw milk substantially without any physiochemical or nutritional loss in milk. Further, it could be suggested that the efficiency of the method could be increased by increasing the mass of TiO_2.

Keywords: Bacterial Count, Milk, Photocatalysis, TiO_2

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Potential of using Biocontrol Agents as Postharvest Treatments to Manage Carrot Soft Rot

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Carrot (*Daucus carota* L.) is an economically important vegetable crop that experiences a considerable amount of postharvest losses due to soft rot caused by a bacterial pathogen, *Erwinia carotovora*. The present study was conducted to determine the antagonistic effect of three bacteria namely, *Burkholderia spinosa*, *Bacillus megaterium* and *Bacillus subtilis* and to isolate potential bacteriophages against the pathogen. Pathogenic bacterial isolates were purified from typical symptom showing carrot tubers. Identification of *E. carotovora* among purified isolates was done by biochemical tests and PCR amplification using *E. carotovora* specific primers. Based on the results of the aggressiveness test, two out of six, *E. carotovora* isolates were highly virulent while the other four isolates were weakly virulent. Cross streaking method revealed that, *B. spinosa* was antagonistic against all isolates of *E. carotovora*. Despite repeated attempts with nine different soil samples, it was not possible to isolate potential bacteriophages against the isolates of *E. carotovora*. *In-vitro* efficiency of antagonism of *B. spinosa* was evaluated using six different cell concentrations of *B. spinosa* according to a Completely Randamized Design with five replicates. The highest inhibition of *E. carotovora* was given by a cell concentration of 10^5 cfu/ml of *B. spinosa, in-vitro.* Postharvest application of *B. spinosa* was done on naturally-infected and artificially-inoculated carrot using two application methods, namely dipping and spraying. Irrespective of the method of application there was a significant ($P<0.0001$) effect the control of soft rot development in carrot tubers by the cell concentration of *B. spinosa*. Application of *B. spinosa* as a $1.73x10^7$ cfu/ml cell suspension to freshly harvested carrot tubers reduced the development of soft rot lesions by 84.8% under naturally-infected condition. These results suggest that *B. spinosa* has the potential to be used as an effective biocontrol agent for the management of soft rot in carrot.

Keywords: Antagonistic bacteria, *Burkholderia spinosa*, Carrot Soft Rot

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Potential Use of Coconut Flour as a Coconut Milk Powder Supplement for Improving Health Benefits and Reducing Cost of Product

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In coconut milk extraction, about 40% of the kernel is converted to low fat cake which is mainly used for animal feed at present. The coconut milk powder produced from coconut milk contains 65% fat, 25% CHO, 2.3% fibre and 7% protein. The byproduct cake produced in milk extraction is a rich source of high quality dietary fibre and also considered as a functional food due to its ability to prevent cardiovascular disease, colon cancer and chronic diseases. Therefore, the objective of this study is to formulate a new coconut milk powder mixture by adding coconut flour made from cake into milk powder without sacrificing the physical and organoleptic properties in cooking for improving the health benefits and reducing the cost of product. Initially, the suitable particle sizes were determined based on sedimentation velocity, viscosity and whiteness of the particles. The particle sizes considered were <75 µm, 75-150 µm, 150-250 µm, 250-425 µm and >425 µm.Based on the physical properties, three sizes below 250 µm were selected and the consumer preference was tested for the particle size. The highest preference was given for particles less than 150 µm. Sensory evaluations were conducted in order to determine the best mixing ratio of coconut flour to coconut milk powder and consumer preference for selected particle sizes. Then, the coconut flour to coconut milk powder mixing ratios (15:85, 25:75, 35:65) were investigated through sensory evaluation using commercial coconut milk powder as the control. There is no significant different ($P<0.05$) between the control and three mixing ratios. But the preference based on taste and texture for 15:85 ratio is significantly higher than the control.

Keywords: Coconut milk powder, Coconut flour, Coconut cake, Particle size, Mixing ratio

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Preservation of white Coconut Kernel for The Production of Desiccated Coconut (DC) In Sri Lanka.

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Desiccated coconut (DC) processing industries should meet the increased demand while maintaining the continuous supply throughout the year. Fresh coconut kernelshould be stored for some time prior to production of DC. Therefore, study of storage stability of fresh coconut kernel for the production of desiccated coconut is important. This research was conducted to preserve the fresh coconut kernel by application of hurdle technology.Two treatments were applied to preserve the fresh coconut kernels; treatment 1:a mixtureof 0.3% citric acid and 0.02% ascorbic acid andthetreatment 2:a mixture of 0.3% citric acid, 0.02% ascorbic acid, 3% sodium chloride, 0.1% tri sodium citrate and 0.05% sodium benzoate. Control samples were evaluated for their physico-chemical propertiesat every 2 h intervals for 18 h under ambient temperature conditions. Treated kernels were evaluated at every 6 h intervals for 48 h. The color (L), moisture(% db), total soluble solids (^{o}Brix), pH, total sugar (%), fat (%), free fatty acids (%), peroxide value (meq/kg), total plate count (TPC) were analyzed as physico-chemical parameters. It was found that there was a significant difference ($P<0.001$) between two treatments and storage time for all tested physico-chemical properties.DC sample of treatment 2, which was stored for 24 h showed the best quality among all samples.Sensory evaluation was conducted to assure the quality of final product which was made out of 24 h sample of treatment 2. In sensory evaluation it was found that there is no significant difference ($P<0.05$) in color, aroma and texture of two tested samples (control and treatment 2). This study showed that the treatment 2 effectively preserved the fresh coconut kernel without qualitydefects. The kernels can be kept for 24 h of storage under ambient temperature conditions, without noticeable changes in sensory attributes.

Keywords: Coconut kernel, Desiccated coconut, Hurdle technology, Physico-chemical properties

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Quality Improvement of Waste (Effluent and Ash) Using Engineered Wetland in a Meat Processing Industry

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Study was conducted for further improvement the quality of treated effluent from a meat processing plant by designing and developing an engineered wetland (EWL) using the existing natural valley in the premises. In addition, the potential use of ash generated in the processing plant also investigated as a media for wetland. Contour survey was done and Depth-Area-Capacity relationship was developed. A perforated pipe with 50 mm diameter and 8 m length of was buried at the depth of 15 cm from the ground surface in left side of the valley 5 m away from the center of the valley. Wastewater discharged from the existing treatment plant was supplied through this perforated pipe. Water sample were collected from inlet and outlet (valley) and measured for BOD_5, COD, Nitrate, Phosphate, pH, EC, TDS, TS and total suspended solid. Removal efficiency of the system was calculated. In order to assess the Phytotoxicity of ash, a pot experiment was conducted with different percentage (0, 0.5, 1.0, 2.5. 5 %) of ash in soil. The germination of Tomato seeds was measured. The wastewater quality was improved by reducing the BOD_5, COD and Nitrate concentrations from 98, 300 and 15 mg/L to 15, 250 and 8.2 mg/L, respectively. The removal efficiency of BOD_5 was 85% which varied with plant growth. The EWL can be used with maximum hydraulic loading rate (HLR) of 0.14 m/day and organic loading rate (OLR) of 0.07 kg/m^3 COD/day. Ash has a high salinity although it contains plant nutrients. The germination percentage was high in 0.5% ash content thus this ratio can be used as a wetland media.

Keywords: Ash, Engineered wetland, Phytotoxicity, Plant nutrients, Wastewater

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Relationships of Broiler Breeder's Age and Egg Weight with Shell Thickness, Moisture Loss, Chick Yield and Hatchability of Eggs

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Hatchery performance is critical for profitability of poultry breeder operations. This study was conducted in a commercial hatchery in North Western province to determine the effect of age of broiler breeder hens and egg weight on shell thickness, moisture loss, chick yield and hatchability of eggs. A total of 61560 eggs were collected from Hubbard Flex broiler breeder hens from three random commercial breeder farm locations. Eggs were graded into five weight groups (PX:>72g, PA: 65-72 g, PR: 58-64g, ST: 52-57g, and SM: 48-51g). Starting ages of breeder hen groups were 26, 27, 31, 44, 55, 56, and 74weeks and recording was continued for 9 weeks. Shape index (=width*100/length) was recorded randomly from eggs of the age groups before setting eggs. Egg weights were measured at the setting and at the point of transfer to the hatcher (19thday) to calculate moisture loss. Shell thickness and chick weights were measured at hatching.Regression analyses performed revealed that as breeder hens get older, significant reductions can be seen in hatchability, moisture loss, shell thickness and shape index with significant increases in chick yield (=chick weight/egg weight), egg weight and percentage of culled chicks ($P<0.05$). Analysis of variance conducted showed that chick yield and shell thickness increased significantly with egg weight (grade) while hatchability and moisture loss dropped significantly ($P<0.05$). Peak performance of breeder hens was achieved at 30-40 weeks.

Keywords: Chick yield, Hatchability, Moisture loss, Shell thickness, Shape index

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Repellent and Oviposition Deterrent Effects of Commercial Formulations of Neem on Melon Fly (*Bactrocera cucurbitae*)

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Bactrocera cucurbitae is a major pest of cucurbit crops throughout the world. More than 125 plant species are susceptible for the attack of *B. cucurbitae*. Management of pest population is important to secure the yield. Conventional control of *B. cucurbitae* requires the frequent application of insecticides and it causes numerous health and environmental hazards, therefore, integrated pest management has been proposed, with the objectives of reducing the insecticide application and achieving sustainable suppression of pest populations. In this approach, mechanical, cultural and biological control are encouraged together with the application of botanicals. Plant-based natural products are appeared to be relatively safer for non-targets; hence, possible environmental impact is minimal. Therefore, the present study was conducted to determine the effect of neem on *B. cucurbitae,* with a special reference to oviposition and repellency. Neem, a plant-based natural product, formulated as commercial formulations: Azadirachtin 50 g/L, Azadirachtin 10 g/L, OK 81 % Micro-agrow and 1 % EC were evaluated against*B. cucurbitae*. Different concentrations of each neem formulation were evaluated in free choice bioassay under laboratory conditions.Among the tested neem formulations, Micro-agrow, Azadirachtin 10 g/L, Azadirachtin 50 g/L and OK 81% were effective oviposition deterrents and they suppressed overall egg laying capacity at the rates of 14.8, 15, 7 and 8 ml/L respectively. Most effective spraying intervals of OK 81 % and Azadirachtin 50 g/L neem formulations were determined to be 1 day and 2 days respectively. Within the first three hours, the repellent activity was high in cucumbers treated by all neem concentrations. Among the five commercially available neem formulations, Azadirachtin 50 g/Lwas the best giving 100% repellency at the application rates of 3.5 to 8.7 ml/L in 1-2 hours.The findings of the present study would be helpful to develop an eco-friendly and sustainable management system for controlling the melon fly.

Keywords: *Bactrocera cucurbitae*, Neem formulations, Oviposition deterrence %, Repellency%

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Root Cause Analysis of Bloated Wood Apple (*Limonia acidissima L.)* Nectar in PET Bottles

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A study to identify root cause of bloated wood apple (*Limonia acidissima L.)* nectar in PET bottles was conducted. Industrially produced defecting bloated nectar bottles were tested against the control. pH, brix, total plate count and yeast and mould counts were determined in samples of bloated bottles before the expiry date. Suspected ingredients of the product were tested for total plate and yeast and mould counts. Gas production during the incubation of yeast count test was observed using Durham tubes. Ingredients with the highest initial microbial load was further subjected to four heat treatments (85 and 90 ^{o}C for 5 and 10 minutes each) and further tested. The best heat treatment was determined and the confirmatory experiments were conducted in a batch wise process industrially with preheated pulp and treacle, preheated pulp, preheated treacle. pH and brix of nectar in bloated bottles was not significantly different from the control ($P > 0.05$). There was a significant difference ($P < 0.05$) in total plate count (4693 CFU/ml) and yeast and mould count (5 CFU/ml) in nectar in bloated bottles compared to the control. In normal bottles collected from the market (four brands) this difference was not observed. It has been confirmed that bloating has resulted due to spoilage by yeast. Wood apple nectar is a high acidic beverage that suppresses the bacterial spoilage but encourages yeast and mold growth. This causes the bloating of PET bottles. Morphological examination of colonies has confirmed the best time - temperature combination as 90 ^{o}C for 5 minutes for pulp and treacle. This study confirmed that major contamination source of nectar is wood apple pulp therefore an additional step of preheat treatment (90 ^{o}C, 5 minutes) for pulp and treacle is recommended during the production process of wood apple nectar.

Keywords: Wood apple, Nectar, Bloating, Total plate count, Yeast and mould count

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Screening of Bovine Brucellosis in the Central Province of Sri Lanka

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Brucellosis is one of the main zoonotic diseases prevalent throughout the world. Although many developed countries have eradicated *Brucella abortus* from cattle, it continues to be a major public and animal health problem in developing countries. Even though *Brucella* has definite host preferences, bovine brucellosis is mainly caused by *Brucella abortus*. Being the most contagious widespread form, *Brucella abortus* has the potential for spreading due to free animal movement in the country. This study was carried out to screen brucellosis in the Central Province of Sri Lanka. Considering its simplicity and cost effectiveness, the Milk Ring Test (MRT) was used to screen brucellosis. A locally produced MRT reagent using *Brucella abortus S.99* reference strain, which is routinely used for field screening, was obtained from the Veterinary Research Institute (VRI). Bulk milk samples from 18 milk chilling centres and 234 milk samples from individual farms were screened. Approximately 65% of the milking cows in the Central Province were screened covering nearly 49.17%, 75.22% and 85.38% of milking cows in Kandy, Nuwara Eliya and Matale districts, respectively. All tested samples gave negative results. Accordingly, the results of this study suggest that the Central Province is still free from bovine brucellosis. Consequently, it provides necessary information for the authorities to understand the current situation of bovine brucellosis in the Central Province, and give insight to formulate management strategies to prevent infection of milking herds in the province by restricting animal movements from *Brucella* infected areas to the Central Province.

