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Seventh Undergraduate Research Symposium
UReS 2020

"New Frontiers in Research and Innovations to Develop Healthy Food Systems"

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FOREWORD

I am delighted to write this Foreword to the Proceedings of the 7th Undergraduate Research Symposium of the Faculty of Livestock, Fisheries & Nutrition, Wayamba University of Sri Lanka. The objective of this Proceedings is to disseminate up-to-date, high-quality and original research work done by the undergraduates to the scientific community. This great event will also provide an opportunity for undergraduates to open the path for their future careers and further studies.

This Proceedings consists of 84 abstracts under the theme of "New Frontiers in Research and Innovations to Develop Healthy Food Systems" from two-degree programmes, Food Science & Nutrition and Food Production & Technology Management. Each abstract provides details of original research studies conducted by the undergraduates of the Wayamba University of Sri Lanka in the field of Human Nutrition, Food Science and Technology, Aquaculture and Fisheries and Livestock and Avian Science. All abstracts were reviewed by internal and external supervisors as well as the members of the editorial committee.

I would like to express my sincere gratitude to Senior Prof. Udith K. Jayasinghe, the Vice-Chancellor of the Wayamba University of Sri Lanka and Prof. B.P.A. Jayaweera, the Dean of the Faculty of Livestock, Fisheries and Nutrition for the valuable support and guidance given in organizing UReS 2020. Dr. (Mrs) W.A. Harindra Champa is greatly acknowledged for her utmost contribution as the Coordinator of UReS 2020 to make this event a great success. I congratulate and appreciate all undergraduate researchers who publish their abstracts in this proceedings, with lots of difficulties encountered as a result of the prevailing situation of the Covid pandemic. I convey my thanks to all internal and external supervisors who guided the students for this great achievement. On behalf of the editorial committee, I wish to thank all authors and reviewers for their contribution to this Proceedings. In addition, I express my gratitude to all members of the organizing committee/UReS 2020, all academic and non-academic staff of the faculty who assisted in various ways to publish the Proceedings of the 7th UReS 2020.

Dr. Thilanka Ranathunga
Editor-in-Chief/UReS 2020
Faculty of Livestock, Fisheries & Nutrition
Wayamba University of Sri Lanka

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Message from the Vice-Chancellor

It is my great pleasure to write this message for the Undergraduate Research Symposium (UReS 2020) organized for the seventh consecutive time by the Faculty of Livestock, Fisheries & Nutrition of the Wayamba University of Sri Lanka, with a well-timed theme, "New Frontiers in Research and Innovations to Develop Healthy Food Systems".

The world is facing many challenges related to hunger, economic crisis, climate change, environmental degradation and global level pandemics. In this backdrop, much attention has been given to the idea of sustainable food systems to tackle key issues in promoting safe, nutritious and healthy diets. Therefore, it is vital to search for new horizons to develop healthy food systems to ensure food security and establish sustainable food systems for ensuring safe and quality food for everyone. I wish that these research findings will open up various paths for new research and innovations for many young scientists who are waiting to break the barriers and looking to overcome the challenges of the future. Therefore, I am proud of the highest quality research carried out by the Faculty of Livestock, Fisheries & Nutrition at the Wayamba University of Sri Lanka, encompassing the fields of Food Science, Nutrition, Livestock and Aquaculture.

I would like to take this opportunity to appreciate the efforts of the Dean, Heads of the Departments and all the academic and academic support staff and all the non-academic staff and also the UReS organizing committee of the Faculty for their unwavering support and contribution to a fruitful symposium amid these unprecedented times. May this be a great example of how the University, the Faculty and its academic community stand together in unity for the betterment of its undergraduate students.

Last but not least, I congratulate all the undergraduates who are presenting their research at UReS 2020 and I wish them the best of luck in their future endeavors. I hope they will continue to excel in their respective fields and will be a great strength to our mother country one day.

Senior Prof. Udith K. Jayasinghe
Vice-Chancellor
Wayamba University of Sri Lanka

Message from the Dean

I am highly pleased to send the greeting and give this message to the 7th Undergraduate Research Symposium (UReS 2020) of the Faculty of Livestock, Fisheries & Nutrition. The Annual Undergraduate Research Symposium of the Faculty gives the best immediate opportunity for undergraduates to present what they have learned through their research experiences to a larger audience of interest. We strongly believe that research and innovation are integral parts of our academic culture and dissemination of new knowledge is our utmost duty for serving mankind. The Symposium is a forum for students and the faculty to discuss cutting edge research topics and to examine the connection between research and education for the betterment of the wider community.

The academics of the faculty who are creative and innovative in their respective fields have open up the opportunities of the undergraduates to integrate knowledge and strategies to conduct ethically sound research which is timely relevant and oriented for outputs to address the pressing needs of the food production and nutrition sectors globally. The Symposium includes projects from all disciplines of the faculty that encourage interdisciplinary discourse allowing students to learn from each other about a broad range of exciting research topics. I am very happy to note here that being a leading faculty of the university; we have been successful in delivering numerous innovations and research to the food and nutrition sector in the recent past which has been recognized well and awarded in various national and international forums.

On behalf of the Faculty, I would like to congratulate all the researchers who would present the outcomes of their excellent work in the symposium and those who are awarded for the excellence of the achievements. Further, I would like to extend my gratitude to the supervisors and other collaborators who have immensely contributed to achieving objectives and successful completion of the research. On behalf of the faculty, I would like to acknowledge the organizing committee of the URes 2020 who have taken enormous efforts to make the event a complete success amidst various challenges.

Prof. B.P.A. Jayaweera
Dean, Faculty of Livestock, Fisheries & Nutrition
Wayamba University of Sri Lanka

Message from the Coordinator

On behalf of the organizing committee, it is my pleasure to welcome you all to the Seventh Undergraduate Research Symposium (UReS) 2020: "New Frontiers in Research and Innovations to Develop Healthy Food Systems" organized by the Faculty of Livestock, Fisheries & Nutrition, Wayamba University of Sri Lanka. Unfortunately, the COVID-19 outbreak was a serious threat posing critical implications to our education system, well-being, and workstyles in 2020. The pandemic significantly affected the calendar events of the faculty and, as the organizing committee of UReS, we had to reschedule the symposium date consequently keep informing the keynote speaker and guests, sponsors while revising the budget several times which was a tedious task.

However, taking this challenging situation as a new opportunity to gain new experiences, the organizing committee decided to conduct a virtual symposium. For the first time in the history of UReS, it is conducting in a virtual environment. We as the organizing committee, our prime aim was to create an ideal platform for the final year students of the faculty to present, discuss and debate their research findings in front of a distinguished scientific audience. Despite this is a virtual event, I believe we have accomplished our mission as a team.

On behalf of the organizing committee, I wish to take this opportunity to acknowledge, Senior Prof. Udith K. Jayasinghe, Vice-Chancellor, Wayamba University of Sri Lanka, for facilitating the research culture in the university, and Prof. Ajith Jayaweera, Dean, Faculty of Livestock, Fisheries & Nutrition, for providing continuous encouragement and timely advice for organizing the event. I extend my sincere gratitude to Prof. Rangika Halwathura, Commissioner, Sri Lanka Inventors Commission cum Professor, Department of Civil Engineering, Faculty of Engineering, University of Moratuwa for accepting our invitation to deliver the keynote speech and inspiring our young scientists. I also congratulate Mr. U.R.M. Tharindu Jayanath Rathnayaka, for winning the Best School Inventor Award 2019 at this seventh UReS 2020.

Amidst the financial difficulties, the generous support extended by our sponsors who are listed in this proceedings are gratefully acknowledged and on behalf of the faculty, I convey my heartfelt thanks to them. I express my profound gratitude to Prof. W.J.S.K. Weerakkody, Director, Information & Communication Technology Center, Makandura Premises, Wayamba University of Sri Lanka and his team for the valuable guidance and untiring support extended in launching this virtual symposium. My sincere gratitude also goes to the home crew - the members of the organizing committee - for their hard work, dedication and patience rendered in organizing the symposium. Furthermore, I acknowledge the Assistant Registrar of the faculty, the staff of Deans' office, the technical officers of the media unit and all the nonacademic staff of the faculty for supporting the organizing committee in various ways to make this event a great success. My special

thank also goes to Ms. ASF Zeinab and Ms. MKDO Warunika – third-year students of the faculty, for acting as comperes in the inaugural ceremony.

I wish to thank the academia of the faculty and the external supervisors of these budding young scientists for being patient with them as beginners and creating their interest in research while guiding them to publish the findings. I extend my sincere gratitude to the judges for accepting our invitation amidst this pandemic situation and evaluating the research presentations. Last but not least, I highly appreciate the final year students who are disseminating new knowledge and technology generated by their research projects at this symposium.

While congratulating all the presenters, I wish the 7th UReS a great success.

Dr. W. A. Harindra Champa
Coordinator
Organizing Committee UReS – 2020
Faculty of Livestock, Fisheries & Nutrition
Wayamba University of Sri Lanka

Keynote Address

NATURAL SCIENCE Vs ARTIFICIAL SCIENCE

By

Prof. Rangika Halwathura

Commissioner, Sri Lanka Inventors Commission, Sri Lanka;
Professor, Department of Civil Engineering,
Faculty of Engineering, University of Moratuwa, Sri Lanka

Nature is a huge teaching space that offers many lessons for those who take the time to reflect and discover. In decades ago, scientists and inventors studied characteristics of things in nature and came up with amazing technologies and products invented as a result of studying nature. However, in the recent past we forgot this simple fact and started ruling nature. As a result, the human factor was deteriorating and more than inventions/ innovation, the disruptions have come into the picture. This was evident immensely in the recent past. Many of the recent man-made developments have not only threatened nature, wildlife, environment but also the humans themselves.

Sustainability has become the most important challenge not just for the present, but also for the decades to come. Real sense of sustainability is not to disturb nature and do things which last many decades while blocking the ability of the next generations to plan as they wish, it should be merely a natural or near natural process, which will satisfy the needs of our generation. Scientifically based solutions should drive technological innovations that enable compliance with the still-growing environmental constraints. Research in this particular field of interest is advanced from the physical, chemical, biological, life cycle assessment, engineering, and materials science perspective, often leading to synergistic approaches. Decoding nature will end up with marvelous creations, which can rebuild the lost link between nature and humans and that will sure heal the world.

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Development and validation of an educational curriculum on type 2 diabetes self-management

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Diabetes mellitus is a series of metabolic conditions associated with hyperglycaemia and it has become one of the most common non-communicable diseases. Diabetics can have better quality of life with proper life-style management. Improvement of patients' knowledge of diabetes self-management is much important for proper glycaemic control. In Sri Lanka, there was no effective educational curriculum developed by targeting self-management of type 2 diabetes. Therefore, the objective of this study was to develop an educational curriculum for self-management of type 2 diabetes. This is a qualitative study which conducted under the three methodological approaches; gathering information regarding diabetes self-management from previous studies and experts' comments, curriculum development, validation of the developed curriculum. Experts' suggestions and comments of the health care professionals in the diabetes management team were collected using online Google forms and printed questionnaires. Expert panel consisted of medical practitioners (n = 5), dietitians (n = 5) and public health nurses (n = 5). Experts' views and suggestions were considered in the curriculum development. It has developed under 8 modules to cover most important sections of diabetes self-management including; "Background of diabetes", "Diabetes management", "Dietary management", "How exercise affects diabetes management", "How stress affects diabetes", "Impact of alcohol and smoking on diabetes", "How can overcome the diabetes management barriers", "Continuing diabetes self-management". After the development of the educational curriculum, the validation was carried out with the same panel of experts. Experts verified that the developed content of the curriculum is adequate enough for proper delivery of diabetes self-management. Therefore, developed curriculum can be used in diabetes self-management programmes.