Keywords: Milking cows, zoonosis, brucellosis, MRT

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Spatial Characterization of Yield Limiting Soil Properties of Banana grown in Mahiyanganaya using Secondary Information

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The use of secondary information is gaining popularity as a cost-effective method of characterizing the spatial patterns of soil properties. This study investigated the potential of proximally sensed soil apparent electrical conductivity (EC_a) and topography as secondary information to characterize the spatial variability of soil properties of a land (25 ha) in Mahiyanganaya that limit banana yield. Soil EC_a survey was conducted using DUALEM-1S soil sensor in horizontal (HCP) and perpendicular (PRP) coplanar measurement modes. Shuttle radar topographic mission (SRTM) data (30 m resolution) was used to extract elevation data. Conditioned Latin hypercube sampling was used to prepare the sampling plan (n = 31) and samples were collected at 0-30 cm depth. Soil samples were analyzed for texture, pH and plant available fractions of P, K, Ca, Mg, and Na. The data set was subjected for exploratory and Geostatistical analysis. A strong correlation (r = 0.89) was observed between perpendicular and horizontal coplanar EC_a measurements. Semivariogram analysis and spatial predictions made by ordinary kriging revealed moderate to strong spatial dependencies of soil properties where relative nugget effect ranged from 0 – 41.97%. Horizontal coplanar EC_a correlated with clay % (r = -0.5), sand % (r = 0.42) and available K (r = -0.48). Elevation showed correlations with sand % (r = -0.48), clay % (r = 0.50) and available K (r = 0.51). Joint classification of EC_a and elevation partitioned the study area into two contiguous potential management classes by accounting for the spatial variability of sand % (intra-class correlation, R_i^2 = 0.3), silt % (R_i^2 = 0.3) and available K (R_i^2 = 0.3). This study revealed that elevation and proximally sensing are two important sources of secondary information for spatial characterization of yield limiting soil properties of banana grown in the studied site.

Keywords: Banana, Soil ECa, DUALEM-1S soil sensor, Soil spatial variability

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Studying the Process Line of a Commercial Sponge Cake Manufacturing Plant to Identify the Steps That Lead to Overweight Final Products

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Commercial-scale sponge cake manufacturing involves semi- or fully-automated high throughput continuous process lines. In such establishments, adjustment of processing parameters at regular intervals is essential to maintain the product consistency. This study was conducted at a local sponge cake manufacturing plant with an aim to resolve non-conformity of their product weight to the company standard. Considerable differences in product weight were observed even within a same batch, hence it was decided to study process parameters for a selected batch which utilizes same raw materials. The production line consisted of seven steps: batter mixing, aeration, batter deposition, baking, cooling, cutting and decorating the cake. After the cooling step, the baked layer is divided into twelve longitudinal sections by roller cutters and four sections (next to each other) are mechanically assembled into a single line of cakes. Thus, there are three lines of cake, which were identified as left, middle and right. Physical dimensions and weight of the cakes obtained from each line according to a predetermined sampling plan were measured. Results showed that density of the cakes of all three lines remained constant. However, variations in volume were observed in all 03 lines, and this was prominent for the middle line. Increase in the volume was found to be the main reason for overweight products. Fluctuation of cake height was the main cause that led to volume variations. Nevertheless, deposition height remained same across the batter, thus non-uniform heat distribution within the oven can be stated as the possible cause for the deviation of cake height, which led to overweight products. As the cakes resulted from all three lines were generally overweight, reduction of batter deposition height from 0.1 mm (that will result in 0.3 mm reduction in final cake height) could be a possible solution to overcome this problem.

Keywords: Sponge cake, Continuous production line, Process parameters, Overweight

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Testing and Performance Evaluation of Heat Pump Dryer for Small Scale Drying of Spices

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A heat pump dryer (HPD) was developed for small farmers for drying of spices like black pepper, cloves and cardamom. A HPD uses a lower temperature (40-50 ^{0}C) than conventional hot air drying hence reduces the loss of volatile aromatic compounds. Heat pump drying is potentially more energy efficient and lower in cost. It does not involve furnaces and flue gases hence minimize pollution. It is convenient to operate.This project developed a cabinet batch type HPD. It was operated in four different air flow configurations, whichwere recovery, closed, dehumidification and open cycles, to select the best configuration. Specific Moisture Extraction Rate (SMER), and Coefficient of Performance (COP) were used as comparison criteria. Paddy soaked overnight was dried in comparison trials. A load of 25 kg of soaked paddy was dried for four hours in these trials. Open cycle showed the highest SMER of 1.97 kg/kWh and others were between 1.4 to 1.8 kg/kWh. Recovery cycle produced highest COP of 4.64 and others rangedbetween 2.6 to 4.6. Drying of green pepper was done using the recovery cycle. Results showed that pepper dried from initial moisture content (MC) of 78.4% (wb) to final MC 15.2% (wb). Total drying time was 36 hours and the total energy consumption was 18.6 kWh. The weight of pepper after drying was 6.4 kg. SMER of pepper drying trial was 0.99 kg/kWh. Conversion rate was 25.6%.Performance of the HPD was below expectation. The differences among four configuration cycles were not excessive. The drying cost was higher than expectation. Insufficient air flow rate was identified as the cause of poor performance of the HPD. Higher air flow and improved controls can increase the efficiency and lower the operating cost and make HPD a viable tool for small spice farmers.

Keywords: Heat pump, drying, spices

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The Effect of Colour Polythene Propagators on Shoot and Root Growth of Selected Tea (*Camellia sinenses* L.) Cultivars

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Proper nursery management is necessary to produce quality planting material for field planting. In mid country, the nursery period for tea takes about 9 months. Reducing nursery period minimizes the cost of production (COP). An experiment was carried out using four recommended tea cultivars (TRI 3072, TRI 4006, TRI 4046, and TRI 4071) for mid country using coloured polythene as shading material. The experiment was a split- plot design. Red, blue and transparent polythene were used as shading materials Measurements were taken as shoot height, stem girth, number of leaves and roots at 6, 8 and 10 weeks after planting of single node cuttings. Shoot dry weight and root dry weight were taken at 0, 8, 10 weeks after planting of cuttings. The results revealed that, TRI 3072 positively responded to red coloured polythene shade and giving the highest shoot height of 12.45 cm. TRI 4006 gave the highest shoot height of 8.40 cm for transparent shading while TRI 4046 gave the highest stem girth of 0.32 cm for blue coloured shading. There was no significant difference in plant response to colored polythene shades ($p>0.05$) in term of number of leaves, number of roots, dry weight (shoots and root), shoot and root ratio among cultivars. Therefore, this experiment concluded that, the red colour polythene gave the best results over the other shading materials. Cultivar TRI 3072 showed the overall best results over TRI 4006,TRI 4046,and TRI 4071 cultivars.

Keywords: Colored polythene, Shading material, Nursery management, Tea cultivars

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The Prevalence and Control of Aerobic Spore-forming Bacteria and Thermo Resistant Spore-forming Bacteria in Ultra High Temperature Milk Manufactured at Cargills Quality Dairies Pvt Ltd., Banduragoda

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The occurrence of the spore-forming bacteria in different segments of production lines of Ultra High Temperature (UHT) milk of a commercial plant and its transfer to the final product was studied. The objective of the study was to evaluate the contamination level of raw ingredients and different unit operations of UHT milk manufacturing for aerobic and thermo resistant spore forming bacteria.The samples were collected from different segments of production lines, over a period of 42 days at a rate of two sampling a week, from Cargills Quality Dairies Pvt Ltd., Banduragoda, Sri Lanka. The total colony counts of aerobic spore forming bacteria and thermo resistant spore forming bacteria were enumerated using Nutrient Agar. The highest total colony count of aerobic spore forming thermophilic bacteria was detected in raw milk (3.2×10^3 CFU/mL) and aerobic spore forming mesophilic bacteria was detected in skim milk (5.3×10^2CFU/mL). The mean count of aerobic spore forming mesophilic and thermophilic bacteria in UHT milk were 1.1 CFU/mL and 1.64 CFU/mL, respectively. The average levels of aerobic total spores and thermo resistant spores in UHT milk were reduced ($P<0.05$) after UHT treatments. The average levels of aerobic spore-forming bacteria and thermoresistant spore forming bacteria were considerably lower in the UHT milk than in the other samples of raw ingredients, pasteurized milk, UHT milk (before storage) and UHT milk stored at 35 °C for 7 days. The study reveals that raw ingredients are the primary factors influencing the number of aerobic spores and thermo resistant spores in the final products. Aerobic spores are reduced to the acceptable level during UHT manufacturing process. The proportion of aerobic spore-forming bacteria in the final product depends on storage temperature and storage period.

Keywords: Mesophilic, thermophilic, UHT, milk

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Use of Biochemical, Morphological and Anatomical Indicators for Early Detection of Grafting Compatibility of Mango (*Mangifera indica*) Var. Karthakolomban

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There is a growing demand for quality planting materials of fruit crops. Therefore, grafting of elite germplasm is the common practice. Grafting-incompatibility has been identified as a cause for poor growth and yield of grafted plants especially at the latter part of the economic lifespan of the fruit crop. This could be resulting in from poor craftsmanship and problems in genetic purity of the plant materials. Therefore, developing appropriate morphological, anatomical and biochemical tools (indicators) for early detection of grafting incompatibility were envisaged for mango var. *Karthakolomban*, which is highly affected with grafting incompatibility-based yield retardation at commercial level. In this study, 6 month-old mango (*Mangifera indica*) var. *Kohu amba* seedlings were grafted with var. *Karthakolomban* (as scion), keeping 3 seedling (stock plant) vigor groups as treatments. The anatomical developments in the graft union showed formation of necrotic layer, followed by callus. As for morphological features of newly emerging shoots, vigorous plants (T1) showed the highest sprouting rate and grafting success than lesser vigorous plants (T2 and T3) within the first 45 days after grafting. For the biochemical analysis, peroxidase activity (PA) was determined at 90 days after grafting. The T1 showed the lowest PA value in graft union while T2 and T3 gave higher values. Moreover, significantly different PA was recorded for the graft union of the failed grafts, unsuccessful grafts, normal rootstocks and successful grafts. Unsuccessful grafts recorded the highest PA. Therefore, the T1 (highly vigorous plants) was the most suitable rootstock type for grafting in order to reduce the grafting incompatibility. The findings on the peroxidase activity could be used as a parameter for determination of grafting compatibility, in addition to the morphological and anatomical tools.

Keywords: Grafting incompatibility, Peroxidase activity, Graft union formation, Callus

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Use of CROPWAT8.0 Software for Irrigation Scheduling Using Real Time Meteorological Parameters

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Use of micro irrigation systems such as drip and sprinkler irrigation can substantially reduce water use in irrigated agriculture. When to irrigate and how much water to be applied are two important decisions to be made in operating the micro irrigation system. Data collected at climatological stations in addition to information on crops and soils is a pre-requisite for taking such decisions. There are many advantageous if this entire process starting from collecting meteorological information right up to operating the micro irrigation system is automated with available technology. Hence, this study is conducted to automate an irrigation scheduling process in order to get information to activate a drip irrigation system. This process includes transmission of weather data and determining evapotranspiration using CROPWAT 8.0 and decide when to irrigate and how much to apply. The first part of the research in transmitting meteorological data from weather station at Meewathura farm using CR1000 data logger to a mobile phone via an Arduino Uno board was completed, though the accuracy of information was questionable. A new code had to be written to facilitate this process. It was required to set reference voltages of Arduino Uno board to 1.1V to read the voltage received from CR1000 data logger in millivolts. After setting reference voltage, voltages of every sensor could be seen though they did not represent the readings in specific units of each weather parameter. Therefore, it was necessary to convert the input voltage read by Arduino Uno board to the required weather parameter. The CROPWAT software was used for the calculation of reference evapotranspiration (ET_0) and effective rainfall. A separate programme was written using visual basic 6.0 to calculate the time to irrigate and irrigation requirement.

Keywords: CROPWAT8.0, irrigation requirement, Arduino Uno, SIM900 GSM module

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Validation of an Alternative Test Method for Detection and Enumeration of Coliforms in Milk Powder with ISO 4831:2006 Standard

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ISO 4831:2006 is the standard that describes the procedure for the detection and enumeration of coliforms using most probable number technique. In order to obtain a negative result of a sample by ISO 4831:2006 method, a minimum of 72 hours are required. In order to obtain a negative result within 48 hours, an alternative method can be usedin place of ISO 4831:2006 method. This study was done to develop an alternative method, by modifying the ISO 4831:2006 method and to validate the developed method using the ISO 16140:2003 standard for validation of alternative methods in the field of microbiology. Milk powder was artificially contaminated using coliform bacteria and 25 contaminated samples and 15 non contaminated samples were analyzed using both methods (reference method-ISO 4831:2006 and alternative method), for coliform detection. The relative accuracy, relative specificity and relative sensitivity values according to the results were, 95, 100 and 90.48%, respectively. Discordant results analysis showed that there was no significant difference between the two methods (reference method- ISO 4831:2006 and alternative method) at $\alpha = 0.05$ level of significance. For the validation of the alternative method, for coliform enumeration, 25 artificially contaminated milk powder samples were analyzed using the same methods. The results showed a strong correlation between two methods with Pearson's correlation coefficient of 0.953. the coefficient of determination (R^2) was 0.91. Assessment of relative accuracy relationship between reference method (ISO 4831:2006) and the alternative method showed that those two methods do not behave equally. Therefore the developed alternative method can be only considered as a validated method for coliform detection, but not for coliform enumeration. In order to complete the validation procedure of the alternative test method, a collaborative inter-laboratory microbiological study should be conducted.

Keywords: Alternative method, Coliform detection, Coliform enumeration, ISO 4831:2006method, Validation

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Yield and Quality Comparison of Hybrid Napier (*Pennisetum glaucum x Pennisetum purpureum)* Fodder Varieties of CO-3 and CO-4 Grown in Sri Lanka

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A field experiment was carried out to analyze the growth parameters, herbage yield and quality of CO-3 and CO-4 (*Pennisetum glaucum x Pennisetum purpureum)* fodder grown in Mid Country Wet Zone of Sri Lanka. The experiment was a Randomized Complete Block Design with 3 replicates. Growth parameters such as number of leaves/plant, number of tillers/plant and height of plants were measured at 2 week intervals up to the 8 weeks and, plants were harvested at 70 days after establishment. Fresh matter yield, dry matter yield and leaf to stem ratio were recorded for both varieties. In addition, already established fields of CO-3 and CO-4 (at pre-bloom stage) were selected from different regions in Sri Lanka in order to collect samples for chemical analyses (24 samples/variety). Chemical analyses of forages were done to determine crude protein, ash, water soluble carbohydrates, nitrate, oxalate and *in vitro* digestibility according to the standard methods. Data were statistically analyzed using Analysis of variance and means were compared using Duncan's New Multiple Range Test. At the end of the 8th week, CO-4 had 37% more ($P<0.05$) number of tillers per plant, 46% more ($P<0.05$) leaves/plant and 27% more ($P<0.05$) dry matter yield compared to CO-3 in the Mid Country Wet Zone of Sri Lanka. According to the nutritional composition study, CO-4 had 3% more ($P<0.05$) crude protein and 4% more digestibility compared to CO-3. However, oxalate and nitrate content in CO-3 was similar ($P>0.05$) to that of CO-4. Results revealed that based on the yield and nutritional quality, CO-4 is an ideal variety of fodder for dairy cattle feeding in Sri Lanka.

Keywords: Hybrid Napier, yield, quality, oxalate, nitrate

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Analysis of Genetic Diversity of *Naimiris* (*Capsicum chinense* Jacq.) using Simple Sequence Repeat Markers

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Among the *Capsicum* species, *Capsicum chinense*has the highest pungency and antioxidant activity, and a wide genetic diversity. The present study was conducted to analyze the genetic diversity of *C.chinense* (*Naimiris*) germplasm conserved in the seed bank at the Plant Genetic Resources Centre (PGRC), Gannoruwa, Sri Lanka. Molecular characterization was done for 25 *C.chinense*germplasm, two *C. annuum*, two *C. frutescens* and one *C. baccatum*accessions. DNA extraction was done based on population DNA bulk strategy using the modified CTAB method. Fourteen Simple Sequence Repeat (SSR) markers were used and amplified products were resolved in 8% denaturing Polyacrylamide Gel Electrophoresis (PAGE). Statistical analysis was done for molecular data using PowerMarker V3.25 software. Genetic diversity was found among the *naimiris* germplasm and between different species of *Capsicum*. The allelic richness ranged from 2 – 6 per locus. The mean Polymorphism Information Content (PIC) value was 0.49 which ranged from 0.15 (CAMS806) to 0.73 (CAMS117, CAMS156). Mean genetic diversity was 0.55 with a range of 0.15 (CAMS806) to 0.77 (CAMS117, CAMS156). This reflects a higher genetic diversity among the tested germplasm. According to the frequency based distance values, the highest genetic distance was recorded as 0.8951 between C-2012-03-206/1 and C-2012-2-72 germplasm while the lowest of 0.0738 was observed for C-2012-2-72, C-2014-6-50 and C-2014-6-51 germplasm.The cluster analysis based on genetic distance showed three main clusters. While 88% of *C. chinense* germplasm grouped into one cluster, *C. annuum* and *C. frutescens*were separated into two clusters. Within the *C. chinense* cluster, sub clusters were identified and a higher genetic diversity was observed within *C. chinense* cluster. The genetic diversity identified in this study will be useful in *C. chinense*breeding programmes and conservation activities.

Keywords: *Capsicum chinense*, *Capsicum species*, Genetic diversity, Molecular characterization

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Analysis of Pesticide Residues and Evaluation of Selected Beneficial Effects in Tomato Grown Under an Eco-Friendly Management Package in Comparison to Existing Commercial Cultivation Practices

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Indiscriminate use of pesticides which has become a practice of present-day agriculture leads to the accumulation of pesticide residues in agricultural produce, and causes numerous hazardous impacts on human health and environment. Therefore, identification of alternative strategies that ensures food safety and the safety and profitability of agricultural systems has become a timely need. Thus, the present study was conducted to analyze pesticide residues and evaluate several selected beneficial effects of tomato grown under an Integrated Pest Management (IPM) based eco-friendly management package in comparison to an existing commercial cultivation system. The study was conducted as an open field experiment using three selected tomato farmer fields in Marassana, Kandy. Determination of pesticide residue levels present in tomatoes (variety *Abiman*) was done by Gas Chromatography-Mass Spectrometry and Gas Chromatography-Electron Capture Detection techniques. The two crop management systems were compared with respect to crop growth, pest and disease incidence, yield, environmental impact and cost effectiveness. A detailed farmer survey was conducted to collect information on the agricultural practices and pesticide management practices currently adopted by the farmers in the study area and to gather information about their perception on practicing IPM. Findings of present study revealed the presence of Chlorothalonil, Profenofos and Phenthoate in tomatoes grown in fields under existing commercial cultivation system and Tebucanazole in one of the fields under IPM management. In all the cases detected pesticide residue levels were below the maximum residue limits (MRL). Moreover, there was no significant difference (P<0.05) between the two management systems with respect to yield and incidences of pests and diseases. Plant height was significantly (P<0.05) higher in tomatoes grown under the IPM package. Calculated costs and field use environmental impact quotient proved that IPM was more cost effective and environmentally safer than the existing commercial cultivation system.

Keywords: Eco-friendly, Gas-Chromatography, IPM, MRL

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Assessing Impacts of Certain Traditional Farming Techniques, Biodynamic Vitalizers and Structured Water on Mungbean Cultivated in Organic Farming System

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This study was carried out in University Experimental Station, Dodangolla, Sri Lanka to investigate the impacts of *karana*-system, biodynamic-vitalizers and structured water on mungbean production. Field experiment-1 was carried out in a Randomized Complete Block Design with 5 treatments and 3 replications. They were; application of compost in the rate of 10 t/ha (Control), Control + application of biodynamic-vitalizer of BD-500 (Treatment-2), Control + BD-501 (Treatment-3), Control + irrigated with structured water (Treatment-4) and Control + 3 application of BD-501 (Treatment-5). Field experiment-2 was conducted to evaluate the effects of traditional farming based on *Karana*-system which are the auspicious animal periods within a lunar month, for the crop protection from wild animals. It consisted of 4 treatments as planting was practiced during *Sinha-karanaya*, *Uru-karanaya*, *Gaja-karanaya* and *Divi-karanaya.* In the experiment-1, Treatment-4 performed well with significantly ($p<0.05$) higher yield (43% yield increment) compared to the Control (0.97 t/ha). This may be due to the significantly higher leaf area index, plant height, plant dry weight at its early growing stages and number of pods/m^2 at the harvest. *Yak* grain (Hard-seed) percentage in the harvest was significantly ($p<0.05$) lower in all 4 treatments which had a higher yield quality than the Control. In the experiment-2, after 2 weeks, total growing area which represented different *karana* treatments were completely damaged by wild animals and did not show a positive effect on crop protection. Precision of auspicious times obtained may be subjective and vary from person to person and region to region, therefore repeating with more precise methodologies are required before any generalization are made in these aspects. Based on the outcome of experiment-1, vitalizers enhance the quality of yield and specifically, structured water application showed profound yield and quality increment which could be used as a yield enhancing treatment in organic farming.

Keywords: Biodynamic farming, *karana* system, organic farming, structured water

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Assessing the Soil Salinity Status in Pooneryn Area of Kilinochchi

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About 99,600 hectares of land in Northern region is utilized for agricultural activities and soil salinity is one of the threats. This Study was conducted to assess the status of soil salinity in Pooneryn area in Kilinochchi district of Sri Lanka. Soil pH, exchangeable sodium percentage (ESP), cation exchange capacity (CEC) and electrical conductivity (EC) were measured in topsoil (0-15 cm) and subsoil (15-60 cm) samples collected from 20 locations along a 6 km transect. The sampling transect covered five land uses namely, paddy, home garden, vegetable cultivation, forest and plantations while connecting sea and the lagoon at western and eastern corners, respectively. The pH of surface soil ranged from 4.87 to 8.60 (CV = 16.9 %) of which 60 % of soil samples were in acidic range (4.87-6.50) and 15% of samples were in moderately alkaline range (7.5 to 8.6). Rest of the soil samples had neutral pH. A positive trend in values of all salinity parameters were observed from sea to lagoon. Electrical conductivity of all samples ranged from 0.14 - 0.66 dS m^{-1} indicating absence of soil salinity. Values of ESP ranged from 0.46 – 12.7 % indicating slightly sodic conditions in some locations. Statistical analyses indicated an influence of land-use and soil texture on the development of soil salinity in this area ($P<0.05$). This study indicated a considerable spatial variability of soil salinity parameters in the Pooneryn area which is affected by the intrusion of brackish water, land use and soil texture.

Keywords: Soil salinity, Sodicity, Spatial variability, Sea water intrusion

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Contamination of Paddy and Home Garden Soils with Selected Trace Elements in Ginnoruwa, Girdurukotte

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Agricultural soils can be a sink for trace elements in long term and may lead to contaminate the food chain. This study was conducted to determine the level of contamination in paddy and home garden soils in Giradurukotte, Ginnoruwa area with As, Cd, Cu, Pb and Zn and identify the impact of soil properties on the accumulation of the trace elements in the studied soils. Twenty three sample locations (paddy-10 and home garden-13) were selected based on a grid map in the area where each grid represented 4×4 km^2 area. Soil samples were collected from two depths at each location to approximately represent the A and B horizons. Soil samples were digested with trace metal-grade aqua regia and analyzed for the trace elements using Inductively Coupled Plasma Mass Spectrophotometer. Active Fe, pH, texture, available phosphorous (P), cation exchange capacity (CEC) and organic carbon (C) contents of soils were determined using standard methods. Concentrations of all the trace elements were low and below the maximum allowable limits of United States and European Community standards. Paddy cultivated soils had three times higher Cd concentrations (0.09 mg/kg) than home garden soils. The Zn concentration in paddy cultivated soil was significantly lower than that in home garden soils (38.56 mg/kg).Concentrations of trace elements did not differ significantly between two depths of each paddy cultivated and home garden soils. In paddy cultivated soil, 76% variation of total As concentration was explained by CEC, active Fe and available P. About 30-60 % of variation of trace element concentrations was explained by the absorption capacities of soils, which depend on CEC, organic C and clay contents.

Keywords: Home garden, Paddy, Soil Properties, Trace Elements

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Determination of Heavy Metal Concentration in Milk Powder Collected from Kurunegala District in Sri Lanka

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Milk powder as a nutritious dairy product occupies a significant portion in healthy diets. However, contamination of milk with heavy metals is a major problem worldwide. Intake of milk powder produced from heavy metal contaminated milk can cause direct and indirect adverse health hazards to humans due to long-term exposure to toxic heavy metals. Hence, it decreases the safety, quality and the consumers' acceptability of milk powder. Thus the aim of this study was to determine the concentration of potentially toxic heavy metals including arsenic (As), cadmium (Cd), chromium (Cr), mercury (Hg) and lead (Pb) in milk powder (Full Cream Milk Powder and Non-fat Milk Powder) available in major supermarket chains in Kurunegala District. Total of 54 samples (18 different brands in triplicates) were evaluated. Inductively coupled plasma mass spectrometer (ICP-MS) was used for the quantitative determination of heavy metals. The tests were performed after microwave digestion of samples with HNO_3 (70% v/v) acid. All the brands tested showed lower values for As, Cr and Hg compared to maximum permissible levels. However, four brands had significantly ($P<0.0001$) higher values for Pb (0.146± 0.01, 0.155± 0.03, 0.121± 0.03 and 0.099± 0.03 mg/kg) and 1 brand had significantly ($P<0.0001$) higher value for Cd (0.316± 0.43 mg/kg) than the maximum permissible levels (0.025 mg/kg for Pb and 0.007 mg/kg for Cd) established by the Codex Alimentarius.

Keywords: Milk powder, Heavy metals, Microwave digestion, Inductively coupled plasma mass spectrometer (ICP-MS)

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Determination of Land Suitability for Oil Palm (*Elaeis guineensis*) Cultivation Using Geographic Information System, and Its Impact on Environment Compare to Rubber

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The ongoing expansion of oil palm cultivation in Sri Lanka has become the subject of political and environmental debates. Present study was undertaken to determine suitable land areas to cultivate oil palm using Geographic Information System (GIS) and to assess the impacts of oil palm cultivation on selected soil properties and flora diversity.Mapping of suitable areas for oil palm were undertaken for Kaluthara district. Environmental impact assessment was conducted Udugama Estate of Watawala Plantations (Pvt.) Ltd. located in Low Country Wet Zone.Climatic (Rainfall and Temperature) and topographic information were used to map the suitable areas. Maps were prepared considering optimum growing conditions for oil palm and the existing climatic and topographic information of the district. For the environmental impact assessment, existing oil palm and rubber cultivated lands were categorized in to three age categories (<10 yrs) , 10-20yrs, and >20yrs) as well as two slope categories (<10% and >10%). Soil samples were taken from three depth levels (0-15cm, 15-30cm, 30-45cm) from each age and slope categories for analysis. Floral diversity in each experimental plot(20mx20m) was assessed. Using GIS mapping most suitable, possible and constrained land areas were identified. Results revealed that no difference in soil pH, EC, N, P, K, Organic matter (OM)% among three soil depths in different age and slope categories of oil palm and rubber cultivated fields. However, these soil properties reduced with the increase of depth except pH and EC. In both crops OM% increased with the age. Number of flora species recorded comparatively high, in oil palm <10yrs and >20yrs for both crops while the lower flora diversity was recorded for 10-20yrs for Oil palm.Overall results suggest that there is no significant difference in flora diversity and soil properties between oil palm and rubber cultivated lands in the study area.