Keywords: diabetes mellitus, educational curriculum, life style modification

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Energy and macro nutritional composition of commonly available takeaway lunch packets in selected market places

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Currently takeaway foods have become increasingly popular in Sri Lankan urban and semi-urban population. The growing proportion of the population consumes food from restaurants. Therefore, it is an important contributing factor to the overall quality of the diet. However, consumers receive little or no nutrition information from takeaway meals outlets. Therefore, information on the nutritional composition of takeaway meal packets has become vital. Lack of studies have been conducted in Sri Lanka regarding the nutritional composition of takeaway lunch meals. This study was carried out to identify the energy and the macro nutrients content of commonly available takeaway lunch packets in selected restaurants. This study was conducted using the convenient study sampling method in *Ampara, Batticalo* and *Kurunegale* districts. Energy and macronutrients compositions of sample of lunch packets were analyzed using FoodBase 2000 software. Average available total energy was 927 kcal/pack (range770-1020 kcal/pack). It is 46.4% of the average daily energy requirement of a person (2000 kcals per day). Most of the selected lunch packets were rich in carbohydrate and provide more than 65% of energy. Fat and protein provided 25% and 10% of total energy, respectively. According to the guidelines of healthy canteen policy published by Nutrition Division, Ministry of Health, the required energy for Sri Lankan adult is 600 kcals from the lunch. The lunch samples were analyzed in this study have exceeded the recommended amount of energy and the majority of the lunch packets were rich in carbohydrate as the main energy source.

Keywords: macro nutrient intake, nutrition information, takeaway lunch

Fortification of rice flour to prevent common micronutrient deficiencies in Sri Lanka

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Rice is a potential vehicle for fortification to address micronutrient deficiencies among the community because on its widespread consumption by at-risk populations. However, rice is minimally processed before consumption, fortification of rice is costly. This study is investigated on feasibility of rice flour fortification in order to fulfil the nutritional needs of the community at a lower cost as a long-term solution for emerging major micronutrient deficiencies in Sri Lanka. A questionnaire was administrated among selected 300 families to evaluate the rice flour consumption pattern among the population and concerning the recommended dietary intake values and upper tolerance limits the optimum fortification amount of each micronutrient, iron, zinc, folate, vitamin A and vitamin B12, to be included in the premix is decided. A sensory test with 7-point hedonic scale was conducted among a sensory panel to determine the overall acceptability of the prepared fortified string hoppers, roti and pittu that were prepared by changing the premix composition for each micronutrient and the data were analyzed by one way ANOVA. Moisture, color and texture analysis were also done. The final fortification amount was decided as 60ppm for Fe and Zn, 2ppm for folate and vitamin A and 30μg/kg for vitamin B12without affecting for sensory properties color, texture and moisture absorptivity. The mineral content of samples was determined by Flame atomic absorption spectroscopy and no significance losses of Fe and Zn were observed during cooking or storage. The study concludes that rice flour fortification can deliver higher benefits to the at-risk population.

Keywords: anemia, iron, malnutrition, nutrition, zinc

Acknowledgement: Financial support was provided by the research grant AHEAD/ICE/WUSL

Formulation and evaluation of physicochemical and sensory properties of jelly candies incorporated with watermelon (*Citrullus lanatus*) rind

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Watermelon (*Citrullus lanatus*) rind is usually discarded as agricultural waste and considered an important source of bioactive compounds. Jelly-candies are highly consumed confectionery products preferred by all age groups but may be unhealthy due to high sugar content and non-nutritive value. Hence, the main objective of this study was to evaluate the nutritional potential of the watermelon rind and the quality attributes of the jelly candies incorporated with rind pulp. Three different formulations of jelly candy were prepared with watermelon rind pulp: pineapple juice: gelatine at 20:20:12, 30:20:12, 40:20:12 ratio and three other formulations by replacing pineapple juice with orange juice. The six formulations were evaluated for their proximate composition, sensory and physicochemical properties, phenolic content and microbial quality. Replacement of pineapple juice with orange juice affected the flavour, colour, sweetness, after taste, acidity and polyphenolic content of the products. The formulation containing 40:20:12 rind, pineapple, and gelatine resulted in candies with the highest contents of protein and fiber ($P<0.05$) and showed the highest scores for overall sensory acceptability. The same formulation also showed significantly higher ($P<0.05$) total phenolic content (4.997 mg of gallic acid equivalents/g), total flavonoid content (2.552 mg of catechin equivalent/g), vitamin C content (0.04g of ascorbic acid/100g) and titratable acidity (1.05g of citric acid/100g) and lowest colour coordinates (45.76, 2.92 and 33.15 for L*, a* and b*, respectively). Water activity and total soluble solids content of the products were not affected much by the level of rind pulp added and were varied between 0.70-0.74 and 69°-73°, respectively. Six formulations had a desirable pH (3.5-4.0) and showed no significant growth ($P>0.05$) of bacteria, yeast and mold over a period of four weeks under refrigerated conditions. Consequently, this study demonstrated that watermelon rind had the potential for utilization in the development of jelly-candy rich in nutritional and bioactive compounds.

Keywords: bioactive compounds, fruit by-product, gelatine candy, pulp incorporation

Acknowledgement: Financial support was provided by the research grant AHEAD/ICE/WUSL

A controlled release nutraceutical formulation based on ginger *(Zingiber officinale)* bioactive compounds/montmorillonite nanocomposite

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Ginger *(Zingiber officinale)* is a tropical plant, has green-purple flowers and a fragrant rhizome which is widely consumed as a flavoring or fragrance purposes. The whole plant of ginger (flower, leaves, rhizome, roots, stem, etc.) is a collection of different bioactive compounds including phenolic and terpene. Gingerols, shogaols, and parasols are principle bioactive compounds that provide unique flavor with medicinal value such as antimicrobial, anti-inflammatory, anti-cancer, anti-obesity, cholesterol-lowering, antiplatelet aggregation and antioxidant properties. However, these bioactive compounds are relatively less stable and possess poor bioavailability and low water solubility. There are numerous extraction methods are available to extract oleoresin from ginger and the solvent extraction is considered a cheap and safe method. During this study, ginger oleoresin was extracted (in 96% ethanol) from ginger rhizome followed by encapsulation of ginger bioactive compounds in montmorillonite (MMT) nanoclay. The prepared MMT-ginger bioactive compounds nanocomposite was oven-dried at 60°C overnight and the resulting powder was palletized. Total phenolic content (13.925 ± 0.361 mg/g), total antioxidant activity (91.68 ± 1.817%) and maximum antioxidant capacity/IC50 (98.704μg/mL) of the ginger extracts were determined. In addition, Gas Chromatography Mass Spectroscopy (GC-MS) was carried out to identify bioactive compounds present in the extract. After the preparation of MMT-ginger nanocomposite total antioxidant activity (89.88±2.858%) was determined. In addition, prepared nanocomposite was characterized using powder X-ray diffraction (PXRD), scanning electron microscopy (SEM) and Fourier transform infrared spectroscopy (FTIR). The release study results showed that 80% of active compounds (phenolic) release within 2 hours and 30 minutes in distilled water at pH 5.4. To determine the antimicrobial activity, the total plate count technique was employed. The observed results indicated that MMT-ginger nanocomposite showed antibacterial activity against *Escherichia coli* (9 CFU/mL). In summary, the prepared MMT-ginger nanocomposite is a potential candidate to be used as a nutraceutical with sustained release properties and improved bioavailability.

Keywords: antibacterial activity, antioxidant properties, gingerols

Development and optimization of flour using Embul banana (*Musa spp.)* variety and application in nutritious product

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Banana is a widely grown fruit all over the world and has a high nutritional and medicinal value. Embul banana (*Musa spp.*) variety is the most cultivated banana in Sri Lanka which has nearly 40% of annual post-harvest loss. Although, produced banana is seldom utilized commercially to minimize the loss. Therefore, this study was conducted to develop nutritionally enrich flakes using Embul banana flour while optimizing keeping quality of flour by introducing a combination of anti-browning agents. Preliminary studies were done to identify the optimum maturity level of bananas for flour development. Flour was prepared using unripe matured banana by introducing a mixture of citric acid and sodium metabisulphite to optimize keeping quality of the flour. Product developed by incorporating 60% of banana flour, was highly scored product in the sensory evaluation and was used for further analysis. The developed product was analyzed for the proximate composition by using AOAC methods (2000). The shelf life analysis of the product was done by determining microbial count and water activity. Results revealed that the use of sodium metabisulphite for the development of flour significantly ($P<0.05$) controlled the growth of yeast and mould and preserved the white color of the developed flour. Results of proximate composition showed that the product contained; carbohydrates (47.73%), crude fiber (31.20%), crude protein (2.35%), crude fat (6.03%), moisture (2.37%), and ash (10.32 %). The water activity and microbial counts of flakes were not significantly ($P>0.05$) changed during the shelf life study. Sodium metabisulphite can inhibit the browning reactions of banana flour. It maintains the keeping quality and yeast and mold count of developed flour. Banana flakes contained comparatively high fiber content. In conclusion, Embul banana can be profitability converted into flour, for the preparation of good quality and nutritionally enriched processed products like banana flakes.

Keywords: anti-browning, flakes, keeping qualities, unripe

Development of a water treatment filter bag using bael (*Aegle marmelos* L.) and coconut (*Cocos nucifera* L.) shell active carbon

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Consumption of hard water and *Escherichia coli* contaminated water severely affects public health. This study focuses on introducing a filter bag to remove hardness and *E. coli* in drinking water using activated carbon synthesized from bael and coconut shells. Alkaline activated bael shell active carbon (BSAC) and coconut shell active carbon (CSAC) were characterized using FTIR and SEM techniques. Batch experiments were done to determine the effect of various adsorbent factors such as initial hardness, adsorbent dose, pH, temperature and contact time. The analysis was done by EDTA titrations using AOAC: 973.52B method. Filter bags with 4.0g active carbon were applied under optimum conditions to field water samples collected around Gonawila area. The effect of active carbon on *E. coli* count was analyzed using the MPN test method. Hydroxyl groups on carbon surface were observed in the FTIR spectrum and BSAC showed the highest porosity in SEM images. Removal efficiencies at a nearly neutral pH of 6.3 for BSAC and CSAC were 33% and 25%respectively. The temperature study showed that the softening process in BSAC and CSAC is endothermic as removal efficiency increased from 32% and 19% at 303 K to 60% and 47% at 333 K respectively. Removal efficiency enhanced when increasing contact time and adsorbent dose until 15 hours and 1.00g/cm^3 respectively. The maximum removal efficiency was reported with the lowest initial hardness at 200mg/L. BSAC showed significantly higher efficiency than CSAC in all optimizations except for pH ($P < 0.05$). Field water samples reported an average hardness reduction of 39% and 36% by BSAC and CSAC respectively. The microbial analysis resulted *E. coli* counts of 11 MPN/100mL and < 2 MPN/100mL with 63% and > 93% efficiencies for BSAC and CSAC respectively. The results indicated that filter bags developed using BSAC perform better in water softening while filter bags with CSAC remove *E. coli* more efficiently.