Keywords: Flora diversity, GIS, Oil palm, Rubber, Soil properties

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Development of a Methane (CH_4) Emission Concentration Map: Case Study at Karadiyana Dump Site

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Municipal solid waste landfills and dumpsites generate a mixture of hundreds of different gases including methane (CH_4) and carbon dioxide (CO_2) which are major components among many other tracer gases. Quantification of methane emission from dumpsites is an important aspect of disposal site management since the assessments are needed for landfill rehabilitation, landfill gas recovery and reducing the green-house emissions. However, in Sri Lankan context, quantification of dumpsite gas emission is rarely done and use in disposal site management. This study was conducted to develop a landfill surface gas emission of Karadiyana dumpsite which is one of the largest dumpsite in the country with extend of 37 acres and receiving 500 tonnes of waste per day. First, a contour map of dumpsite was developed through a comprehensive topographic survey and a grid of 200 sampling points at 10 m distance was marked. Perforated PVC pipes sections were installed to a depth of 1 m on each grid point and passively vented methane concentration was measured using a portable gas analyzer (Gas board 3200P). The measurements were continued for six times at each location during 28 days. The methane measurements were developed to a concentration map using ArcGIS software. The average surface emission was 13.8% that varied from 0% to 65.9% at different locations. Maximum emission rates were observed above the places where organic wastes are dumped. The developed emission map can be used to identify "hot spots" at the dump site, to identify high risk and low risk areas during the operations and to install gas wells for methane recovery and emission control.

Keywords: Methane, surface emission, open dump

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Effect of Bio-char on Reduction of Nitrogen Loss During Composting

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Nutrient loss is an unavoidable problem during the composting of organic matter and this is especially the case for nitrogen. During the process of composting addition of bio-char will reduce the loss of Nitrogen and produce stabilized organic fertilizer. Laboratory scale experiment was conducted to investigate the effects of bio-char on nitrogen conservation during the composting. The four treatments were prepared with 18 kg of shredded immature grass and 2 kg of Gliricidia leaves which had 14 mg/g and 16 mg/g of total nitrogen contents respectively. The moisture content, total solids, volatile solids, total fixed solids and pH of used bio-char were 8.18%, 76.42%, 78.02%, 22.13% and 9.29 respectively. 3%, 6% and 9% of bio-char was incorporated from dry weight basis. In the initial stage, nitrogen content was lower in all four treatments than the final stage because the enzyme urease concentrations and also the CEC of the bio-char were low. However, the 9% and 3% bio-char mixtures had lower nitrogen contents than others in the initial stages and among these two mixtures 9% bio-char mixture had the lowest. It has higher specific surface than the other three mixtures which caused to utilize more oxygen from the atmosphere and oxidization of nitrogen leads to volatilization of the nitrogen. 3% bio-char mixed compost pile would have had high nitrogen content in the char surfaces and it leads to lack of adequate sites for the ammonia to remain on the surfaces which created well defined paths for allowing the ammonia to escape to the atmosphere. 6% mixed bio-char pile was in between the 3% mixed bio-char pile and 9% bio-char mixed pile. As a result 6% bio-char mixed pile showed higher performances and kinetics of VS loss can predict the level of decomposition required to maintain a C:N of 9.

Keywords: Bio-char, compost, nitrogen loss

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Effect of King Coconut Waste Biocharon Selected Physical and Chemical Properties of Two Coconut Growing Soils

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King coconut waste is an environmental pollutant that could cause health concerns. This can be converted into biochar and incorporated to coconut lands to improve soil fertility. This study was conducted to characterize biochar made from king coconut waste using a retort method, and to investigate the effect of biochar addition on selected chemical and physical properties of two contrasting coconut growing soils at the Coconut Research Institute, Lunuwila. Three to four years old young coconut palms growing in a Sandy Regosol (*Madampe* series) and a Red Yellow Podsolic soil with soft and hard laterite (*Boralu* series) were amended with three levels of biochar (0, 0.5 and 2% w/w). These palms were also supplied with recommended chemical fertilizers (CF). Additionally, a control plot with no CF or biochar application was maintained. Soil physical and chemical properties were measured initially, and at one and three months after application. One month after biochar application, soil pH significantly ($P<0.05$) increased from 6.90 to 7.84 in *Madampe* series soils. A significantly ($P<0.05$) high exchangeable K contentafter three months (482 ppm)were observed in CF+2%biochar treatment compared to CF only treatment (159 ppm). The bulk density values significantly decreased ($P<0.1$) from 1.54 to 1.41Mg m^{-3}in CF+2% biochar treatment compared to the CF only treatment. Soils of *Boralu* series showed a significant increase in EC (0.218 dS m^{-1}) with CF+2%biocharcompared to CF only treatment (0.119 dS m^{-1}) at three months after application. Biochar application did not affect available P, exchangeable Ca, Mg, and Na levels in both soil series during this period. This study shows that king coconut waste biochar has the ability to improve fertility in coconut growing soils. In addition, this technology could be used to disposeking coconut waste in an environmental friendly manner.

Keywords: Biochar, Coconut growing soils, King coconut waste, Soil fertility

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Evaluation of Vermicompost Produced Using Common Earthworm Speciesand Waste Materials Collected From Tea Estates

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Earthworms are important biological organisms having the ability to convert organic waste into high quality compost.Decomposition of waste materials using earthworms is known as vermicomposting. Three experiments were conducted to achieve the objectives, namely; evaluation of waste materials collected from tea estates enriched with poultry dung and cow dung as bedding material for vermicomposting, the efficiency of different earth worm species on vermicomposting and the crop growth under different compost types that are produced using common earthworm species.In the first experiment, four bedding material treatments;gliricidia, Mana(*Panicum maximum*), Tea prunings and refused tea was composted using *Eudrilus euginea*.Each bedding material was mixed with either cow dung or poultry manure before using as a bedding material.The highest ($P<0.05$) total nitrogen content (14.6 mg g^{-1}) and potassium content (11.65mg g^{-1}) in the resultant compost was found in tea waste + poultry manure treatment whereas differences among other treatments were not significant. The differences of phosphorus among different treatments were not significant. In the second experiment,earth worm species *Eisenia foetida*, *Periyonix excavator and Eudrilus euginea*a were evaluated for their vermicomposting ability.The results were non-significant in relation to N, P andK levels in the produced compost.In the third experiment vermicompost produced from tea waste + poultry manure with the use of *Eudrilus euginea* was compared with garden compost and inorganic fertilizer using tomatoas the indicator crop. Vermicompost treatment showed significantly higher ($P<0.05$) fruit weight and number of branches when compare with other treatments. The results show that waste from tea waste can be successfully used as bedding materials for producing vermicompost as it can be considered as better soil amendment for producing vegetables such as tomato.

Keywords: Vermicompost, earthwormspecies, cow dung, poultry manure

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Investigation on Effect of Mud Snails (*Cipangopaludina chinensis laeta*) and Intertillage in Lowland Paddy Cultivation with Zero Chemicals

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Agro-chemicals lead higher yield in modern agriculture. However, extensive use of agro-chemicals causes substantial environmental and ecological damage. Therefore, alternatives to minimize the use of chemicals without compromising the yield are necessary. Mud snail (*Cipangopaludinachinensis*laeta) can be considered as bio-based nutrients source and intertillage may enhance the biomass accumulation and mineralization. Therefore, a study was conducted to assess the effect of intertillage and mud snails in paddy cultivation without agro-chemicals. Altogether, 8 treatments, Intertillage x Snails x Plant, Intertillage x Snails, Snails x Plant, Snails, Intertillage x Plant, Intertillage, Plant, Control were designed. Plastic containers (56.5 x 36 x 31 cm) were used for treatment. Forty snails were introduced to respective treatments. Intertillage was practiced on weekly interval using hand fork up to 55 days after planting. BG 300 variety was planted with 15 x 30 cm spacing. Water was managed up to 5 cm depth until 2 weeks prior to harvesting. No synthetic chemicals were used. Plant height, number of leaves, Soil organic matter (OM), Total nitrogen, exchangeable phosphorus and exchangeable potassium were measured on weekly interval. Grain yield was measured at the harvesting. The average OM content varied significantly in reproductive stage in all treatment. Total Nitrogen was significantly higher in ripening phase. Exchangeable potassium was higher at the end of the experiment. There was no significant difference in exchangeable phosphorus in soil at the end of the experiment. Plant height as not varied significantly among the treatments. Grain yield is slightly higher in Intertillage x Snails x Plant treatment (4087 kg/ha) than that in Snails x Plant (3990 kg/ha), Intertillage x Plant (4038 kg/ha) and Plant (3607 kg/ha).The biomass accumulation followed by mineralization may lead to release nutrient for plant. There is a positive effect by mud snails and intertillage in paddy cultivation.

Keywords: Paddy cultivation, intertillage, mud snails, bio-based nutrients

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Level of Contamination and Potential Bioavailability of Trace Elements in Up-Country Vegetable Growing Soils in Sri Lanka

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Excessive application of agrochemicals and organic amendments tends to accumulate trace elements in soils. Vegetable growing farmers in the Up-Country area have been using agrochemicals and organic amendments extensively during the last four decades. The objectives of this study were to evaluate the level of soil and vegetable contamination with Cd, As and Zn, determine whether the cultivated fields have accumulated above trace elements in higher concentrations compared to uncultivated fields, and build relationships between basic soil properties and total concentrations of trace elements. Thirty six soil samples from0-15 cm depth were collected from intensively cultivated fields with chemical and organic inputs (n=13), fields under organic farming (n=13), and forest areas (n=10). Twenty six vegetable samples were collected from the cultivated fields. Soils and edible portions of the vegetables were digested with trace metal-grade acids and analyzed with Graphite Furnace Atomic Absorption Spectrophotometer for trace elements. Soil pH, organic carbon content, cation exchange capacity, texture, available P and active Fe concentrations were also determined in soil samples. Concentrations of Cd, As and Zn in all soils were below the maximum allowable concentrations of United States and European community. Only concentrations of Zn were significantly different ($p<0.05$) in cultivated soils compared to uncultivated soils. Vegetables grown in intensively cultivated soils had significantly higher Cd concentrations ($p<0.05$) than vegetables grown in organic fields. Concentrations of Cd in all the vegetables were below the maximum allowable limits given by FAO/WHO. Accumulation of trace elements in cultivated soils was partly explained by soil pH, clay and organic C contents. Concentrations of the tested trace elements in the soils had not increased up to a risk level according to the standards.

Keywords: Intensive agriculture, Soil, Trace elements, Vegetables

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Organic Carbon Dynamics in Two Biochar Amended Soils in Sri Lanka

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Low soil organic carbon (SOC) reserves is a major constraint that limits productivity in agricultural lands of Sri Lanka. Biochar can be applied to increase the SOC reserves in a sustainable manner, but the magnitude depends on soil type and biochar quality. This study was conducted to investigate the effect of biochar quality on changes of SOC mineralization in two biochar amended soils in Sri Lanka. Two types of biochar were produced fromcorn cob waste and rubber-wood using a Top Lit Up Draft method (300-350 °C) and characterized. Reddish Brown Earth (RBE) and Red Yellow Podzolic (RYP) soils were amended with the two biochar types at 0% and2% (w/w) rate in a short term laboratory incubation experiment. CO_2 evolved from treated soils over a period of 184 days was measured at different time intervals. At the end of the incubation period,abundance of fungi and dehydrogenase activity were assessed. Corn cob waste biochar (CC-BC) exhibited significantly higher ($p<0.01$) pH, CEC, ash content and more recalcitrant compounds than rubber-wood biochar (RW-BC). The RW-BC contained significantly higher ($p<0.05$) fixed carbon and volatile matter content than CC-BC. Addition of biochar increased abundance of fungi but decreased dehydrogenase activity in both soils significantly ($P<0.001$). Amending soils with biochar significantly increased ($p<0.001$) carbon mineralization rates during initial stage. At the end of the incubation period cumulative CO_2 emission did not change significantly with CC-BC addition in both soils. Applying RW-BC released 15% more CO_2 compared to un-amended soils ($p<0.001$). The observed differences in C mineralization can be attributed to more readily mineralizable C present in rubber-wood biochar. Results suggest that CC-BC could be a better organic amendment for increasing SOC reserves and sequestering atmospheric CO_2 than RW-BC in both RBE and RYP soils.

Keywords: Biochar, Carbon mineralization, Corn cob waste, Rubber-wood, Soil organic carbon

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Quantification of Trace Elements in Raw Buffalo Milk in Selected Areas in Sri Lanka by ICP-MS: Determination of Trace Elements Availability and Sensory Attributes of Curd in Clay and Plastic Containers

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The objectives of this study were to identify variability of trace element concentrations of buffalo milk with geographical locations in Sri Lanka, to identify variability of trace element concentrations of buffalo curd prepared in clay containers and to determine the sensory attributes of buffalo curd in different packaging materials. Sampling areas were selected based on the major buffalo rearing areas in Sri Lanka and seventy eight buffalo milk samples were collected from twelve different locations. Trace elements in buffalo milk (Ca, K, Zn, As, Cd, Pb, Hg) and curd (Ca, As, Cd, Pb) were quantified by Inductively Coupled Plasma Mass Spectrometry (ICP-MS). There were significant differences ($P<0.05$) in each trace metal presence in buffalo milk among different geographical locations. The highest calcium (2362.22±26.05mg/L), potassium (1622.12±83.81mg/L) and zinc (4.93±0.78mg/L) contents were observed in Polonnaruwa, the highest arsenic (2.67±0.58µg/L) and Pb (8.84±0.69µg/L) contents were observed in Embilipitiya and the highest cadmium (35.76±4.31µg/L) content was observed in Padaviya. Cadmium concentrations in Padaviya exceeded the provisional tolerable weekly intake (PTWI) of 7µg/kg body weight. When compared to curd prepared in plastic cups, curd prepared in clay pots received higher ($P<0.05$) preference from the panelists for texture and aroma. Analysis of the effect of clay pot on trace metal variability of buffalo curd indicated a significant difference ($P<0.05$) between the availability of trace metal concentrations in milk (As=1.70µg/L, Cd=6.85µg/L, Pb=8.54µg/L) and curd (As=47.65µg/L, Cd=9.21µg/L, Pb=30.98µg/L) prepared from same milk. However, there was no significant difference ($P>0.05$) in the calcium content in milk and curd prepared in clay pots. It can be concluded that, except cadmium content in milk collected from Padaviya, other trace metals are well below the recommended levels defined by World Health Organization (WHO) and curd can be contaminated by migration of trace metals from clay containers.