Keywords: adsorption, agricultural waste, *Escherichia coli*, hardness

Teaching and learning approaches in the current secondary school food literacy curricula

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Food literacy is a new and emerging concept, that helps understand the impact of food choices on individual well-being. The purpose of this qualitative study was to explore the importance of food literacy education, teaching and learning approaches used in the classroom, and the challenges and barriers faced by teachers in teaching food literacy curriculum in secondary schools. The teachers who are teaching the subjects; Health and Physical Education, Agriculture and Food Technology, Home Economics, Practical and Technical Skills, and Science in the Northern Province were selected using the maximum variation sampling technique. A total of 96 teachers participated in 11 focus group discussions. The discussions were analyzed using the template analysis technique using the NVivo 12 qualitative data analysis software and six major themes related to teaching and learning approaches were identified. All teachers approved of the importance of food literacy. Most teachers indicated that they use textbooks, blackboard and school gardens as the main teaching tools while practical sessions, group discussions, and field visits as the main methods of teaching. Most teachers perceived textbooks and practical sessions as the most effective teaching tools and methods. Student assignments and school term examinations were considered as the major forms of evaluation methods. Teachers faced certain barriers and challenges such as lack of support from parents, school administration and necessary resources including financial support, tools and equipment and training in food and nutrition. Though the majority of teachers were generally positive and understood the importance of food and nutrition education they face certain barriers and challenges. Further, they need more resources and training in terms of different ways to deliver the curricula content. The findings of this study will help future studies to understand strengths, drawbacks, and potential areas for improvements in the secondary school food literacy curriculum in Sri Lanka.

Keywords: food literacy, secondary school students, teaching and learning approaches

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Perception and usage of herbs for wellness by adults: a cross-sectional online survey

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The possibility of herbs to heal a wide variety of diseases, have drawn the interest of traditional healers as well as researchers over many years. *In vitro, in vivo* and *ex vivo* studies have shown the beneficial pharmacological effects of herbs such as antioxidant, anti-carcinogenic, anti-inflammatory, antimicrobial, anti-diabetic, bone forming and immune strengthening abilities among others. This cross-sectional study was aimed to determine the level of knowledge, attitude and usage of herbs to obtain wellness; and the association between the knowledge, attitude, and behaviour (KAB) levels with socio-demographic factors of Sri Lankans. Data collection was done through a pre-tested online questionnaire. A number of 417 respondents were selected for the analysis after screening for the completeness of the questionnaire. Data analysis was done using SPSS version 20, AMOS software and descriptive statistics. Almost 85% of the participants were young adults belonging to the age group of 20-34 y. Majority of the respondents were Sinhalese and 45% and 55% of participants were males and females, respectively. The findings revealed that the levels of knowledge and attitude were high, but the level of behaviour was medium as evaluated based on scores given. Significant correlations were observed between different categories of KAB and socio-demographic factors, namely age, gender, ethnicity, education level and presence or absence of NCDs. The top five herbs used by this group included ginger, garlic, curry leaves, turmeric and lime. About 92% knew that herbs were protective against non-communicable diseases. Though majority of the respondents had knowledge on health benefits of herbs, they were unaware about the negative interactions with nutrients and prescription drugs. In conclusion, majority of adults have high level of knowledge and positive attitudes on herbs/herbal products, but their usage is medium. There is a need to make people are aware of the harmful effects of herb over-consumption, herb-nutrient interactions, and specific benefits of each herb.

Keywords: attitudes, behaviour, knowledge, socio-demographics, Sri Lanka

Impact of COVID-19 on the food security status of households in Badulla and Nuwara Eliya districts

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COVID-19 and the related containment measures taken may affect the households' food security status. This cross-sectional study aimed to assess the impact of COVID-19 on households' food security status in the Badulla and Nuwara Eliya districts. The objectives of the study were to: (i) determine the percentage of food security and food insecurity households (ii) study the effects of COVID-19 on food security (iii) determine the factors associated with food insecurity (iv) identify the coping strategies adopted by houses and (v) determine the dietary diversity of the households during the outbreak of COVID-19. A total of 183 families from the Badulla and Nuwara Eliya districts were studied. Computer Assisted Telephone Interviews were conducted to collect data. Food Insecurity Experience Scale was used to assess the households' food security status. Food Consumption Score (FCS) was used to determine the dietary diversity. Univariate, chi-square test and binary logistic regression were used for the statistical analysis. The percentage of households with food security, moderate food insecurity and severe food insecurity was 31.1%, 42.6% and 26.2%, respectively. Respondent's educational level (OR = 0.494; P = 0.05) and ethnicity (OR = 3.469; P = 0.001) were significantly associated with household food insecurity. The percentage of houses that lost their regular income during the pandemic wave was 78.1%. Nearly 83% of households' personal or family movement was affected. About 51% of respondents noted increased food prices of staple food, and 69% noticed certain food items stock out. The percentage of households that could not pay the loans and make new loans to cover expenses were 54.1% and 32.2%, respectively. Contrary to this, based on FCS, 90.7% of Households' food consumption was acceptable. The study concluded that 43% of households were moderately food insecure in Badulla and Nuwara Eliya districts during the outbreak of COVID-19. COVID-19 outbreak affected the households' income, community or family peoples' movement, food prices, food availability, and access to food markets.

Keywords: coping strategies, food insecurity experience scale, food consumption score

Evaluation of pesticide usage in up-country cabbage production in Sri Lanka

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Cabbages are vulnerable to a variety of diseases which seriously injure or may destroy the crop, resulting in ultimate yield with a reduced quality. Therefore, pesticides application has become an essential requirement in cabbage cultivation. However irresponsible pesticide usage can cause adverse effects to humans and the environment. Up-country cabbage-cultivation is one of the farming systems which consume a higher quantity of pesticides. Cabbage is short durational and highly humid states may result in the rapid spread of pests and diseases. The main objective of this study is to estimate the extent of pesticide use and identify the factors affecting the overuse/misuse of pesticides. Primary data collection was performed using a questionnaire survey from 100 farmers randomly selected from selected areas within Badulla and Nuwaraeliya districts. Based on the research findings, about 66% apply pesticides before arising of any symptoms of pest or disease. Many farmers applying higher quantities than mentioned in labels in the Badulla and Nuwara-Eliya and which are 58% and 64% respectively as they believe that the recommendations given in the pesticide labels are insufficient to manage the pest/disease. If an excessive quantity of pesticide solution is remaining after spray, the farmers tend to repeatedly apply the remaining solution to the same cabbage field (69%) or store the remaining solution for future use (31%). Nearly 29% do not adhere to the pesticide-free period before harvesting the final product. About 85% wear protective garments regularly during the pesticide spraying. Appropriate personal protective equipment and clothing should be used while mixing and application of pesticides. Farmers are advised to consider the Color coding system in the label of the particular pesticide. The order of preference of pesticides should be Green (more preferred) > Blue > Yellow. The pesticide amount applied for cabbage cultivation is higher in Nuwara Eliya district than in Badulla district.

Keywords: hazardous, overdose, precautions, recommendation

Carboxymethyl cellulose/TiO_2 nanocomposite coating for shelf-life extension of "*Ambul*" banana (*Musa acuminata*) under ambient conditions

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Ambul banana which is the most widely cultivated and consumed banana type in Sri Lanka becomes unmarketable after 5-6 days from harvesting at the mature green stage. The postharvest losses of banana in Sri Lanka account for about 30%. The present study was conducted to evaluate the effectiveness of CMC/TiO_2 nanocomposite coating to extend the shelf-life of banana under ambient conditions (31 ± 1 °C, 70 ± 1% RH). CMC/TiO_2 nanocomposite (TiO_2 was 5% w/w of CMC) solution was prepared by adding sonicated TiO_2(E171) (25 nm) into CMC (2% w/v) solution and stirring for 1 hour. Glycerol (25% w/w of CMC) was used as the plasticizer. Three treatments (uncoated, CMC coated and CMC/TiO_2 coated) were carried out using 60 bananas per each (20 per replicate) and prepared by dipping in respective solutions for 1 min. The shelf life of banana was analyzed using physical appearance, visual quality rating, quantitative peel colour changes, firmness, starch content, total soluble solids (TSS), titratable acidity (TA), ripening index (RI–ratio of TSS/TA), pH, weight loss (%), moisture content (%) and disease incidence. Besides, the prepared nanocomposite films were characterized using powder X-ray diffraction, Fourier transform infrared spectroscopy and scanning electron microscopy techniques. Banana coated with CMC/TiO_2 exhibited the highest shelf life of 19 days (yellow but no brown freckles) whereas uncoated and CMC coated banana displayed a shelf-life of 6 and 10 days (yellow with brown freckles) respectively. RI of uncoated banana increased from 9.0 to 27.6 in 6 days whereas banana coated with CMC and CMC/TiO_2 nanocomposite, the RI increased from 9.0 to 23.1 and 18.3 in 6 days respectivel ($P < 0.05$). A similar pattern of variation was observed for the other quality attributes examined. In conclusion, the CMC/TiO_2 nanocomposite coating significantly reduced the rate of ripening of *Ambul* banana extending the shelf-life up to 19 days under ambient conditions.

Keywords: banana, nanocomposite, postharvest losses, quality, ripening index

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Green coffee bean bioactive compounds based on species, geographic origin and processing method - a review

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Coffee, the well-renowned beverage everybody adores, is made from the green coffee bean of the coffee tree. Mostly the coffee trees are cultivated targeting the beverage industry but sometimes targeting the nutraceuticals or pharmaceutical industry. The coffee trade is among the most valuable trades in the globe. This value is achieved by the presence of bioactive compounds in coffee. Caffeine and Chlorogenic acids (CGA) were the targeted compounds for this study. The amounts of these bioactive compounds may vary with its species, geographical origin and post-harvest processing methods. In this article, the variation of the caffeine content and the CGA contents in green coffee beans, regarding the above-mentioned factors, were reviewed. To gather research articles and book chapters, the databases of Scopus, Science Direct, and Google scholar were used. For recent news and articles, respected and reliable web sources were referred. More than a hundred references are included. The *Coffea canephora* species has the highest amounts of both caffeine and CGA than the *Coffea arabica* species. The caffeine content and CGA contents in green coffee beans, regarding the geographic origin is controversial for both above mentioned coffee species. Some studies have reported they are different from one country to another and some do not. Studies regarding the effect of processing method towards caffeine and CGA contents are minimal. The genetic variation between the *Coffea canephora* and *coffea arabica* species might be the reason for the caffeine and CGA contents differences. Previous studies on country basis bioactive compound differences, have considered different countries according to their purposes. For authentication purposes, one compound alone cannot be used but a combination might be helpful.