Keywords: Trace metals, ICP-MS, buffalo milk, buffalo curd

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Structure and Composition of Homegardens in Monaragala District in Sri Lanka and their Contribution for Conservation of Plant Genetic Resources

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Homegarden system is considered to hold a large potential for conservation of plant genetic resources (PGR). The main objectives of this study were to assess the structure and composition of homegardens and their contribution for conservation of PGR in 50 homegardens representing seven agroecological regions (AERs) in the Monaragala district of Sri Lanka. A vegetation survey was carried out, and the above ground carbon stock was measured. Soil samples were collected from each homegarden and pH, EC, OC, OM, N, P, K and CEC parameters were analyzed. Species diversity was measured using Shannon-Wiener Index (SWI). The study identified 526 plants species including 16 endemic (3%), 259 native (49.2%) and 251 introduced (47.7%) species belonging to 114 families. Timber, fruits, vegetables, medicinal, ornamental and spice were the main plant categories observed. Species in homegardens showed clear stratification and species are arranged in four to five layers. The most dominant species were *Cocos nucifera* L., *Areca catechu* L., *Musa* sp., *Mangiferaindica* L. and *Citrus sinensis* L. The SWI varied from 0.246 to 0.313 within the seven AERs of Monaragala districts. The study also identified 19 underutilized fruit and 18 underutilized vegetable specie and 14 species of crop wild relatives (CWR) indicating the contribution of homegardens to conservation of PGR. The average pH, EC, P, CEC were significantly different among the AERs. At individual homegardens, the above ground carbon stock varied from 8.5 Mg C ha^{-1} to 211.8 Mg C ha^{-1}. The results showed a heterogeneity in terms of carbon stock and tree diversity in different homegerdens in the study site. Such information can be used to develop homegarden models, and their administration and conservation plans to promote homegarden systems in the Monaragala district.

Keywords: Homegarden, carbon stock, species diversity, conservation, Monaragala district

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Study on the Effect of Harvesting of Plant - Cattail (*Typha angustifolia*) in Constructed Wetland for Dairy Wastewater Treatment

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Wastewater has to be treated up to the effluent standards of Central Environmental Authority (CEA) before discharge into the environment. Wastewater generated from the production units of yoghurt, ice cream, milk toffee and buffalo curd is sent through a neutralization tank, anaerobic tank and finally through a constructed wetland in Milk processing plant in Mawelawattha farm. The plant Cattail (*Typha angustifolia*) is used in the wetland since the establishment of the treatment unit. This plant is periodically harvested when it becomes matured. This might have an impact on the performance of the wastewater treatment. This study was conducted to characterize dairy wastewater and to assess the treatment efficiency with plant growth after harvesting. Influent and effluent from the wetland were collected weekly and analyzed for pH, salinity, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Total Solids (TS), Volatile Solids (VS), Total Suspended Solids (TSS), Volatile Suspended Solids (VSS), Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD). Average wastewater generation varied from 0.65 to 1.34 m^3/day. Higher amount of wastewater was generated from ice cream and yoghurt production compared to other products. The BOD and COD of the wastewater from the process of ice cream and toffee were higher compared to other products. Higher EC, BOD and COD were observed in outlet than the inlet in the first week after harvesting. The removal rate increased thereafter with the plant growth. In flowering stage, BOD and COD were reduced to 250 mg/l and 440 mg/l, respectively. Strip harvesting is better than complete removal of plant to avoid fluctuation of removal efficiency.

Keywords: Constructed wetland, dairy waste water, harvesting, biochemical oxygen Demand, Cattail

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The Effect of Agricultural Byproduct-Based Liquid Fertilizer on the Growth and Development of Hydroponically-Grown Green Cucumber*(Cucumis sativus* L.)

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Hydroponics is a popular technology used in modern agriculture to overcome most of the biotic and abiotic constrains in crop cultivation and to gain the advantage of higher productivity. However,there are several issues regarding the fertilizer use in this cropping system such as high cost and environmental pollution (caused by continuous use of inorganic fertilizer). Moreover, there is a growing demand for eco-friendly food products in the market and for use of agricultural byproducts in meeting the production targets and standards. Favoured by this situation,the present study aimed at investigating the effectiveness of agricultural byproduct-based liquid fertilizers on the growth and development of hydroponically-grown green cucumber (*Cucumissativus*L.). The effectiveness of agriculture byproduct-based liquid fertilizers, namely,(T1) coco-peat effluent, banana stem extract and *Gliricidia* leaf extract, (T2) coco-peat effluent, banana stem extract, *Gliricidia* leaf extract and poultry manure, (T3) cow dung and poultry manure,and (T4) biogas slurry were tested in comparison to the widely used Albert's fertilizer (T5; Control).Significantly high ($P<0.05$) vegetative growth and reproductive growth were observed in the hydroponically-grown green cucumber treated with Albert's fertilizer than the agricultural byproduct-based liquid fertilizer treatments due to the balanced nutrient composition of the former. Biogas slurry-based liquid fertilizer gave similar results to Albert's fertilizer for most of the vegetative and reproductive growth parameters measured. None of the agricultural byproduct-based liquid fertilizers showed deficiency in N, P and K thus, suggesting that the lower yields observed are not due to N, P and K deficiency. Further improvement in the agricultural byproduct-based liquid fertilizers is necessary to make them potential alternatives to Albert's fertilizer in terms of cost effectiveness and eco-friendliness.

Keywords: Agriculture byproducts, Hydroponics, Liquid fertilizer, Green Cucumber

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A Comparative Study of Sri Lankan Food Controlling Infrastructure with that of Developed Countries

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An effective food controlling system is an essential factor for any country to ensure safe and healthy food supply. Although most of the developed countries have well established food controlling systems that encompass divisions to address diverse aspects of food industry, still Sri Lankan food control system doesnot execute all the expected functions satisfactorily. As a result of that, food borne disease outbreaks, contaminations, food recalls and export bans have been frequently reported. Hence, the objective of this research was to identify gaps prevailing in the Sri Lankan food controlling infrastructure with respective to the food controlling systems of developed countries. In this study, data on Sri Lankan food controlling infrastructure were gathered through the meetings and discussions with regulatory officials and other respective authorities. Thereafter, prevailing gaps in Sri Lankan system were identified. Suggestions were provided by conducting a comparison with regulatory systems of developed countries. Results revealed that Sri Lankan food legislations are not sufficiently addressing modern food safety issues and they do not comply adequately with international requirements. According to the study, Sri Lanka does not have sound surveillance system and qualified, adequate workforce for enforcement activities. To overcome these gaps, Sri Lanka should implement independent food authority which is entirely dedicated to food control administration and food legislations should be frequently updated in accordance with modern food safety issues. Strong surveillance system should be implemented along with well-coordinated information network.

Keywords: Sri Lankan food controlling infrastructure, Food act, Codex alimentarius commission

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A Comparative Study on Production Systems in Minor River Diversion Schemes in Kumbukkan Oya Basin.

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Kumbukkanoya is the main irrigation sources in Monaragala District of Sri Lanka. Monaragala is a district with high incidence of poverty and understanding production interrelationships and differences in income would provide useful insights to planning. This study assesses the factors effecting on productivity and cost of cultivation minor irrigation schemes located in upstream and the midstream areas of the basin. The study was conducted in Lunugala and Medagama DS areas. Net revenue from one ha of rice was used to represent farm productivity. Data were collected through face to face interviews from 30 randomly selected farm households in each area using structured questionnaire. Sampling method used was stratified random sampling. Data on inputs; land, labour, fertilizer, seeds and machinery; and family details were collected. Production relationships were modeled using Cobb–Douglas functions and Farm budgets were computed. Mean comparison was done to compare net returns between areas. Midstream farmers are full time farmers. According to the results a significant difference between net returns between two means were observed. Mean in the midstream is higher than in upstream. In upstream area land, labour, fertilizer quantity and amount of seeds are positively affecting on productivity. In midstream area land, quantity of chemical application, fertilizer quantity and amount of seeds positively affect on productivity.Cost of production for 1 kg of rice in midstream area is higher than the upstream area.Cost of production for 1kg rice is 30.31 LKR for midstream and 20.74 LKR for the upstream areas. Net revenue in midstream area is 101297.4 LKR/ha and in midstream it is 86848.68 LKR/ha.But most of the upstream farmers do not sell their production. They use it for their own consumption. It can be concluded that farmers' practices are different mainly due to their access to factors of production.

Keywords: Productivity, Minor irrigation, Upstream, Midstream, Cost of cultivation

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Adoption of Crop Diversification by Smallholder: the Case of Paddy Farmers Mannar District, Sri Lanka

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Crop diversification, the practice of growing different crops in the same land at different times increase farmer incomes and reduce income fluctuations. Crop diversification is aggressively promoted by the Sri Lanka Department of Agriculture for many years. Adoption levels by farmers are reported as low despite its known merits and continuous promotions. Specific objective of the study were to identify the factors favoring crop diversification in the study area, and to assist developing strategies to promote and disseminate new technologies that would enhance increase farm incomes. The study was conducted in Mannar District. Sixty farmers participated in the study. Farmers from 2016 Yala Season were randomly selected to include 15 farmers from each of four Agricultural Instructor's divisions. Sample farmers included farmers who grew paddy only and who grew other field crops in fields that are conventionally used to grow paddy. The theory of diffusion of innovation was used as the theoretical framework. Data were collected using a structured survey schedule. Binary logistic regression model was used to identify factors affecting the decision for diversification. Results indicate that main constraints in adoption are, unstable producer prices of other field crops, lack of knowledge on cultivation practices, and low market accessibility. Objective of market orientation contribute positively on decision to adopt new technology. Analysis of farm budgets reveals that 35% of the gross revenue from field crops is used as cash payments to outsiders. Fertilizer accounts for 73% of current input costs. Mean net revenue of adopters and non-adopters are respectively LKR 720990.59 and LKR 359269.02 per ha per season. Farmers using organic fertilizer reported lower costs. Managing sustainable yield of productive crop within cultivated land could be increased if net revenues to farmers can be increased.

Keywords: Crop diversification, Institutional factor, Farming objective, Theory of Diffusion of innovation, Social factors

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An Assessment of Perceived Service Quality, Customer Satisfaction and Customer Loyalty at *Hela Bojun* Sales Centers in Kandy District

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Hela Bojun sales centers were initiated to promote local traditional food while empowering women entrepreneurs. Service quality is a vital factor for achieving customer satisfaction which leads to customer loyalty and long term success of an organization. The objective of this study was to determine the influence of perceived service quality on customer satisfaction and customer loyalty in *Hela Bojun* sales centers. Customers of *Hela Bojun* centers in Kandy District were the target population. Data collection was done through a questionnaire with a sample of 120 respondents with 30 customers per sales center. Multiple linear regression, One-way ANOVA, Mann-Whitney U test and frequency distributions were used to analyze the data. Results of the multiple linear regression analysis (R^2=0.522) showed that material, price, perceived trust and customer satisfaction significantly (all $p<0.1$) influence customer loyalty. Also, material, price, personnel and perceived trusthad a significant influence on customer satisfaction (R^2 = 0.403, all $p<0.1$). There was a significant difference in customer satisfaction according to the location. Gannoruwa showed the highest satisfaction. Customer loyalty showed a significant difference in relation to the time of service with those coming in the morning being more loyal. Customers above 50 years of age consume foods lower in oil. It is noted that differential strategies maybe needed given the differences seen in location, customers and time of service. Increasing the space, improving the physical facilities and increasing the number of women entrepreneurs are the main suggestions provided by the customers who visit *Hela Bojun* sales centers.

Keywords: Service quality, Customer satisfaction, Customer loyalty, *Hela Bojun* sales center

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An Assessment of the Technical Efficiency and the Sources of Inefficiencies of Smallholder Dairy Sector in Gampola Veterinary Division

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The Sri Lankan dairy sector which is dominated by smallholders is facing an immense challenge in achieving 50% self sufficiency in milk production. Increasing the efficiency levels of the firms is one of the ways available for achieving this. For doing that, having a prior knowledge of the current level of technical efficiency (TE) and the barriers to achieving the potential yield is a priority. Therefore the objective of this study was to assess the TE and to investigate the inefficiency sources in the smallholder dairy sector. The study estimates the TE of 86 farms in Gampola veterinary division which are located in the mid country, which contributes the most to the domestic milk production. A stochastic production frontier estimated using STATA - 11 has been used for the analysis. According to the results, the mean technical efficiency (MTE) of the sector was 0.678. In the second part of the analysis, some farm and farmer related factors that could affect on TE have been regressed against the TE score. The results indicate that knowledge on dairying, the percentage of milking animals in the herd positively and significantly affects on the TE of the farm. Furthermore, it was revealed that farms which are managed by full-time dairy farmers are more technically efficient than that of farms which are managed by part-time farmers. Additionally, the usage of manure directly or indirectly in income generation activities, as well as medication cost indicate significant ($p<0.05$) positive relationships with TE. Considering the implication of the results, it can be suggested that TE of dairy farms can be increased by increasing the percentage of milking animals in the herd as well as increasing the knowledge on dairying, more time spent on dairying as well as a more efficient use of all farm outputs including manure.

Keywords: Technical Efficiency (TE), Knowledge on dairying, Herd size, Smallholders, Gampola

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Analysis of the Production Performance, Cost of Production and Revenue of a State-owned Dairy Farm

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An in-depth analysis of milk production, cost of production (CoP) and income from cattle and buffalo (C&B) at National Livestock Development Board farm, Melsiripura was conducted to identify factors (F) that increase CoP, determine cost effective supplementary feeds (SF) and estimate achievable cost reduction through removal of F. Data on daily milk yield (DMY), lactation length (LL), age at first calving (AFC), calving interval (CI), SF, income and expenditure of cattle and buffalo from 2012 August to 2016 September were obtained from farm records. Information on management was collected through interviews. Descriptive statistics and ANOVA procedures were used to analyze data. Of total cattle (n=115±25) and buffalo (n=328±25) population, 20% and 18.6%, respectively were lactating, while 13% and 23% were dry cows (DC). In both herds, 32% of DC was not pregnant (DNP), and <5% was calves. Daily milk yield, LL and CI of C&B were 10.21±1.4 L and 5.01±0.9 L, 291.57±57.7 d and238.89±37.4 d, and 368.14±26.7 d and 385.33±45.8 d, respectively. Monthly income per C&B (Rs. 8355.39 and Rs. 2564.53) was lower than CoP (Rs. 9192.51and Rs. 5170.61). Of the CoP in C&B, 81% and 57% were spent on feed (FC), of which 81% and 67% were for SF. M onthly FC per milking C&B were Rs. 7363.76 and Rs. 3551.23, respectively. Of the different SF used, beer pulp, coconut poonac and their combination had produced more milk than rice bran, while beer pulp was more cost effective. Reducing AFC by one month and CI by one day per C&B would save Rs.1316.00 and Rs.855.00, and Rs. 306.50 and Rs. 124.00, respectively. Culling a DNP C&B would save Rs. 5200/= and Rs. 1900/= per month. To reduce CoP and increase revenue, culling all DNPs, using cost effective SF and reducing AFC and CI through improved management are suggested.