Keywords: caffeine, chlorogenic acids, *Coffea arabica, Coffea canephora*

Quality determination of selected milk powders and liquid milk brands in Sri Lankan market

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Annually Sri Lanka imports milk powders from all over the world. Self-sufficiency of milk production of Sri Lanka requires twice the local production. Consumers are frequently concerned about the quality of the milk they consume. Thus, the research was conducted to assess the physicochemical and microbial quality in selected milk powder and liquid milk samples available in the local market. As the experiment, two brands each from locally produced and imported full cream milk powder samples and three pasteurized milk brands were selected. Under physicochemical parameters, fat %, protein %, ash %, carbohydrate %, moisture %, pH, titratable acidity, total solids % and specific gravity were measured. The microbiological quality was determined by measuring the total plate count and the presence of *E. coli*. Fresh cow's milk was used as the control. All parameters were assessed according to the SLSI methods and AOAC methods. The data were analyzed with statistical tool SPSS at a 95% confidence level. The results showed that Protein % and Carbohydrate % of milk powders were significantly higher than the pasteurized milk and cow's milk. Compared with imported milk powder brands, the local milk powders have lower protein %. The average fat% of tested milk powders was significantly lower than SLS values. The insolubility index and moisture contents of milk powders were agreed with the SLS value. The average titratable acidity of every sample was agreed with the SLS value. Every tested sample was free from *E. coli* contaminations. Total plate counts of tested milk powders brands achieved the Sri Lankan standards, while two brands of pasteurized milk were not agreed with the SLS specifications. In conclusion, tested milk powder brands lie within standards in both physicochemical and microbial qualities except fat %. Though the physicochemical properties in pasteurized milk and cow's milk agreed with SLS values, microbial hygiene is poor.

Keywords: microbiological quality, physicochemical, pasteurized milk, SLSI

Acceptance of legumes as a food group among Sri Lankan young adults

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Although legumes are considered a staple food worldwide, its consumption has seen a decline in recent times. This study aimed to evaluate the acceptance of legumes as a food group among Sri Lankan young adults using a cross-sectional online survey focusing on the legume consumption patterns, perceived importance, benefits and barriers for their consumption and remedies to promote legumes as a food group. Most of the respondents were legume consumers (75%) and the mean intake of legume consumption was reported as 114.64 g/d, while consumption of lentils (mean intake:55.05 g/d) accounts for nearly half of the legume consumption compared to other legume varieties (mean intake of all the other legumes varieties combined: 59.5 g/d). Legume consumers were later subdivided into 3 groups as low (on or below 45 g/d), marginal (between 45 g/d and 87.5 g/d), and disease prevention (above 87.5 g/d) based on their recent legume consumption pattern. The majority of the legume consumers belonged to the disease prevention consumer group (59%). Lentils were the most often consumed, followed by green legumes, chickpeas and green grams, which were most commonly consumed as a curry or either as a breakfast item. Consumers were well-aware of the benefits of legumes' as a good protein source and as a meat alternative and had only a few barriers for their consumption. The main barriers perceived by non-consumers and low consumers were the cost of legumes and preparation challenges. Based on the results, the acceptance of legumes as a food group among the young adult population was fair. The differences between the non-consumers and consumers mainly revolved around the limited knowledge about legumes' disease prevention benefits, lack of use of legume types, recipe variety, and various legume preparation techniques which should be the focus of future legume promotion materials.

Keywords: acceptance, legume consumption, young adults

The energy and macro nutritional composition of snacks in the Sri Lankan marketplaces

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Non-Communicable Diseases (NCDs) account for 75% of death in Sri Lanka. NCDs are categorized as "lifestyle" diseases; the most common causes include poor diets and physical inactivity. Majority of the snacks available in the marketplaces are calorie-dense and lack of vitamins and minerals. Continuous consumption of calorie-dense snacks will lead to several health issues including NCDs. In Sri Lanka, only commercially packed foods provide data on the nutritional composition in the practice of labelling. However, foods available in marketplaces are lack such nutritional information which is vital for health-conscious consumers. There are no comprehensive studies have been conducted to identify the nutritional composition of popular snacks available in Sri Lanka. This study aimed to identify the total energy and the macro nutritional composition of popular snacks available in Sri Lankan marketplaces. The study was conducted based on convenient study samples. Thirty popular snacks were identified from 18 marketplaces in Sri Lanka. The data on the recipes, raw ingredient weights and final cooked weight were collected from the selected marketplaces. Energy and macro nutritional compositions of one serving size of the snacks were analyzed using FoodBase 2000 software. The results showed that the total energy of one serving size of snacks ranges from 46 to 436 kcals. Mean calorie contribution by carbohydrate, protein and fat were 59.91%, 9.08% and 31.01%, respectively. Results showed that the majority of the studied snacks available in the marketplaces were calorie-dense. Most of the snacks were rich in carbohydrate, fat and low in protein content. Results of this study will provide vital information to the public to choose the snacks based on their total energy and major nutritional preferences. Further extended studies are required to provide generalized nutritional information for different snacks.

Keywords: calorie density, non-communicable diseases, portion size, Sri Lankan snacks

Nurses' knowledge, attitudes and behaviour regarding nutritional requirements of elderly

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There is steady increment of elderly population in Sri Lanka. Nurses need to be well equipped with knowledge, positive attitude regarding elderly care and good behaviour to maintain effective care practices with senior citizens. The current cross-sectional study was aimed to assess the knowledge, attitude and behavior (KAB) of nurses regarding nutritional requirements of elderly. Using convenient sampling technique, 50 nurses were enrolled in the study. A pre-validated self-administered questionnaire was used to assess the KAB of nurses regarding elderly nutritional requirements. The knowledge part consisted of 16 multiple choice questions with one correct answer and total score was categorized as poor, average and good. The attitude was assessed on a Likert five-point scale. The total score was further categorized as negative, neutral and positive attitude as per the scores obtained. The behavior was assessed with 11 questions with multi correct answers. Total score was categorized as sufficient and insufficient. According to analysis majority (88%) of the subjects were females. Mean age (yrs) ± SD was 22.6 ± 3.3 with the range of 21-30 y. Mean knowledge score was 11.1 ± 1.7 with the range of 6-11. About 58% subjects belonged to the average category of knowledge. Mean attitude score was 51.6 ± 6.4 and the range of 51-75% were in the positive category of attitude. Mean behaviour score was 11.2 ± 3.2 with the range of 10-20% were in sufficient category. In conclusion, nurses have average knowledge but poor behaviour towards nutritional requirements and care of elderly.

Keywords: healthy aging, nutritional deficiencies, primary, questionnaire

Determination of debittering efficacy on the nutritional aspects and palatability of palmyrah tuber flour (*Borassus flabellifer* L.) incorporated muffin

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Palmyrah tuber flour has a characteristic bitterness caused by flabelliferin present in the tuber. This bitterness reduces the consumption of palmyrah tuber flour hence debittering is vital for the development of palmyrah tuber flour-based foods. The flour was oven heated at 80 C for one hour and subjected to 4 different soaking treatments in favour of debittering. They were; 1% sodium chloride solution for 1 hour, 1% sodium chloride solution for 2 hours, 1% sodium bicarbonate solution for 1 hour, and 1% sodium bicarbonate solution for 2 hours. The best treatment out of these four was determined by the amount of flabelliferin removed during the treatment, as determined by the spectroscopic method using Naringin as the standard. The amount of flabelliferin removed was the highest when the flour was heated at 80°C and soaked in 1% sodium chloride solution for 2 hours. Proximate compositions of untreated and debittered flour were significantly different. 50%, 55%, 60% and 65% (w/w) of the selected palmyrah tuber flour were incorporated in the preparation of muffins and 9 points hedonic scale was used to select the most sensory appropriate level. 60% (w/w) debittered palmyrah tuber flour incorporated muffin was chosen the best. The nutrient composition of debittered palmyrah tuber flour muffin was compared with the untreated palmyrah tuber flour muffin and wheat flour muffin. The nutritional value of debittered palmyrah tuber flour incorporated muffin contained 44.4%, 9.90%, 4.09%, 2.38% of carbohydrate, fat, protein and fibre, respectively with rich mineral content of potassium, magnesium and calcium where both fibre and minerals were significantly higher than wheat flour muffins and lower than the muffins with untreated tuber flour.

Keywords: bitterness, flabelliferin, nutritional value, palmyrah tuber flour

Fatty acid composition of commercially available processed edible plant lipids in Sri Lanka

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Crude plant oils are processed using several techniques like refining, bleaching, deodorizing, frying and partial hydrogenation. In partial hydrogenation, a part of the unsaturated fatty acids (USFA) changes to saturated fatty acids (SFA) and *Trans* fatty acid (TFA) can also be produced. Due to the changes in fatty acid (FA) composition during the processing, the determination of FA composition in processed plant lipids is prime important. Under this study, twelve processed plant oil types and twelve partially hydrogenated lipids or partially hydrogenated oil mixed lipids were analyzed. Oil was extracted by using a mixture of normal saline, chloroform, and methanol, then oil samples were methylated and analyzed in triplicates using Gas Chromatography fitted with Flame Ionization Detector for the determination of FA composition. In plant oil category, total SFA ranged from 12.26% for sunflower oil to 91.80% for virgin coconut oil with the predominant presence of palmitic acid and stearic acid. Total polyunsaturated fatty acid (PUFA) ranged from 1.14% for virgin coconut oil to 56.17% for sunflower oil. The prominent PUFA was linoleic acid. Total monounsaturated fatty acid (MUFA) ranged from 7.03% for virgin coconut oil to 70.31% for olive oil. The prominent MUFA was oleic acid. In the hard lipid category, SFA content was higher than USFA content. Total SFA ranged from 22.57% to 62.34%with the predominant presence of palmitic acid. Total USFA ranged from 37.37% to 77.42%. The USFA/SFA ratio was high in Margarine (2.89%) with high MUFA content. Also, margarine contained TFA. Margarine made from sunflower oil has contained more total SFA than sunflower oil. FA composition of refined, bleached and deodorized oil is different from the FA composition of respective crude oil. In conclusion, the FA composition of processed edible plant lipids varies among samples and most plant oils were contained USFA than SFA.

Keywords: partially hydrogenated lipid, refined; bleached and deodorized oil, trans-fatty acid

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Green synthesis of silver nanoparticles using *Averrhoa bilimbi* fruit and assessment of their antioxidant, anti-diabetic and antibacterial properties

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In this study, an emerging field of nanotechnology was applied for the green synthesis of silver nanoparticles using *Averrhoa bilimbi* fruit. The present investigation highlights screening of ethanoic extracts of fruits, leaves and flowers of *A. bilimbi* for bioactivities, synthesis of nanoparticles and characterization including the particle morphology, physicochemical properties and stability of nanoparticles through scanning electron microscopy and Fourier-transform infrared spectroscopy techniques. Total phenolic, flavonoids, carotene and chlorophyll contents of the ethanolic extracts of fruits, leaves and flowers of *A. bilimbi* were within the range of 69.13-261.58 GAE mg/ g DW, 37.74-95.50 CE mg/g DW, 0.534-2.434 μg/g DW and 13.29-59.89 μg/g DW respectively. α- Amylase inhibition % of the extracts was within the range of 6.48-13.43% and the leaves and flowers have shown higher inhibition % comparatively. Among the plant Ariel parts screened for their total antioxidant capacities, the leaf extracts showed the highest values ($P < 0.05$) mg AAE/g DW. The potential application of nanoparticles (100μg/ml) in bacterial inhibitory capacity revealed through disk diffusion and colony-forming unit count methodologies against *E. coli* have resulted in a significantly lesser ($P < 0.05$) number of colonies 70×10^7 CFU/mL compared to the control 150×10^7 CFU/mL under 24 hrs of the incubation period. DPPH radical's inhibition activity of the synthesized nanoparticles was within the 6.8-23.6% under different concentrations (4-20μg/ml) values compared to the control, Ascorbic acid, (89.2-96.5%). The study reveals that the ethanolic extracts of aerial parts of *A. bilimbi* showed comparable antioxidant and anti-diabetic properties. Also, silver-nanoparticles were successfully synthesized through the green route using the fruits of *A. bilimbi*. Based on the obtained data, the study can suggest that phytosynthesized silver nanoparticles can be potential alternatives in the treatment of diseases because of the presence of bioactive agents and their bioactivity.