Keywords: Production performance, revenue, cost reduction, cattle

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Career Aspiration of Agricultural Undergraduates: An Application of theTheory of Planned Behavior

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Studying career aspiration among undergraduates has become an important topic. Information on the career aspiration of students as well as the factors affecting career aspiration are important for the career development programmes. This study investigates students' career intention in the government sector, private sector and business startups separately by applying the theory of planned behavior by Ajzen (1991) which describes that intention of a behavior depends on a person's attitudes, social norms and perceived behavioral control (PBC). This study also investigates if students' intention towards a career would change as they progress along the degree programme. Further, the influence of demographic and socio-economic characteristics of students on their career intention has been explored. Data were collected from undergraduate students (first year 139 and final year 133) of Faculty of Agriculture, University of Peradeniya. Multiple linear regression and ANOVA analytical techniques were used in data analysis. According to the results, attitudes, PBC and social norms have a significant positive relationship with career intention in government and private sectors and business startups. However, only career intention in private sector is significantly different between final year and first year students. Career intention, attitudes, social norms and PBC towards private sector show a significant difference between males and females but not for business startups. Attitudes related to career intention in the government sector show a significant difference between urban and rural students. Career intention in private sector and attitudes and PBC towards private sector have a significant difference between urban and rural students. In business startups only social norms are significantly different between urban and rural students. By this study we can conclude that intention towards career can be predicted by attitudes, social norms and PBC. Furthermore, those factors are affected by gender and urban/rural status of students.

Keywords: Career intention, Theory of planned behavior, Attitudes, Social norms, Perceived behavioral control

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Consumer Preference for Major Product Attributes of Organic Vegetables: A Conjoint Analysis

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Demand for organic food is increasing all over the world due to food safety and environmental concerns together with consumer awareness. Although Sri Lankan organic food market is not well-developed, there is an increasing trend in production and consumption of organically grown fruits and vegetables. With this background this study was carried out with the objective of evaluating major product attributes of organic vegetables including production system, presence of information, availability and price. The attributes and levels were developed through a literature review and a focused group discussion. The consumer preference for these attributes each with three levels (3^4 factorial) were assessed based on the conjoint methodology. Then using fractional factorials nine profiles were constructed and arranged them into pairs of choice sets. A conjoint questionnaire with nine pairs of choice sets were administered using a sample of 58 consumers from three selected supermarkets in Kandy. A logit model was estimated using effect coded variables, and then part-worth utilities and marginal willingness to pay (MWTP) estimates were obtained. Relative importance of each attribute was calculated from part-worths. Part-worth estimates revealed that organic vegetables at current market price derive the highest utility for consumers. MWTP is highest (66.7% over current market price) when organic vegetables are available at supermarkets and the second highest MWTP (64.9% over current price) is for certified organic vegetables. Relative importance calculations revealed that production system was the most important attribute for consumers with 31.08% of relative importance followed by price, availability and information with 29.76%, 24.39% and 14.72% respectively. The study sheds important insights to the production and marketing of organically grown vegetables.

Keywords: Organic vegetables, Conjoint analysis, Part-worth utilities, MWTP, Relative importance

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Contract Farming for Smallholders in Commodities with Export Potential: Assessing the farm profits of Gherkin farmers in Sri Lanka

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Private sector involvement in commercial cultivation of fruits and vegetables has been encouraged by the Sri Lankan government, and steps have already been taken to enhance cultivation with the concept of Public-Private-People Partnerships (4P). The study was conducted to find the impact of Gherkin contract farming under the National Agribusiness Development Programproject in Nedungkerny GN divisions, Vavuniya North Divisional secretariat of Vavuniya district, based on the primary data collected from 60 individual gherkin farmers. The sample of 60 Gherkin farmerswere randomly selected and there were 32 project beneficiaries and 28 non-beneficiaries in the sample. Heckman selection model (two stage) was estimated to find the profitability of gherkin contract farming conditional on determinant characteristics of contract farmers under the partnership projects. The results revealed that,the gherkin contract farming under the 4P models project favoured entrepreneurial farmers having enough family labour, despite the presence of stringent selection criteria in the contract farming under 4P model projects. As a result of involving in gherkin production, farmers were able to earn significant net profit compared to other crops such as paddy and vegetables. There was a significant ($p<0.05$) impact of project participation and education level on gross farm income of gherkins.Inverse Mill's ratio was not statistically significant ($p<0.05$) implying that there was no sample selection bias. Although the farmers are not satisfied with the price paid by private party, quality requirement, and grading policies, overall relationships among the private party and farmers was good.Hence, NADeP should consider the entrepreneurial skills of farmers and number of family labour in the household of farmer to select project beneficiaries with the existing selection criteria. Implementing 4P model projects will help to contribute to poverty reduction and sustainable livelihood improvement of women and men in poor rural households in the program area.

Keywords: Contract farming, Gherkins, Heckman selection model, Selection bias, Public-Private-People partnerships

This study was funded by National Agribusiness Development Program, Presidential Secretariat.

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Critical Success Factors to Sustain Profitable Partnership Venture in Seaweed Farming : A Case Study in Killinochchi District

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Seaweed farming is one of the opportunities which have a potential of providing an alternative income generating source. In recent years there has been an effort to introduce seaweed farming in Sri Lanka by National Agribusiness Development Program. Mannar, Jaffna and Killinochchi were selected in Sri Lanka. This study aims to investigate the critical success factors to sustain profitable public private people partnership venture in seaweed farming. There are about three hundred seaweed beneficiaries in killinochchi district. Primary data was collected from sixty randomly selected farmers at Valaippadu. At first respondents categorized into two groups as farmers who still engage seaweed farming and who dropped. Demographic, socio- economic, farmers' satisfaction of seaweed farming, farmers' satisfaction with the farmers and agribusiness relationship and entrepreneurial skill were studied using descriptive statistics. A Logit model was estimated to analyse the factors which determine the farmers' continuation with the seaweed farming. Education level, number of training session attended and attitude of the famers were the factors that had positive significant ($p< 0.05$) relationship to the continuation of seaweed farming. Based on the result, overall relationship between farmers and private parties are satisfied however farmers are not satisfied with the price of the seaweed. Most of the farmers reported seaweed farming development is better to improve their livelihood style. Based on the result, farmers are satisfied with the seaweed farming activities. Overall evaluation result of entrepreneurial skills of farmers almost all farmers have adequate entrepreneurial skills. Change of the rainfall pattern and temperature were the main constraint faced by farmers.

Keywords: Seaweed, Contract farmers, logit model, Public Private People Partnership

This study was funded by National Agribusiness Development Program, Presidential Secretariat

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Effect of Floor Price on Demand and Supply of Fresh Cow Milk in Sri Lanka

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Dairy sector plays a significant role in the Sri Lankan economy by ensuring protein requirement, providing livelihood to rural people. However, due to the low level of domestic supply, the country is spending close to US$ 400 million in importing milk and dairy products to the country. Among the various government initiatives that have targeted at increasing the domestic production, imposing a price floor is one of the key initiatives. Despite the potential influences this policy could have, no scientific study has been carried out to evaluate the effect of this policy. Against this background, this study is conducted to assess the effect of the policy. To achieve this, the study , estimate demand and supply functions of fresh milk using secondary data published by Central Bank of Sri Lanka, Department of census and statistics, Department of animal production and health, FAO and World Bank during the period from 1985 to 2015. The seemingly unrelated regression equation model was used due to contemporaneous cross equation error correlation between demand and supply functions. Results indicate that milk supply of the country does not depend on the farm-gate price of milk. Thus, the study concludes that the effect of increasing price floor will not have any impact on the milk supply of the country. Therefore, it is imperative to take other alternative strategies to increase the milk supply in the country to reduce the total import bill, while achieving fifty percent self-sufficiency in milk.

Keywords: Floor price, Seemingly unrelated regression, Contemporaneous correlation

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Evaluation of Farmer Attitudes on Dairy Cattle Welfare in Central Province of Sri Lanka

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Welfare of dairy cattle is important for achieving high milk yields in dairy farming. Dairy farming involves high incidences of human animal interactions which affect the productivity and welfare of the cow. Farmer is responsible for management decisions and housing conditions which affect welfare of dairy cattle. This study was conducted to examine the attitudes of dairy farmers towards dairy cattle welfare and its relationships with farm welfare aspects. Study consisted of farmer interviews, behavioural observations and questionnaire surveys conducted in 129 farms in the central province of Sri Lanka. Farmers were asked questions targeting answers that reflect their attitude towards welfare of dairy cattle. According to the number of positive and negative answers given by a farmer the farms were categorized as negative or positive farms. Several questions in the questionnaire were aimed at examining the attitude while the other questions were related to observational welfare traits of cows. Housing and environmental factors affecting cow welfare were also observed. Behavioural observations were recorded during milking time in 42 farms to cross check the farmer attitudes with animal handling. According to the questionnaire survey 52.8% of farmers had positive attitudes and 48.2% had negative attitudes towards dairy cattle welfare. Statistical analysis revealed that the number of forceful slaps/cow/milking is significantly higher ($P<0.05$) when the farmer has a negative attitude. This study could not establish any other significant relationships between farmer attitudes and welfare aspects tested in the study. Many farms had problems in housing, management and sanitation conditions which affect cow welfare negatively regardless of the attitude of farmer (positive or negative). More detailed investigation of farmer attitudes and improving the knowledge on importance of proper housing and management are suggested to ensure dairy cattle welfare and productivity.

Keywords: Dairy cattle welfare, human animal interactions, attitudes of farmers

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Evaluation of Milk Suppliers Perception towards Initiating Evening Milking as a Response to the Newly Installed Mini–Chilling Tank Facilities at Thirty Two Collecting Points in Six Milk Chilling Center (MCC) Areas of CIC Dairies (Pvt) Ltd.

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The study was conducted focusing on smallholder dairy cattle farmers in Dambulla, Thambuththegame, Medirigiriya, Kanthale, Siddhapura and Muthuwella MCC areas to investigate the constraints for evening milking and the perception towards the newly installed mini-chilling tanks. A total of 155 dairy farmers were interviewed representing 503 dairy farmers. The survey gathered data on personal information, livestock, management type, services rendered by milk collecting points, constraints for evening milking and hygiene practices. The data were analyzed with chi square tests and binomial tests using Statistical Packages for Social Sciences. Highest average milk yield of 12.6 liters was recorded from Dambulla while lowest of 6.5 liters was recorded from Kanthale area. Siddhapura and Muthuwella had the highest herd size of 20 while all the other areas recorded a herd size of 10 or less. Jersey-Sahiwal cross was the most prominent cattle breed in all the areas except Dambulla where jersey blood was dominant. Dambulla had the highest number of evening milk providers (58%) while Siddhapura and Muthuwella had lowest (15%). The study indicated that farmers do not practice proper hygienic practices during milking. More than 70% farmers agreed to the concept of evening milking in all areas while lack of adequate roughages of good quality was the major constraint in most areas. The study also indicated that low number of milking cows per farmer and low yielding cows were the considerable constraints for evening milking in Thambuththegama, Siddapura and Muthuwella areas. Existing veterinary services were at inadequate level except in Dambulla and Kanthale. Most farmers were satisfied about the services, facilities, and payments they receive from collecting points. The study results can be utilized to improve production via evening milking and enhance the quality of milk being produced in respective MCC areas.

Keywords: Evening milking, constraints, perception, mini-chilling tank, roughages

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Factors Affect on Adoption of Recommended Agricultural Practices by Cashew Growers in Mannar District

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Cashew, a cash crop, contributes 0.03% to the GDP in Sri Lanka. A major concern in cashew cultivation is the yield gap between potential and the national average yield. The reason of the gap isa lack of adoption of proper agro technology (Jayasekera and Wijesekera, 2003). Objectives of this study were to investigate the factors affectingthe adoption of recommended agricultural practices by cashew farmers and to determine the present level of adoption of recommended agricultural practices in Mannar District. Primary data were collected from a stratified random sample of 100 farmers from three Divisional Secretariat using a pretested questionnaire. Data were analyzed using descriptive and inferential statistics. Rogers' adoption of innovation model was used to develop the conceptual framework. According to the model, social system, communication channel and attributes of innovation influence on adoption of a particular innovation. The result showed, communication channel significantly ($p<0.1$) and positively influences the adoption level of pest and disease management, pre planting practices and fertilizer application. Attributes of innovation significantly ($p< 0.1$) and positively influences pruning practices and pest and disease management practices. Social system significantly ($p<0.1$) and positively influences pre planting practices, fertilizer application, pruning practices and new varieties. Knowledge of pre planting practices and varieties were higher in comparison to the other recommended practices. Farmers had a poor level of knowledge about fertilizer application, pest management practices and pruning. More than half of the respondents had not adopted recommended practices related to pest and disease management (67%), fertilizerapplication (51%) and pruning practices (69%).Fifty five percent of respondents adopted pre planting practices and 51% of farmers partially adoptednewvarieties. Extension activities should be focused to improve the knowledge, skills and attitudes on pruning, pest and disease management and fertilizer application since the adoption of these practices were low.

Keywords: Adoption, Cashew Farmers, Recommended Agricultural Practices

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Factors Affecting Adoption of Agarwood Cultivation in One Company

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Agarwood is reputed to be the most fragrant and economically valuable resin in the 21st century. *Aquilaria* and *Gyrinops* are two important agar producing genera which belongs to the family Thymelaeceae. *Gyrinops walla* (Walla patta) is the only species found in Sri Lanka. It is desirable to increase the extent of commercial cultivation of agarwood. In Sri Lanka only a few private companies are promoting agarwood cultivation. The scope of this study was limited to one company. No study has been done related to factors affecting cultivation of agarwood by farmers. Hence, the objective of this study was to identify the factors affecting adoption of Agarwood cultivation. A cross-sectional study was conducted. Stratified random sampling was used to select a total of ninety respondents including, thirty agarwood growers and fifteen non-growers each from Kegalle and Kurunegala Districts. A pre-tested structured questionnaire was used for data collection. Data were analyzed using binary logistic regression analysis, Chi-Square test, t- test and descriptive statistics. Total family monthly income ($P=0.036$), land size ($P=0.062$), characteristics of information source ($P=0.001$) and attitudes ($P=0.021$) had significant correlations ($R^2=0.816$, $P<0.1$) with the adoption of agarwood cultivation. Major reasons for not growing agarwood in Kegalle were high investment and maintenance cost (60%) and lack of trust in the organization (40%). In Kurunegala past experience (60%) and lack of water (40%) were the main reasons for not-growing agarwood. Type of labor, type of cultivation and attitudes showed significant differences among growers in the two areas. Characteristics of information source showed a significant difference in the two areas.

Keywords: Agarwood, adoption, non-adopters, Sri Lanka

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Factors Affecting Adoption of Organic Chilli Cultivation, Among Farmers Registered Under Bio Foods (Pvt.) Ltd. in Vavunia District

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According to the Export Development Board Sri Lanka, demand to organic chilli is drastically increasing in the global market in recent years. Sri Lanka has potential to increase organic chilli production in the dry zone. Government and Non-governmental organizations are trying to increase organic chilli cultivation in Sri Lanka because of its' potential to lift up farmers' livelihood. However farmers are reluctant to adopt organic farming practices. This study was carried out to investigate the factors influencing adoption of organic chilli cultivation among organic chilli farmers registered with Bio Foods (Pvt.) Ltd. in Vavuniya District. Out of the 300 farmers registered with Marginalized Organic Producers' Association (MOPA) from Vavuniya District, sixty farmers were selected for the study by using simple random sampling. Pretested self-administered questionnaire was used to collect data. Data were analyzed using multiple linear regression and descriptive statistics. Findings revealed that, the majority (83%) of farmers are male. Farmers mean age was 53 years. Majority (58.3%) of the respondents had education up to ordinary level. Following a literature review, about 14 independent variables that are affecting adoption of organic farming were selected for the regression analysis. There were significant positive relationships ($p<0.1$) between adoption level of farmers and farmers' experience, availability of extension services, incentives, number of cultivated crops and access of export market. Study concludes that organic farming can be promoted among chilli farmers in Vavuniya District by improving extension services, providing incentives, and establishing connection with export market increase adoption level in organic chilli farming.

Keywords: Organic chilli farming, Adoption level, Extension services, Vavuniya District, Agriculture

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Factors Affecting Adoption of Organic Vegetable Cultivation: A Case Study at a Commercially Successful Organic Farm in Badulla District

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Start of the 21st century gave rise to awareness of organic vegetable cultivation (OVC) all around the world. According to the IFOAM (International Organic Agricultural Movement), high growth rates were recorded in the advanced markets for organic products. It is mainly due to changed dietary habits, to consume organically cultivated food items, due to increased health awareness. However, in the Sri Lankan context, both organic vegetable consumption and organic farming is not widely practiced. This research was conducted to identify the factors related to adoption of organic vegetable cultivation among commercially successful OV farmers. A commercially successful organic farm, located in Bandarawela was selected for a case study. Information was collected from one farm owner, his employees, supplier farmers, and customers of the farm. Primary data were collected via in-depth interviews, informal discussions and field observations. Secondary data were collected from farm records and web based sources. Results revealed that farmers' decision to adopt OVC is affected by a number of factors including the ability to obtain a continuous and stable income, secure market opportunities, consumers' demand for healthy food, and minimum input requirement. The farm owner had faced problems such as high labor cost, and high land tenure while supply farmers experienced problems such as poor knowledge on OVC, lack of skills on farm management during the dry season, poor attitudes, water scarcity, and difficulties when applying for certification. It can be concluded that OVC is a profitable venture for small scale farmers if they can organize into groups and request for certification and regular inspection as a group.

Keywords: Organic vegetables, case study, in-depth interviews, organic farmers, adoption factors

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Factors Affecting the Adoption of Organic Tea Cultivation in Selected Areas of Kandy District

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Cultivation, processing, and marketing techniques used in the production of organic tea is environmentally friendly, socially acceptable and economically sound. Many small scale growers are involved in organic tea production and obtain premium prices. The local demand for organic tea has increased recently.However adoption levels of organic tea is low and need to be improved.As previous studies have not been done,this study was conducted to determine the factors affecting adoption of organic tea cultivating practices in selected areas of the Kandy District. For this study, 60 organic tea small-holders, attached to an agricultural organization, were selected randomly from Kandy District. Both primary and secondary data were collected and data wereanalyzed using the Statistical Package for Social Sciences. Multiple linear regression was used to analyzedata. TheR^2 = 0.654.It wasfound thatfarmers'education level (P=0.073), duration of farmers' experience in organic tea cultivation (P=0.04), knowledge about organic tea cultivation (P=0.065), attitudes(P=0.085), farm animal availability (P=0.082), organic tea leaves price(P=0.075), extension services(P=0.048) and labor cost (P=0.038)affectedadoption positively. There is a need to improve farmers' perceptions of cost and benefits through extension services.

Keywords: Adoption, Organic tea, Small-holders, Kandy District

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Factors Affecting the Perception towards Organic Farming among Pepper Farmers in Matale District

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Conversion into organic farming from conventional farming has increased in recent years due to the adverse impact of inorganic chemicals. Farmers have potential to serve the country by producing more organic products. This study was carried out to investigate the factors influencing perception towards organic farming of pepper farmers in the Matale District. Multi-stage stratified random sampling technique was used to draw a sample of 84 pepper farmers. Out of the 11 Divisional Secretariat (DS) Divisions in Matale District, 2 DS Divisions were selected. They are Ukuwela and Yatawatta. Six Grama Niladhari (GN) Divisions each were selected from those 2 DS Divisions. From one DS Division 42 farmers were selected consisting of 21 organic farmers and 21 conventional farmers. A self-administrated questionnaire was used to collect information. Analysis was done by using correlation, multiple regression, t-test, and descriptive statistics with the help of the Statistical Package of Social Science. Majority of the farmers were males (69%). Their mean age was 54.6 years. Most of the respondents had education up to secondary level (42.9%). Results of the regression showed that five study variables affect farmers' perception towards organic farming. There were significant relationships ($P<0.1$) between farmers' age, knowledge, past experience, farm land size, and support from stakeholders with their perception of organic farming. Results of the t-test revealed significant mean differences ($P<0.1$) between organic and conventional pepper farmers' groups. There were no significant differences ($P>0.1$) of age, gender, educational level, and farmland size between these 2 groups.Farmer training programmes and support of stakeholders for organic farming have potential to increase the knowledge level and perception of farmers towards organic farming.

Keywords: Organic farming, Perception, Knowledge, Conventional farming

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Factors Affecting the Quality of Carrots, Leeks and Tomatoes During Handling in the Supermarket Supply Chain

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Loss of quality of fresh produce during handling in the supermarket supply chain is one of the major reasons for short shelf life. This study investigated the factors affecting the quality of carrots (*Daucus carota* subsp. *sativus*), leeks (*Allium porrum*) and tomatoes (*Solanum lycopersicum*) during handling. Samples were collected from six places of handling, such as collection centers (CCs), vegetable processing unit (VPU) and supermarkets (Ss) and evaluated for quality using pre-prepared rating scales. The most acceptable produce colour, the least amounts of produce damage and the highest overall produce quality were evident at CCs followed by VPU and Ss ($P<0.05$). The hand-felt texture did not significantly vary depending on the place of handling ($P<0.05$). Effects of method of washing of carrots at CCs on overall quality were studied using pre-prepared rating scales. The results revealed that manual washing of carrots resulted in significantly better overall quality compared to mechanical washing ($P<0.05$). Carrots subjected to manual and mechanical washing were weighed at Ss after 60 h for evaluating the effect of washing on moisture loss. Non-significant effect of method of washing on moisture loss was evident ($P>0.05$). Weights of carrots, leeks and tomatoes were measured at Ss 60 h after obtaining from CCs and the percentage loss of moisture was 14.6, 4.6 and 1.2 respectively. Effect of volume of sales on overall quality of carrots, leeks and tomatoes handled at Ss were studied using pre-prepared rating scales. The results revealed that volume of sales did not significantly affect the overall quality of carrots, leeks and tomatoes ($P>0.05$). As minimum quality loss based on colour, produce damage and overall quality was evident at CCs, more attention needs to be given on produce handling at receiving points of Ss followed by VPU for further reducing the quality loss.

Keywords: Carrots, Leeks, Tomatoes, Postharvest handling, Supermarket supply chain

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Factors Contributing to Career Indecisiveness among Undergraduates of Peradeniya University

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Career decision making is among the important and inevitable tasks in one's life. As undergraduates, students have to make decisions regarding employment and further education. Career decision has lifelong consequences for the individual's psychological and physical well-being and overall quality of life. Making a career decision can be a difficult and a challenging task for many young people.Career indecisiveness is a commonly found problem among Sri Lankan undergraduates.The objective of the study was to assess the factors affecting career indecisiveness among undergraduates of the Peradeniya University. Multi stage stratified randomsampling was adopted. The sample consisted of 410 final year undergraduates from four study faculties namely, Agriculture, Arts, Management and Science. Research was conducted as a cross-sectional study. Nine hypothesis derived from the conceptual framework were tested.Primary data were collected using a self-administered questionnaire based on nine factors. Data were analysed using descriptive statistics, t-test, ANOVA, Correlations and Regression tests.Career indecisiveness had a significant relationships ($p<0.05$) with career decision making self-efficacy, faculty of study, obligation to family and fathers' education level. There were no significant mean differences with respect to gender and faculty of study in career indecisiveness levels.

Keywords: Career, Career indecisiveness, Career decision making, Undergraduates, Faculty

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Factors Influencing the Choice of Organic and Non-organic Farming Among Spice Growers in Kandy District

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Organic products have experienced a rapid growth in demand over the past two decades. Despite government efforts at promoting organic agriculture with favourable policy changes and promotions, still very few farmers are involved in organic agriculture. Previous studies have shown that farmers choose to adopt agricultural practices for a variety of reasons. But very few studies have focused on understanding local farmer motivating factors related to organic farming practices. This study uses binomial logit modelling to analyse determinants of the decision to adopt organic farming. Motive factors and attitudes are measured using scales and ranking systems. The research was conducted as a cross sectional study with a pre-tested interview schedule administered to organic and conventional spice farmers in the Kandy district. A sample of sixty farmers was used in the study. The analysis indicates that organic farmers, compared to their conventional counterparts, are more likely to be older, more educated, have more interactions with local organizations and are part time farmers. When analysing the motive factors, organic farmers are mainly driven by perceived health benefits of adopting organic agriculture while conventional farmers have stronger economic motivations. The study also indicates that conventional and organic farmers have significantly different attitudes towards their respective agriculture practices. Policy makers should consider non-economic aspects of farmer motivation explored in this study to formulate policies addressing key attributes of farmers when encouraging them to convert to organic farming. Results can also be utilized by extension services to create better extension programmes to promote organic farming in an effective and efficient manner.

Keywords: Adoption, motivation, binary logistic, organic

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Farmers' Participation in Irrigation Management and Returns from Paddy Farming: A Study in Parakrama Samudra Scheme, Sri Lanka

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Participatory irrigation management (PIM) recognizes the role of farmers as active partners in public irrigation systems. Although PIM is considered a key policy and expected to play a major role in increasing agricultural productivity, current level of farmers' participation (FP) is below than expected and inequalities in water availability and access continue in many public irrigation systems in Sri Lanka. The objectives of this study were to; a) investigate differences in land productivity of paddy in relation to distribution architecture; b) identify level of FP in areas with different levels of water availability; c) identify relationship between FP and land productivity, and d) identify factors motivating FP in management, of a large public irrigation system. The study was conducted in *Parakrama Samudra* Scheme; a 10,250 ha surface gravity major irrigation system located in the North Central Province of Sri Lanka. 92 farmers growing paddy in 11 field canals with increasing distance from the main reservoir were selected through multistage cluster sampling. Data on input usage in , and production of paddy in 2015/16 *Maha* (wet) , and 2016 *Yala* (dry) seasons were collected using a pre-structured survey schedule. Estimated production function assuming Cobb-Douglas functional form revealed that land productivity is higher in farms located closer to the reservoir in the dry season. Productivity of farms in middle reaches is higher in the wet season. Level of farmer participation is higher in areas that are more distant to the reservoir. Farmers' age, perceptions of low availability of water at the farm; and on weak conditions of canal structures positively influence FP while lack of time available negatively affects FP. Findings of this study identifies the need for more proactive involvement in system managers to assure more equal distribution of irrigation water among different areas of this large system.

Keywords: Cobb-Douglas production function, Land productivity, Public irrigation systems, Unequal access to water, Water distribution architecture

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Gap Analysis and Establishment of Benchmarks of Good Hygienic Practices for the Spice Processing Plant

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According to the WHO definitions, food hygiene is necessary to ensure the safety of food from production to the consumption. Food can become contaminated at any point during production, slaughtering/harvesting, transportation, processing, storage, distribution and preparation for the consumption. Lack of adequate knowledge in food hygiene can adversely influence product quality and safety leading to food borne diseases and even death. Gap analysis involves the comparison of actual performance with potential or desired performance. If an organization does not make the best use of current resources, it may produce or perform below the achievable potential. A gap analysis was conducted to examine the current hygienic practices and to establish hygienic benchmark in the existing spice processing line of CBL Natural Foods at Minuwangoda. The checklists were developed referring to 148 hygienic clauses extracted from IFS, BRC, ISO 22000:2005 standards and present working instructions of the processing plant. These hygienic clauses consist of six segments; location, equipment, cleaning, facilities, personal hygiene and working instructions. Gap analysis was conducted on 20 working days and the average result was calculated for each section. Appropriate suggestions were implemented for the identified gaps. All the sections have shown lower hygienic level of certainty ($\alpha = 0.95$). Further a brainstorming session was conducted with the production supervisors and selected line workers to share their experience and inputs.