Keywords: antibacterial, anti-diabetic, antioxidant, *Averrhoa bilimbi*, nanoparticles

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Developmental and validation of an educational booklet on dietary management of type 2 diabetes mellitus

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Diabetes Mellitus has emerged as a global health concern accounting for the highest rate of morbidity and mortality. Dietary management is vital for proper glycaemic control and disease management. In the Sri Lankan clinical setup, provision of nutrition education and use of educational materials are scarce. Therefore, the present study aimed to develop and validate a dietary booklet as a guide to improve knowledge, attitudes, and skills of diabetes patients for dietary management. This qualitative study was conducted in two phases; content development and validation. A self-administrated online questionnaire was used to collect expert's opinions, concerns, and suggestions for the booklet content. The booklet entitled "Dietary Management for the Type 2 Diabetes Patients" was composed in Sinhala language and was comprised of 93 pages (A5 paper size). The booklet consisted of six chapters including; "Background information for the dietary management"; "Dietary guidelines and nutrition therapy for diabetes"; "Specific diet types and food products suitable for patients"; "Preparation for the specific days and occasions"; "Guidelines and tips to modify diet"; "Worksheets for the patients". The validation by 22-panel experts and 22 patients involved content validity and face validity respectively. Health care professionals perceived the content was attractive, interactive, and adequate enough for dietary management. Type 2 diabetes patients verified that the contents are readable and easily understandable. Therefore, the developed booklet would assist the proper dietary management of diabetes. The effectiveness of the developed booklet was found to be high after the evaluation phase. Furthermore, clinical studies should be conducted to validate the results of this study.

Keywords: dietary management, educational material, nutrition knowledge, type 2 diabetes.

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Development of fiber-enriched bun from wheat flour fortified with kohila (*Lasia spinosa*) flour

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Buns are one of the most popular yeast leaven bakery products produced from refined wheat flour. Buns are rich in carbohydrates, energy and low in dietary fiber. Due to their small size, shape and easy consumption, buns have become a convenient product among the community. Due to the high percentage of carbohydrates present, high consumption of buns will lead to several health issues such as obesity, constipation, and other non-communicable diseases. This study was conducted to develop a fiber-enriched bun from wheat flour, fortified with kohila (*Lasia spinosa*) flour. Buns were prepared by blending wheat flour and kohila flour in different proportions (5, 7.5, 10, and 12.5%), and buns with 100% wheat flour were used as the control. After mixing all the ingredients, the resultant good consistency dough was baked in a hot air oven at 200 ± 5 °C for up to 15 min until a golden-brown color was obtained. Sensory analysis was conducted using 30 untrained panelists using a 7-point hedonic scale. Statistical analysis was carried out using SPSS-16 software at 0.05 a significant level. The highest acceptability was achieved by the bun formulated from 7.5% kohila flour. After evaluating the proximate composition, it was found that buns with kohila flour contain higher amounts of moisture, dietary fiber and ash while at the same time they contain lower amounts of proteins and carbohydrates compared to the control sample. The kohila flour sample showed significantly lower calorie content compared to that of the control. There was no significant difference in crude fat content between the kohila flour sample and the control. The Color, of the developed kohila flour buns, were significantly different ($P < 0.05$) from the control sample. L* value (lightness) of kohila flour containing bun (57.12 ± 0.64) was significantly lower than the control sample (67 ± 3.64). Findings of this study manifest that 7.5% kohila flour fortified bun can be used as a good source of dietary fiber which will be beneficial to improve the health of the consumers.

Keywords: bakery products, consumers, crude fiber, non-communicable diseases

Comparison of the effect of some selected sources of polyphenols on syneresis and quality of set yoghurt during refrigerated storage

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Syneresis is one of the pronounced textural defects in yoghurt. Polyphenols can bind with milk proteins to form a network in dairy matrices, minimizing the syneresis. The current study focuses on evaluating the effect of some selected sources of polyphenols and their concentration on syneresis, physicochemical, and quality attributes of yoghurt during refrigerated storage. The polyphenol sources used were green tea (GT), black tea (BT), and coffee (CF). Four different polyphenol concentrations {10, 20, 30, and 60 mg GAE/100ml} were selected {GTY-10 represents Green Tea Yoghurt with 10 mg (GAE)/100ml added polyphenol, etc.} by adding different volumes of the infusions. All yoghurts, including the plain yoghurt {control (CY)}, were prepared without adding any stabilizers. Physicochemical properties (pH, titratable acidity), degree of syneresis (spontaneous and accelerated), Water Holding Capacity (WHC), and color measurements were performed for 21 days of storage period. Functional properties of tea/coffee infusions, and yoghurts (Total Phenolic Content (TPC), Antioxidant Capacity), sensory characteristics of yoghurts were determined. Green tea infusion had the highest amount of TPC {144.59 mg GAE/100ml} followed by black tea {76.48 mg GAE/100ml}, and coffee {58.88 mg GAE/100ml}. All treated yoghurt samples showed a significantly lower level ($P < 0.05$) of spontaneous syneresis than control. With the increase of concentration; the ability to reduce syneresis was increased except in CFY. WHC values of all yoghurt samples were within the acceptable level (60-65%). On the 14th day of storage, treated yoghurts showed a significant increase ($P < 0.05$) of WHC than the control. GTY and control had no significant difference ($P > 0.05$) in color during the storage period, while BTY and CFY showed a significant color change with the increase of the polyphenol concentration. The sensory analysis revealed that GTY-10, BTY-10, and CFY-20 attained the desired sensory attributes. Therefore, polyphenols can reduce syneresis in yogurt while improving the flavour.

Keywords: black tea, coffee, concentration, green tea

Development and quality evaluation of non-dairy drinking yogurt-like beverage incorporated with rice, soybean and finger millet milk

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Plant milk substitutes represent the dairy-free alternatives for people suffering from lactose intolerance, milk protein allergy, and vegetarianism. Hence, the present study was carried out for the development of pineapple enriched, probiotic, protein-rich plant- based drinking yogurt-like beverage using rice (*Oryza sativa*) "Suwandel'', Finger millet (*Eleusine coracana*), and Soybean (*Glycine max*) and to evaluate its sensory attributes, nutritional composition, functional and physicochemical properties and microbial quality parameters. To develop each plant milk, the ratio 1:1 (bean/grain: water) was selected. Different soy, rice and finger millet milk blends were prepared by mixing soy milk, rice milk and finger millet milk in different proportions. Each plant milk blend was formulated 5% (w/v) sucrose, 1.5% (w/v) glucose, 1% (w/v) lactose, 2.5% (w/v) sago starch, 10% (v/v) pineapple pulp and fermented with *Streptococcus thermophilus* and *Lactobacillus delbrueckii* sub sp. *Bulgaricus*. Sensory evaluation was carried out with 30 un-trained sensory panelists to select the best formulation and the ratio of 25% soy milk: 25% rice milk: 25% finger millet milk was selected. The selected formulation was analysed for proximate composition; crude protein (12.03%), crude fat (0.11%), moisture (78.49%), crude ash (0.33%), crude fiber (1.30), and carbohydrate (7.74%). As functional properties; total phenolic content (5.83mg (GAE)/g) and DPPH scavenging activity (33.24 mg/mL) were analysed. The results of the physicochemical properties of the product revealed that the pH (4.56), titratable acidity (0.51% of lactic acid), total soluble solid (13%), viscosity (19.52 mPas) and water holding capacity (64.68%). The viability of *Lactobacillus* was significantly reduced, however. up to 14 days it's higher than 10^6 CFU/ mL. Shelf life study revealed that the product can be safely stored up to 14 days under 4℃. Therefore, the utilization of cereals and legumes offer good potential in the development of products that are analogous to others already present in the commercial market like dairy alternatives.

Keywords: dairy alternative, fermentation, plant milk

The development of an education resource: dietary menus for adults with Coronary Artery Disease (CAD) and adults at risk of CAD

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The prevalence of coronary artery disease (CAD) is increasing an alarming rate in the world. The dietary modification is a viable strategy to reduce this global burden. Investigation of dietary intakes of adults with CAD and providing heart-healthy dietary menus help in improving the quality of life of adults with CAD and adults at risk of CAD. The aims of this study were to identify the dietary patterns, food preferences and present dietary intake of CAD patients and adults at risk of CAD and to develop an education resource including dietary menus for CAD. A cross sectional study comprised of 15 adults with CAD and 15 adults at risk of CAD was carried out. An Interviewer Administered Questionnaire (IAQ), Food Frequency Questionnaire (FFQ) and 24 hour dietary recall were used for data collection. Seven whole-day meal planning including breakfast, lunch, dinner and snacks were developed incorporating heart-healthy food items following the Mediterranean and Dietary Approaches for Stop Hypertension (DASH) dietary guidelines. Nutrient composition of developed menus was determined by using FoodBase 2000 software. The developed seven menus' energy ranged from 1100 kcal to 1700kcal.The planned menus were compiled into an e resource (Blog) with serving sizes showing photos. The acceptances of the developed menus were tested by giving prepared menus to five CAD patients and five adults at risk of CAD with a self-administered questionnaire to assess the acceptability and adequacy of the menus. Majority (96%) of the study sample was satisfied with the developed dietary menus. Dietary intake of the sample showed that high intake of wheat based products than other cereals, low consumption of fish and using coconut oil as main fat source in their diets. The developed menus contain e resource of Blog may be useful to reduce the progress of CAD in Sri Lanka.

Keywords: dietary intake, dietary modification, dietary patterns, mediterranean

Encapsulation of phlorotannins from edible brown seaweed in chitosan: effect of fortification on bioactivity and stability in functional foods

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Brown seaweeds are rich in phlorotannins which have proven excellent bioactivity. However, they are hardly stable in processing, storage, and gastrointestinal environment disturbing the expression of their full bioactive potential in the human body. Therefore, this study aimed to apply the encapsulation principle to perpetuate the stability and bioactivity of this marine-derived polyphenol family. Phlorotannins from *Sargassum ilicifolium* were isolated and encapsulated in a chitosan-tripolyphosphate carrier. Encapsulation properties and stability of formulated particles as well as sensorial effects of its fortification on carrier vehicle; jelly were determined. Total phlorotannin content, DPPH, nitric oxide scavenging, reducing power, and α-amylase inhibition assays were performed upon *in vitro* digestion and colon fermentation to investigate the relative bioactivity retention of phlorotannins through encapsulation. Results revealed the highest phlorotannin content in the semi-purified ethyl acetate fraction; 854.38 ± 48.42 mg $PGEg^{-1}$. Encapsulation efficiency and loading capacity of encapsulated particles figured 85.13 ± 0.03% and 62.57 ± 0.06% respectively. Low-temperature storage helped better retention of active compounds in both encapsulated and free form than ambient conditions. Encapsulated form reported 56.40 ± 2.34% of total phlorotannin content and 62.55 ± 17.39% of total antioxidant capacity retention in baking temperature (175° C). Product attributes remained unaltered when fortified with encapsulated phlorotannins. Free phlorotannins exhibited higher antioxidant activity in initial digestion stages while the effects seemed more pronounced towards later digestion stages for the encapsulated compound. Thus, encapsulation has succeeded in delivering phlorotannins to their predominant absorption site; the large intestine. Chitosan has furnished the active substance with the property of targeted delivery. The resistance of chitosan to digestive enzymes and its subsequent colonic microbial hydrolysis would have upshot these outcomes. In conclusion, chitosan is a promising wall material for phlorotannins encapsulation that would widen the scope for better exploitation of its vitality in functional food and nutraceutical formulations.