Keywords: Spice processing, Good hygienic practices, Gap analysis, Benchmark

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Herd Management and Economics of Dairy Cattle Milk Production in the Coconut Triangle

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The present study was carried out to investigate factors affecting dairy cattle milk production in the Coconut Triangle. Randomly selected 85 dairy cattle farms in Maravila, Dankotuwa, Mahawewa, Pannala, Wennappuwa and Katana veterinary divisions were surveyed using a pre-tested structured questionnaire. Information pertaining to herd management (i.e. herd composition, feeding, breeding), milk production, input sources and costs and farmers' perception on constraints were collected. Microsoft Office Excel and STATA software were used to compute descriptive statistics and to derive production function of milk, respectively. Mean herd size of cattle farms was 11.06±1.07 with 3.20±0.36 cows in milk, 1.88±0.23 dry cows, 2.14±0.28 heifers, 1.61±0.24 pre-weaned calves and 2.22±0.36 bulls. Daytime tethering and nighttime stall feeding was the main feeding practice in most of the cattle farms (52.94%). Each herd was fed with 216.14±36.95 kg/d of roughages and 16.59±1.96 kg/d of concentrates. Derived production function revealed that the percentage milking cows, amount of mineral supplement, hours on grazing/tethering and labour usage were the factors that significantly ($P<0.05$) affect the herd milk production. Recorded milk productivity of the system was 5.34±0.31 L/cow/d and 1.64±0.11 L/herd/d. Almost all farms used family labour for dairy farming. Excluding the opportunity cost of family labour, the cost of production of milk was estimated to be Rs. 40.00±2.35. Estimated technical efficiency of milk production of the system was $94.38\pm1.34*10^{-6}$. High level of technical efficiency must have been a result low variability in the sample. Unavailability of roughages particularly in the dry season and birth of bull calves were the main constraints for dairy cattle farming in the Coconut Triangle.

Keywords: Production function, cost of production, technical efficiency, constraints

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Investigation of Critical Factors Associated with Illegal Fishing Practices in Three Major Reservoirs in Sri Lanka

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A study was conducted to investigate the socioeconomic and management factors affecting illegal fishing practices in Victoria, Sorabora and Ulhitiya reservoirs. Representing all the landing sites in each reservoir, a total of 368 fishers were surveyed twice in January, 2014 and December, 2015 on their socioeconomic status, involvement in the community based fishery management process and engagement in illegal fishing practices. Chi-square test was used to determine the associations between socio economic and fisheries organizational involvement indicators of fishers and their engagement in illegal fishing. The main illegal fishing practices found were use of illegal fishing gear (monofilament nets, small meshed (<88 mm) nets), water beating, fishing with no license, use of unregistered boats, or fishing at non-permitted time periods. Characteristics of fishers such as addiction to alcohol, lack of willingness to organize into fishery societies, and noncompliance with fishery regulations were significantly associated with engagement in illegal fishing in all three reservoirs ($P<0.05$). In Victoria reservoir, the fishers who were willing to hold positions in the fisheries organization and voluntarily participate in official raids were significantly less prone to engage in illegal fishing activities ($P<0.05$). In Sorabora, the fishers who participated in training programs and who were educated above primary level were less prone to illegal fishing ($P<0.05$). In Ulhitiya, those who have not received secondary education or have not obtained proper fishing or boat licenses were more likely to engage in unlawful fishing practices ($P<0.05$). Compositions of fishers in the fishing communities in the three tanks were found to be significantly different with respect to education level, full or part time engagement in fishing, receiving subsidies on nets, licensing boats and participation in training programs and fishery organizational activities ($P<0.05$). It is recommended that reservoir-specific management strategies must be formulated to improve management of individual aquatic resources.

Keywords: Aquatic resources, co-management, fisheries organization, illegal fishing, socioeconomics

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Milk Product Purchasing Behavior of Supermarket Consumer in the Kandy City Limits

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The main objective of this study was to investigate the purchasing behavior of milk products by supermarket consumers in the Kandy city limits and the factors that affect their various buying choices in terms of products, place, price, promotion. A questionnaire survey was carried out on a sample of 100 randomly selected respondents from three leading supermarkets in the Kandy city limits during the month of November 2016. Data were collected using a structured questionnaire and the data were analyzed using the Chi-square test and descriptive statistics. The findings reveled that there is a significant difference between the choice of milk products and purchasers' demographics, namely age, civil status, level of education, occupation and the monthly income ($p<0.05$). Findings also revealed that there are significant relationships between the demographics of the purchaser and certain product attributes namely price, taste, storability, nutritional value, health concern and the availability ($p<0.05$).Place of purchasing differed in terms of civil status of the purchaser ($p<0.05$) and there are significant relationships between certain demographic factors (Income, number of family members, employment) and the frequency of purchasing and the quantity purchased at a given time ($p<0.05$). Marketers could design and target their promotional strategies taking into account the demographic characteristics of consumers that were found significantly related with different purchasing choices when promoting the consumption of various milk products.

Keywords: Purchasing behavior, liquid milk, powdered milk, demographic characteristics

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Role of Agricultural Organizations in Promoting Organic Farming in the Northern Province of Sri Lanka

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Organic farming is practiced with concerns for pollution, food security and, human and animal health. Majority of the farmers practice conventional farming, which is believed to give more profit without considering environmental sustainability. Northern Province was famous for generations of organic farming. But, it has been drastically reduced in recent times. Organizational support is required to promote organic farming. In this background, this study was carried out to assess the role of agricultural organizations in promoting organic farming in the Northern Province. Five organizations involved in promoting organic farming as their main community development intervention were selected for the detailed study. Relevant information were collected from key informants of the selected organizations using an interview schedule. A questionnaire survey was conducted to collect data from 40 farmers served by the selected organizations on the type of services they received, satisfaction of the services, and, knowledge and attitudes related to organic farming. Multiple linear regression, correlations and Kruskal-Wallis tests were used to analyze the data. The results showed that satisfaction ($p=0.053$), and attitudes ($p=0.003$) significantly influence the usage of organic inputs. Furthermore, organizational support positively influenced the knowledge, attitudes and satisfaction of the farmers. There is a significant difference among the organizations in the services provided and the outcomes. The extent of agricultural inputs ($p=0.000$), technology transfer ($p=0.014$) and knowledge of farmers ($p=0.069$) are significantly differ among the organizations. Based on the results it could be recommended that the organizations involved should improve standard of services especially, agricultural inputs, financial supports, market facilitation for farm produce and technology transfer in order to improve the organic farming the Northern Province.

Keywords: Organic farming, Agricultural organizations, Technology transfer, Market facilitation

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Smallholder Farmer Participation in Maize Contract Farming in Anuradhapura District of Sri Lanka

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Contract farming is a marketing and financial service mechanism to minimize input-output market imperfections and intended to promote linkages between smallholder farmers and agribusiness firms. Experiences in many countries suggest that the successfulness of a contract farming system is case specific and breaching of the contract is a common occurrence. The overall objective of this study is to ascertain successfulness in contracts signed between maize farmers in Anuradhapura district and the CIC, one of the leading agribusiness firms in Sri Lanka. The specific objectives were to examine the factors influence on farmers' decision making in adoption, retention and selling of their harvest to the agribusiness company. The theoretical approach to the study is Expected Utility Theory which explains the nature of decision making under risk. The analysis of factors affecting for participation and retention was performed using Logistic Regression (logit) method. Primary data was gathered through interviews based on structured questionnaires with randomly selected 150 (contract: 100 and non-contract: 50) farmers. The results indicate that level of education, percentage of harvest sold to contractor and yield per acre have positive and statistically significant effects and total cultivated land and ownership of a tractor have negative effects on retention. Farmers with comparatively higher yield and those who had received more extension services had built strong relationships with the contractor and had not breach the contract. Moreover achievement of higher yield by maize due to the efficient extension service and input delivery mechanisms of contract farmers over non-contract farmers were statistically significant. The results reveal that well integrated value chain management, existence of an assured market for farmers and mutual trust between both parties are the key factors for sustain a Contract Farming system in Sri Lanka.

Keywords: Adoption, Contract Farming, Contractor, Retention, Smallholders

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Social and Economic Impacts of Conversion of Price Subsidy of Fertilizer to Direct Cash Transfer: A Case with Paddy Farmers in Major Irrigation Schemes in Kurunegala District

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Fertilizer subsidy is one of the long lasting and most politically sensitive policies implemented to promote rice cultivation in Sri Lanka. Among them, the *Kethata Aruna* fertilizer subsidy scheme introduced in 2005 was the most expensive one which consumed approximately 2.2% of the annual budget. The present government, in 2016 budget, converted this fertilizer subsidy into a Direct Cash Transfer (DCT) with the intention of encouraging farmers to reduce chemical fertilizer usage while moving them to use more organic fertilizer. This study attempts to analyses the impact of this policy revision in terms of production and socio-economic context. A field survey was conducted with a random sample of 55 paddy farmers in a major irrigation scheme in Kurunegala district using a structured questionnaire. Descriptive statistics, parametric tests and estimation of a production function under Cobb-Douglas specification were employed to test the relevant hypotheses. The analysis revealed that a substantial number of farmers have not used the recommended rates of chemical fertilizer during 2016 *Yala* season while replacing that with organic fertilizer. The analysis further revealed that there was a reduction in productivity in 2016 *Yala* season compared to that of 2015. Production function estimation revealed that amounts of seed, chemical fertilizer, labour and agro-chemicals had a significant impact ($P<0.05$) on productivity in 2016 *Yala* season. However organic fertilizer usage did not show significant impact on productivity. A majority of farmers had a positive perception towards DCT mainly due to its simplicity. Since the study yielded mixed results, it is suggested to conduct further studies.

Keywords: Price Subsidy of Fertilizer, Direct Cash Transfer, Production Function, Productivity

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Stakeholder Perception on Factors Affecting the Achievement of Key Performance Indicators of a Public Private People Partnership Programme in the Dairy Sector of Sri Lanka

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Public- private-people partnerships (4P) are formalized partnerships between public institutions, private partners and the general public designed to address sustainable development objectives. National Agribusiness Development Programme (NADeP) has implemented public-private-people partnership projects in various sectors, including the dairy sector as well. The objective of the research was to assess the factors affecting the achievement of key performance indicators as perceived by the various stakeholders of the programme. the study was conducted through a cross sectional survey. A convenience sampling method was adopted for sample selection. Primary data were collected from the three stakeholder groups using three separate structured questionnaires. The obtained categorical data were analysed using descriptive statistics, Kruskal-Wallis test, and Wilcoxon signed-rank test. The Kruskal-Wallis test was used to draw out the differences and similarities in perception of the stakeholder groups towards the factors that affect project success. Findings revealed that the stakeholder groups had differences in opinion towards the factors affecting the achievement of key performance indicators and placed different levels of importance. Famers placed highest importance on availability of land for dairy farming, whereas theNADeP considers the support provided by the project managementas the most important factor. The private sector considers availability of good dairy cattle breeds as the most important factor that affects project success. The perceived level of achievement of key performance indicators across stakeholder groups were different. Project success is measured through key performance indicators; hence it is important to have a mutual understanding of the factors that affect project success in order to carry out a successful public-private-people partnership project.

Keywords: Public-private-people partnership (4P), Key performance indicators (KPI), Factors affecting project success

The study was funded by National Agribusiness Development Programme, Presidential Secretariat.

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Stress and Coping Strategies among Medical Students of Sri Lanka

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Stress of students is common in medical education and it often exerts a negative effect on their academic performance, physical health, and psychological wellbeing. Stress levels are high during the final year of study as students have to deal with the pressure of graduating and making career decisions. Effective coping strategies protect students against stress. The aim of this cross sectional study was to assess the levels of stress, analysing the factors contributing to the stress and the stress coping strategies of final year medical students of Sri Lanka.This study was carried out among 180 final year medical students of University of Peradeniya, University of Kelaniya and University of Rajarata. Two stage stratified random sampling was practiced to select respondents. Perceived stress was assessed using the perceived stress scale. Professional Student Stress Survey was used to measure factors of stress and Carver's Brief COPE was used to identify thecoping strategies. A majority of respondents recorded a moderate degree of stress. Academic pressures, personal issues, professional identity and avoidant based coping strategies indicated positive relationships ($P<0.1$) with the perceived stress level of final year medical students. Academic performance and emotion based coping strategies have negative relationships ($P<0.1$) with the perceived stress. Findings indicate the necessity for stress management programmes in the medical faculties of Sri Lanka.

Keywords: Stress, medical students, coping strategies

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Technical Efficiency of Maize Farming in Monragala District of Sri Lanka: An Application of the Stochastic Frontier Approach

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Increased production through productivity enhancement is a strategy equally adopted by the government sector and the private sector. The purpose of this study is to examine the productivity enhancements in maize made by the *Ran Saru Pala* project of the CIC, one of the leading agribusiness companies, in Monaragala district of Sri Lanka. The CICentered into forward contractual agreements with maize farmers,and the participants were provided with a package of inputs and extension services.This study compares differences between farmers who signed contracts with the CIC vis-à-vis non-participants focusing on differences in productivities and technical efficiencies. A stochastic frontier production function was specified in multiplicative form to obtain technical efficiency in maize farming. A primary survey was conducted with a randomly drawn sample of 87 farmers in Monaragala district in 2015 *Maha* season to obtain required data. The production function was specified treating maize production as the dependent variable and land extent, total labor usage, total fertilizer usage, machinery cost, plant density and involvement in a contractual agreement as independent variables.The inefficiency model was specified treating technical inefficiency as the dependent variable and demographic and socio-economic factors of farmers as independent variables.The results of the analysis revealed land productivity in contract farmers is significantly higher than those of non-contract farmers. However, the technical efficiency of the two groups (88%) was found to be very similar. According to the results of the inefficiency model, experience in maize farming has a statistically significant ($P<0.1$) and negative effect on technical efficiency. The results indicate that the involvement of private sector in maize farming in Monaragaladistrict has helped in improving land productivity yet there is room to increase productivity further using the existing input package.

Keywords: Productivity, Technical efficiency, Stochastic frontier production function , Maximum likelihood estimates

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