Keywords: antioxidant, phlorotannins, *Sargassum ilicifolium*, targeted delivery

Effect of low temperature and blanching on proximate composition, cyanide content and keeping quality of stored cassava (*Manihot esculenta*)

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Cassava (*Manihot esculenta*) is a cheap and reliable energy food source for people in developing countries. In the recent past, it has become a major horticultural export commodity in Sri Lanka. Exporters store cassava at low temperatures while exporting, but there are no studies to explain the compositional changes of local cassava cultivars at low temperatures. Hence, this study investigated the effect of low temperatures and blanching on proximate composition, cyanide content, and keeping quality of cassava stored for a long period. Two local cassava cultivars; "MU 51" and "*Suranimala*" were selected and were subjected to the normally exported method and minimally processed-blanched method. All samples were stored at refrigerated (13℃, 80% RH) and freezing (−4℃, 80% RH) conditions for a maximum six-week period. Proximate composition (AOAC, 2000), cyanide content, and keeping quality (cooking time, percentage of weight loss) of the samples were determined at one-week intervals. Results revealed that the moisture content of blanched samples of both cultivars was significantly ($p \leq 0.05$) differed with stored temperature during the storage period. It was reduced by 0.8% in MU 51, and 7.8% in *Suranimala* at freezing conditions. Meanwhile, fat, protein, fiber, ash, and carbohydrate content of blanched samples were significantly ($p \leq 0.05$) differed with stored temperature during the storage period. The percentage of weight loss of blanched-frozen samples was decreased by 0.41% in MU 51 and 0.24% in *Suranimala* during the storage period. The blanched-frozen sample of *Suranimala* was showed the lowest cyanide content (0.95 mg/kg) and the lowest cooking time (9.5 min) at the end of the storage time. Because blanching and freezing drastically reduce the cyanide content and soften the tissues of cassava pieces. This study concluded that freezing conditions and blanching improve the keeping quality of cassava while reducing the levels of cyanide.

Keywords: export cassava, minimally process, MU 51, *Suranimala*

Association of coconut fat intake and cardiovascular disease risk in adult men

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Coconut fat (CF) is the major source of fat in the Sri Lankan diet, which consists of about 92% saturated fats and 8% unsaturated fats. The association between coconut fat intake and cardiovascular disease risk (CVD) remains unclear. This study aimed to determine the association between habitual CF intake and CVD risk in adult men living in coconut growing area. In a cross-sectional study, a sample of 92 adult men aged between 30-60 years were recruited. Height, body weight, waist circumference, hip circumference, and blood pressure measurements were taken. A three-day dietary diary (2 weekdays and 1 weekend day) was used to assess habitual dietary intake. An interviewer administered record sheet was used to assess the CF consumption of the participants. The QRISK3-2018 online calculator was used to estimate the participant's risk of developing CVD within the next 10 y. CF intake of the participants were mean ± SD; 45.0 ± 20.8 g/d (89% of the total fat consumption). The percentage of energy from total fat, CF and saturated fat was (mean ± SD) 24.3 ± 4.5%, 20.7± 10.8%, and 16.5 ± 3.7%, respectively. Participants were divided into three groups according to the recommended range of daily total fat intake (low fat group; < 20%, normal fat group; between 20% - 30%, and high fat group: > 30% energy intake from total fat). Means of anthropometric measurements and nutrient intake were compared among the groups. The majority of CF consumed was from coconut milk (76%), followed by coconut oil (15%) and scraped coconut (9%). The mean value of Q Risk was in the low-risk category (mean ± SD; 3.2 ± 2.8%). The correlation coefficients between CF intake and CVD risk was -0.035 (P=0.744). In conclusion, there was no association between CF intake and CVD risk.

Keywords: coconut fat, CVD risk, cross sectional, diet diary, Q-risk calculator

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Nutritional properties, cooking quality and sensory attributes of pasta supplemented with barnyard millet flour

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Pasta products, which are ubiquitous around the world, possess an excellent nutritional value. Nevertheless, certain nutrients such as high biological value protein, lipid, and dietary fiber are scarce in pasta. Partially substituting the wheat flour with other cereal flour can enhance the nutritional value of pasta. This study investigates the possibilities to enhance the nutritional properties of pasta by partially substituting wheat flour with barnyard millet flour. Barnyard millet (*Eichnochloa frumentacea)*, which is a minor millet, is loaded with high-quality protein, dietary fiber and minerals. It has many health benefits. Barnyard millet incorporated foods provide a variety of health benefits to consumers. This investigation assesses proximate composition of wheat flour, barnyard millet flour, wheat pasta and substituted pasta, cooking quality of pasta, and sensory attributes of substituted pasta. Three substitution levels were analyzed: 5%, 10% and 15%. The results of the proximate analysis indicated significant improvement in protein, fat, fiber and ash content when the substitution level increases ($p < 0.05$), which can be attributed to additional nutrients provided by millet flour. Pasta with 15% substitution of wheat flour with barnyard millet flour had a shorter cooking time and lower water absorption due to the presence of insoluble dietary fiber in barnyard millet. Cooking loss was higher in pasta with 15% substitution. The lack of gluten in barnyard millet flour increases cooking loss. Sensory evaluation revealed that consumers highly prefer pasta with a 15% substitution of barnyard millet flour. The results highlight the potential use of barnyard millet flour as a supplement to wheat flour in making pasta products to enhance nutrient composition and taste.

Keywords: minor millet, nutritional value, value addition

Application of convolutional neural network in fruits image recognition

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The role of food for humans is ineluctable for many years. Fruits are the most commonly used good by the food industry for producing food products. In large-scale production, the quality attributes of fruits are inspected by humans for good accuracy in many cases but manual inspection is tedious and time-consuming. The use of novel technologies for automating tedious manual tasks is of crucial importance for the food sector. To that end, this study illustrates the use of Convolutional Neural Networks (CNN) for automatic food image classification. A user-friendly graphical user interface (GUI) program has been created as the front end to interact with the user. The program uses the Keras artificial intelligence (AI) library bundled with Python to implement the CNN. This AI program classifies images of apple, banana, and orange with an accuracy of 99.8%. A training set of 4861 images of apple (with different sub varieties),1604 images of banana, and 564 images of orange were used as the training dataset, and 2431 images of apple, 809 images of banana, and 274 images of orange were used as testing dataset collected from locally available internet sources. A sequential CNN model was designed with three convolutional layers, three maxPooling layers, one flattening layer and two dense layers. The softmax activation function was used for the final classification. Image resolution was 106 x 106 x 3 pixels each. PAGE drag and drop GUI builder was used to create the GUI interface. This simple model can be extended to include more classes of fruit. The concept can be easily extended for automated quality assurance of fruits in an industrial environment given the availability of appropriate images as training sets.

Keywords: CNN, fruits, images, Keras, loss

Compositional and antioxidant evaluation of *Salvia hispanica* L. (chia) seeds, sprouts, microgreens and development of a chia seed-based fortified milk pudding

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The consumption of chia (*Salvia hispanica* L.) seed has increased in recent years owing to its high nutritional and antioxidant properties. The present study was carried out to evaluate the changes in proximate composition and antioxidant properties of chia seed during germination and identify the best growth stage for consumption. Chia microgreens were raised at room temperature ($30 \pm 2°C$) initially under a slightly dark environment followed by the normal light conditions. The moisture and carbohydrate content of samples increased significantly with germination while crude fat content decreased. Even though the values for crude fiber, protein and ash increased with germination, the increase was not significant between growth stages. The highest total phenolic content and flavonoid content were found in chia microgreens (2.49mg GAE/g DW and 13.54mg CE/g DW respectively) and it also showed the highest free radical scavenging activity. The lowest total phenolic content and flavonoid content were observed in chia seed (0.91mg GAE/g DW and 7.56mg CE/g DW respectively). Therefore, chia germination can be a good method to increase certain nutritional and nutraceutical potential of chia seed and it can be suggested that chia microgreen is the best growth stage for consumption compared to seeds and sprouts. Due to the important health and nutritional benefits of chia seeds, a novel chia-based pudding was developed and the nutritional properties were assessed. The highest acceptability was achieved by 10% chia seed incorporated milk pudding. Chia seed pudding prepared were assessed for proximate analysis and found to contain moisture (81.67%), total solid (18.33%), crude protein (2.01%), crude fat (2.39%), crude fiber (1.24%), carbohydrates (12.16%) and ash (0.53%) in wet weight basis. The predicted shelf-life was 12 days for developed chia-based pudding at refrigerated condition (4°C) without any artificial preservative and the product could be promoted for a healthy diet with future research on extended shelf life.

Keywords: edible greens, edible seeds, finger millet, healthy dessert

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Household food waste behaviours and its implications for household food security

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Reducing food waste is a key challenge in developing sustainable food systems. Significant quantities of food are wasted from farm to fork. Since most food waste occurs at the consumer/household level, it is important to identify consumer awareness, perceptions, opinions, attitudes, and behaviours for household food waste and its implications on household food security. A cross-sectional online survey was conducted with a convenient sample of 110 students of the Wayamba University of Sri Lanka. Only a small fraction of households self-identified themselves as high food waste households as opposed to low food waste households (74% low vs 26% high). The results indicated that the level of education and gender might play a role in household food waste behaviours and the amount and extent of food waste generated. Low food waste households indicated that they did not buy less quality food, cook too much food, or didn't buy large quantities of food. Also, they agreed to check the expiry dates of the food items they purchased compared to high food waste households. After analyzing the behaviours of both groups, low food waste households indicated that they are more concerned and motivated about the amount of household food waste generated and wanted to take action against it. In terms of food insecurity status of the households, the low food waste households reported a 4% of moderate or severe food insecurity while the high food waste households reported a 2.6% of moderate or severe food insecurity indicating the more food-insecure households wasted less food while the less food insecure households tend to waste more food. However, based on the t-test results ($P = 0.52$), there was no significant difference between the two groups in terms of the probability of being moderate or severe food insecure concerning the self-declared food waste status of the household.

Keywords: food security, food waste, households, online survey

Development of a photographic tool to assess dietary intake of elderly

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Improvement of traditional dietary assessment methods with paper and pen is necessary, especifically for elderly population. The aim of the present study was to develop a photographic method to evaluate food intake of elderly and to validate the method with 3 day dietary records. Participants of the study were selected purposively from a Grama Niladari division of Deraniyagala area in the Sabaragamuwa province of Sri Lanka. Twenty elders (10 male and 10 females) participated in the study. All dietary information were collected as observational data. Digital photographs were taken using a smart mobile phone of all food consumed for three days. Photographs were taken in three positions before and after the meal consumption. Observational diet records were maintained by the same interviewer for respective three days which photographs were taken. Foods consumed by participants were prepared at the laboratory and measured portions in household measurements were photographed for each food item. An estimate of the amount of food consumed by participants was made comparing photogrphs of measured food and the photographs taken during the meal occasions. Nutrient content of meals consumed were analized using Food Base 2000 software. The comparison between the nutrient contents in the meals obtained by two methods, namely 3 day food records and 3 day meal photographs was made. The comparison was made for energy, carbohydrate, fiber, protein, fat, potassium, and calcium. Fat, protein and potassium were underestimated by -7.64%, -2.66%, and -5.86%, respectively by 3 day meal photographs compared to 3 day diet records. Energy, carbohydrate, fiber and calcium were overestimated by 1.81%, 5.94%, 1.84% and 5.21%, respectively. Spearman's correlation coefficients were significant for all nutrients, energy and fiber. Bland Altman analysis showed that differences between two methods were random and did not exhibit any systematic bias over levels of nutrient, energy and fiber intake, with acceptable 95% limits of agreement. Photographic food records of mixed dishes can be used to estimate dietary intake of an elder population with less burden to the participants and their family.

Keywords: dietary assessment, digital food photograph, 3 day diet records, nutrient contents

Development of a ready to eat vegetarian burger patty with tender jackfruit (*Artocarpus heterophyllus*)

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This study was conducted to evaluate the potential of utilizing tender jackfruit to develop ready to eat veggie-burger patties. Five formulations of patties were prepared using different combinations of ingredients including tender jackfruit, mushroom, mung bean flour, isolated soy protein, texturized vegetable protein, bread crumbs and spices. The developed products were analyzed for their proximate composition, physicochemical properties and consumer acceptability. Results of proximate composition analysis revealed that formulations one, two and five had significantly higher ($P<0.05$) fiber (25.60%), fat (17.82%) and protein (10.28%) content, respectively, compared to other formulations. There was no significant difference ($P<0.05$) in total carbohydrate content between samples. Formulation four showed the lowest ($P<0.05$) water activity and cook loss whereas the water holding capacity was significantly ($P<0.05$) higher in formulation three. The CIE L*, a* and b* values were also significantly affected by formulation. The total phenolic content of the patties ranged between 0.41-0.64 mg Gallic Acid Equivalents per gram ($mgGAEg^{-1}$) and the highest content ($P<0.05$) was found in formulation one with the high percentage of mung beans flour. The pH and total bacterial count of patties increased significantly ($P<0.05$) during the 14-day storage period at -18^0C temperature, however total bacterial count remained within the safe level ($<10^6 CFUg^{-1}$). The formulation four which contained tender jackfruit (35%), mushroom (20%), mung bean flour (15%), isolated soy protein (5%) showed the highest scores ($P<0.05$) for sensorial attributes and overall consumer acceptability, thus, was selected as the most acceptable formulation. In conclusion, the results of this study revealed that organoleptically acceptable vegetarian burger patties can be developed by using locally available tender jackfruit and they are microbiologically safe for two weeks under frozen conditions.

Keywords: phenolic content, physiochemical properties, sensory attributes

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Development of a sun exposure questionnaire to assess vitamin D status of elderly

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High prevalence vitamin D deficiency, despite the availability of sunlight throughout the year has raised in many countries. Limited studies on vitamin D status have been conducted in countries located near the equator. The aim of this study was to develop a sun exposure questionnaire (SEQ) and to estimate the vitamin D status of elders using an equation. Sample of 160 community-dwelling healthy elders (82 females, 78 males) age > 65 years was recruited. SEQ was used to determine the sun exposure habits. SEQ was analyzed using a scoring system to obtain a Sun Exposure Score (SES). Serum 25(OH)D concentration of elders was estimated using an equation which consisted of mean sun exposure time per day, percentage of skin exposure area and the skin type based on the skin color. Mean skin exposure area of the participants was 47% of the total skin. Around 55% of participants' mean sun exposure time was less than 25 minutes per week. Mean SES was 37.6 (SD 9.28) and the mean estimated serum 25(OH)D concentration was 31.0 nmol/L. According to the cutoff values of Institute of Medicine (IOM), 117 participants (73.1%) were vitamin D deficient (<30 nmol/L) while 11 participants (6.9%) had insufficient serum 25(OH)D concentration (30-50 nmol/L). Similarly, according to the cutoff values of Scientific Advisory Committee on Nutrition (SACN), 66.2% of participants were vitamin D deficient (< 25 nmol/L). Predicted serum 25(OH)D concentration was significantly higher in male participants compared to the female participants (P=0.003). In conclusion, according to the estimated serum 25(OH)D concentration majority of the elders were vitamin D deficient. Encouraging elderly people to increase the sun exposure time and skin exposure area might helpful in improving the vitamin D status of elderly.

Keywords: serum 25(OH)D, sun exposure, vitamin D deficiency

Effect of acute watermelon juice supplementation on blood pressure in prehypertensive adult men

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L-arginine can decrease blood pressure by increasing the bioavailability of nitric oxide, an endothelial-derived potent vasodilator. L-citrulline is highly concentrated in watermelon, and effectively converts into L-arginine. Although some studies have demonstrated the differential effects of watermelon supplementation on blood pressure, no study has explored the acute effects of watermelon consumption on blood pressure. This study aimed to determine the effect of watermelon juice supplementation (WJS) on postprandial blood pressure over 3 h in pre-hypertensive adult men. A single-blind, randomized, crossover, placebo-controlled postprandial study was conducted in 10 pre-hypertensive adult men (mean ± SEM: ages 44 ± 3 years; mean ± SEM body mass index (in kg/m2): 26.7 ± 0.5 in kg/m2). After fasting overnight participants consumed 1 kg (~1000mL) of watermelon juice or a placebo drink consist of sucrose, glucose, and fructose at 0 min on separate two occasions. Blood pressure and finger prick blood samples were collected before and regularly after the drinks for 180 minutes. A significant test drink*time interaction with decreasing trend in systolic blood pressure and pulse pressure were observed after WJS compared to placebo drink ($P = 0.009$). The incremental area under the curve (iAUC) for systolic blood pressure was lower after the WJS than after the placebo drink (mean ± SEM: −6.6 ± 4.1 compared with −3.1 ± 3.4 mm Hg x 180 min x 102), with a similar trend for pulse pressure. No significant effects of WJS were observed for postprandial diastolic blood pressure, and glucose. In conclusion, watermelon was shown to have differential effects on postprandial change in systolic blood pressure.

Keywords: acute, diastolic blood pressure, postprandial, pulse pressure, randomized crossover placebo-controlled, systolic blood pressure

Antifungal effect of aloe vera (*Aloe barbadendis*) enriched papaya leaf extract in controlling anthracnose and post-harvest quality of papaya

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Anthracnose contributes to a huge post-harvest loss of papaya. As the currently used chemical fungicides have side effects, this experiment was performed to assess the anti-fungal effectiveness of bio-fungicide developed by Aloe vera and papaya leaf extract to control papaya Anthracnose and physiochemical attributes. First, the isolation of *Colletotrichum gleosporioides* was done using morphological characters. Agar-well diffusion assay was used to test the anti-fungal effect of treatments. Ten different treatment combinations were developed from Aloe vera (AV) and papaya leaf (Tainung) extract (PLE) and were applied in an agar well diffusion assay to determine their antifungal effects. *In vivo* studies were conducted with the best treatments selected from the agar-well diffusion assay using the 'Tainung' papaya variety at 25% maturity. *In vivo* effects of treatments were determined by the disease-incidence and the physicochemical properties at 2 days intervals for 8 days at ambient temperature. The isolated fungi demonstrated greyish white colour mycelia and dark setae and it was identified as *C. gleosporioides* based on the published fungal key by Barnett and Hunter. The treatments, AV (60%): PLE (40%), AV (55%): PLE (45%), AV (70%): PLE (30%) resulted 28mm, 25mm, 22mm inhibition zone diameters respectively while others resulted no inhibition. *In vivo* studies conducted using AV (60%): PLE (40%) and AV (55%): PLE (45%), extended the shelf-life of papaya by 3 days compared to control and had a significant effect ($p < 0.05$) on physicochemical attributes. The mean pH, titrable acidity, total soluble solid, Hunter L*, a*, Chroma values in fruits treated with AV (60%):PLE(40%) resulted 5.28, 0.21%, 8.01° Brix, 40.78, -0.58, 35.57 respectively, while (55%):PLE(45%) resulted5.20, 0.19%, 8.83° Brix, 42.53,-8.18,33.71.However, control fruits resulted in significantly higher values for pH, total soluble solid, Hunter L*, a*, Chroma while lower value for titrable acidity. The results revealed that aloe vera enriched papaya leaf extract can be used to control Anthracnose and to maintain the physicochemical properties of papaya.

Keywords: *Colletotrichum gleosporioides*, disease index, inhibition zone

Geographical variation of polyphenols, volatile aroma compounds and haze level present in instant tea powder produced using broken mixed fannings

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Refuse tea, industrially recognized as Broken Mixed Fannings (BMF) is the most economical raw material that can be used to manufacture instant black tea powder (IBT). The commercial interest lies in determining the ideal geographical regions to source BMF to produce IBT with the desired quality. This study aimed to determine the effect of tea growing elevation and rainfall on quality parameters of BMF and IBT. IBT was prepared from BMF obtained from eight tea estates from the three growing elevation categories in Sri Lanka; high grown (>600m) (HG), mid grown (300-600m) (MG) and low grown (0-300m) (LG). Total polyphenol content (TPC) in both IBT and BMF in HG regions was significantly higher ($P<0.05$) than MG and LG regions. TPC of IBT was approximately 1.5 times greater than that of BMF. The Haze value of IBT from the HG region was also significantly higher than that of MG and LG regions. Linear regression analysis showed significant negative correlations between the rainfall and TPC of BMF ($P<0.05$, $r = -0.60$), rainfall and TPC of IBT ($P<0.05$, $r = -0.67$) and rainfall and haze value ($P<0.05$, $r = -0.85$). Analysis of the aroma profile by HS-SPME/GC-MS revealed that 100 to 200 aroma compounds are present in the headspace of each IBT and BMF samples and no region-specific variation between elevations was detected. Major aroma compounds; Z-3 hexenol, linalool, geraniol and benzenacetaldehyde present in Ceylon black tea were detected in BMF, but only a select few; benzenacetaldehyde, 2-phenylethanol and linalool oxide remained in IBT powder. Polyphenols are precursors that produce haze in black tea and a significant positive correlation ($P<0.05$, $r= 0.77$) was found between TPC and haze in IBT. Aroma profile analysis showed that important volatiles; Z-3 hexenol, linalool, geraniol in tea has been lost due to evaporation and therefore possibilities exist to produce aroma condensates that resemble the aroma of Ceylon black tea as a byproduct when manufacturing IBT from BMF.

Keywords: aroma, elevation, haze, instant tea, polyphenols

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Perceptions of stakeholders of food system on nutrition sensitive agriculture

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The food system includes food environment, food supply chain and consumer behaviors that influence the nutrition and health outcomes of the individuals. Making nutrition-sensitive food system is an effective approach to overcome nutrition issues in the country. The aim of this qualitative study was to identify the perceptions of farmers, consumers, food sellers and agriculture officers (Provincial Directors of Agriculture, and Agriculture Instructors) on nutrition sensitive food system. Focus group discussions were conducted with farmer groups (crop, livestock and aquaculture) and consumers while individual interviews were carried out with food sellers and agriculture officers. The respondents were purposively selected from Anuradhapura, Kurunegala, Jaffna and Nuwara Eliya districts. Most of farmers used to follow profit-oriented farming while giving less attention for the nutritional value in the crop selection and of the harvest. Crop farmers understood 'safe food' as 'nutritious food'. Almost all the crop and aquaculture farmers consumed their harvest at their households whereas only a few of dairy farmers consumed milk that they produced. The overall level of nutrition literacy among farmers and consumers was not satisfactory. Majority of the consumers and the sellers have given priority for the price and the 'quality' (safety) of the food and not the nutritive value of the foods. Consumers have given little attention on nutrition during meal preparation. Availability and accessibility of nutritious foods were low according to the perceptions of consumers. Agriculture officers perceived that there is a need of incorporating nutrition components in agriculture programs and interventions. They were confident enough about their knowledge, experiences and resources to conduct nutrition-sensitive programmes. However, they highlighted negative attitudes of the farmers to incorporate nutrition into agriculture as a barrier. In conclusion, this study showed that present food system is not adequately addressed the nutrition-related concepts and practices but there is a potential to introduce nutrition-sensitive approaches to the current farming practices.

Keywords: consumers, farmers, food system, nutrition-sensitive agriculture, sellers

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Development of gluten-free cracker using kithul (*Caryota urens*) flour and evaluation of its physico-chemical, sensory and functional properties

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The consumption and demand for gluten-free products have risen all over the world owing to an increased prevalence of gluten-related disorders such as celiac disease. This study was carried out to discover novel sources of starch and formulate a gluten-free product with nutritional and healthy benefits, and acceptable for consumers. Kithul (*Caryota urens*) flour is a better response for this requirement, because of its highest productivity and availability of underutilized Kithul palm. Therefore, physico-chemical, sensory and functional properties of native Kithul flour was evaluated and compared these properties with commercially available flour (wheat, rice, corn). Chemical parameters, morphological characteristics, viscosity and gelatinization properties were also evaluated to show its potential as a food ingredient for the food industry. Methanolic extracts of Kithul flour samples were analysed for bioactive contents and were evaluated for total antioxidant capacity, DPPH radical scavenging assay and alpha-amylase inhibition activity by using spectrophotometric methods. Sensory evaluation was conducted with 15 semi-trained panellists using 7-point hedonic scales to select the most acceptable flour blend for cracker preparation. The protein, fat, moisture, ash fiber and starch contents of the Kithul flour were 0.97%, 0.39%, 12.4%, 0.90% and 0.75% and 67.52%, respectively. Kithul flour starch contained 27.66% amylose and 72.34% amylopectin. When compared with other studied flour samples, Kithul flour has significantly higher amylose content. Three types of granular shapes as oval, spherical and irregular globular shapes were observed in Kithul flour. The results indicated that Kithul flour has significantly higher total phenolic (1.36 mg GAE/g) and total flavonoid (1.76 μg CE/g) compared with other commercial flour types. DPPH radical scavenging activity and the total antioxidant capacity of Kithul flour were significantly higher ($P < 0.05$) than tested commercial flour samples. A strong positive correlation was observed between total antioxidant capacity and total flavonoids ($R^2 = 0.673$) and total polyphenolics ($R^2 = 0.546$) contents of all flour varieties. It is revealed from the study that the Kithul flour has a moderate antioxidant property which may associate with its traditional health claims. In addition, Kithul flour exhibited 13.03% alpha-amylase inhibition activity. In conclusions, due to the physico-chemical, sensory and functional properties of Kithul flour, it could be as a potentially valuable food ingredient for the food industry

Keywords: antioxidant activity, bioactive constituents, functional properties, gluten-free

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Formulation of energy-dense functional snack with locally grown grains

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Ready to eat energy-dense and functional foods are in high demand in the new generation. The main aim of this study was to develop composite flour-based extruded snacks with locally grown grains; rice (red and white), maize, sorghum, black gram, green gram, and cowpea. Through the food base diary analysis, appropriate flour blends were taken to develop the snack. Proximate composition and physiochemical properties; texture, color, water activity, water absorption index, water solubility index, swelling index and radial expansion analyzed to determine the quality of the snack. The self-life of the snack was determined by water activity and yeast and mold count. Sensory evaluation was conducted with 30 semi-trained panelists using a 9-point hedonic scale. Appearance, color, odor, taste, mouthfeel, consistency, crunchiness and overall acceptability were evaluated to determine the acceptability of the product. Statistical analysis was carried out through the MINITAB-15 version at 0.05 significant levels. The significance of mean differences for sensory analysis was determined by the Friedman test. The significantly highest overall acceptability was observed for an extruded snack with red rice flour than white rice flour. Color attributes; a*, b*and L* of red and white snacks were 9.72 ± 0.81 and 5.20 ± 0.06, 28.12 ± 1.08 and 26.59 ± 0.13, 55.26 ± 2.79 and 63.22 ± 1.07 respectively. The water activity of the snacks was ranged between 0.31-0.37, and there was no yeast and mold growth observed during the one-month of storage under vacuum. The energy value of red and white rice four used products were 385.82kcal and 392.10kcal while protein contents were 12.45 ± 0.20 and 9.20 ± 0.25 respectively. The respective phenolic compound and DPPH scavenging activity for red and white extruded snacks were 39.25 ± 0.35mg GAE/g, 45.50 ± 0.70mg GAE/g, and 767.6, 419.3μg/g. Results conclude that the incorporation of six grains to the extruded snack providing more energy and protein as well as act as a functional food.

Keywords: composite flour, extruded snack, legumes, physiochemical, radial expansion

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Effect of extraction solvent and technique on the antioxidant and anti-diabetic activity of thebu (*Costus speciosus* (J. Koenig)) rhizome

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Costus speciosus has long been used in traditional systems of medicine. The plant has been found to possess a diverse number of pharmacological activities. The therapeutic activity of bioactive compounds of plant material may vary with extraction conditions and determine its possible food applications. This work was compared the antioxidant and antidiabetic activity of *C. speciosus* rhizomes that prepared as water, methanol and ethanol extracts via homogenization, sonication and maceration methods to determine its suitable food application. Water, methanol; 99%, 95%, 90%, 80%, 50% and ethanol; 95%, 90%, 80%, 50% extracts of rhizomes were tested for DPPH radical scavenging activity, total antioxidant capacity (TAC) and alpha-amylase inhibitory activity. All the rhizome extracts were capable of scavenging DPPH radicals. Pure (99%) and 95% methanol extracts via maceration showed the highest significant ($p < 0.05$) percentage inhibition of DPPH radical which were $71.50 \pm 0.87\%$ and $73.11 \pm 0.65\%$ respectively. The highest TAC was observed in pure and 95% methanol extracts via maceration as 7.46 ± 0.30 and 7.36 ± 0.06 mg Ascorbic Acid Equivalents (AAE)/g dry weight respectively. Pure methanol extract via maceration ($82.97 \pm 0.11\%$) showed the highest alpha-amylase inhibitory activity followed by 95% methanol extract via maceration ($76.17 \pm 0.14\%$) and pure methanol extract via homogenization method ($76.71 \pm 0.24\%$). The results revealed that the amount of the bioactive compounds that can be extracted from the plant material were mainly affected by the vigor of the extraction procedure and efficiency of the extracting solvent as rhizome extracts prepared using methanol and maceration showed significantly higher results. However, water extract prepared from maceration showed a considerable DPPH radical inhibition ($41.49 \pm 0.88\%$), TAC (2.45 ± 0.22 mg Ascorbic Acid Equivalents (AAE)/ g dry weight) and alpha-amylase inhibitory activity ($9.34 \pm 0.46\%$). Hence, bioactive compounds extracted from *C. speciosus* rhizome with water via maceration would be suitable to use indirect food applications to treat diabetes mellitus.

Keywords: alpha-amylase inhibition, *Costus speciosus*, diabetes mellitus, DPPH radical scavenging, total antioxidant capacity

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Relationship between vitamin D status and muscle function in elderly

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Vitamin D plays a role in muscle function through genomic and non-genomic processes. Some studies showed that adequate vitamin D status has a beneficial effect on muscle function while some are not. The aim of this study was to determine the relationship between vitamin D status and muscle function in elderly. This cross-sectional study included 152 community-dwelling elderly men (n = 73) and women (n = 79) aged 65 years or above. Data on socio-demographic, health, sun exposure, muscle function, Physical Activity Level (PAL) and anthropometric measurement were collected via an online questionnaire completed by the participants. Muscle function was assessed using Upper Limb Short Questionnaire (ULSQ), 30 seconds Chair Stand Test (30s CST) and Timed Up and Go Test (TUGT). International Physical Activity Questionnaire (IPAQ) was used to assess the PAL. Sun exposure questionnaire (SEQ) was used to determine the Sun Exposure Score (SES), which was used as an indicator for vitamin D status. Mean ULSQ score, TUGT score (seconds) and 30s CST score were 4.8 ± 3.6 (range 0-14), 27.6 ± 17.1 (range 7-90 seconds) and 6.8 ± 4.3 (range 2-19) respectively. Female participants had significantly higher mean ULSQ score ($p = 0.004$) and TUGT score ($P = 0.037$) compared to male participants. However female participants had significantly lower mean 30s CST score compared to male participants ($P < 0.001$). Muscle function was negatively correlated with age ($r = -0.424$, $P < 0.001$) and positively correlated with PAL ($r = 0.205$, $P = 0.011$). There was no significant correlation between SES with ULSQ score ($r = -0.018$, $P = 0.830$), TUGT ($r = 0.084$, $P = 0.309$) and 30s CST ($r = -0.086$, $P = 0.300$) after adjusting for age, gender, BMI and PAL. In conclusion, there was no significant correlation between estimated vitamin D status and muscle function in elderly.

Keywords: muscle function tests, sun exposure, vitamin D status

Investigating the effects of organic fertilizers and inorganic fertilizers on potato yield

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There is a dilemma in the field of food safety, due to the risk associated with the usage of inorganic fertilizers. This usage has led to the problem of up taking and accumulating chemical residuals in the root crops such as potato. Therefore, it is important to know whether inorganic fertilizers can be replaced by more organic fertilizers and/or novel fertilizers without affecting the potato yield. Therefore, throughout the study, we have attempted to produce practical insights and address the research question "How the types of fertilizers impact the potato yield". Further, the usage of novel potato fertilizers and the negative impacts from the usage of inorganic fertilizers were investigated through the field survey and research findings by the researchers. The potato farmers in Nuwara Eliya and Badulla districts were the target population and forty respondents were interviewed from each district. The data were analyzed by the Pearson correlation test. In conclusion, the results convey that there is a direct relationship between the usage of organic fertilizers and potato yield while there is an inverse relationship between the usage of inorganic fertilizers and potato yield. The potato farmers who used a high percentage of organic fertilizers have practiced "Rice and potato-based cropping system" and therefore the requirement of inorganic fertilizers has been reduced. "Potato towers" which use more organic fertilizers is a hot topic among researchers in Sri Lanka. According to the research findings, though there are many novel fertilizer types, none of the Sri Lankan farmers were used novel fertilizers for potato cultivation.

Keywords: fertilizer types, food safety, novel fertilizers

Knowledge, attitudes and behaviour on whole-grain cereals and pulses consumption; online survey

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Promoting healthy diets among general public is a necessity to mitigate the increasing prevalence rates of diet related diseases in Sri Lanka. Whole grain cereals (WGC) and pulses are pivotal components of healthy diets. A cross-sectional study to evaluate knowledge, attitudes and behaviour (KAB) levels was conducted. Furthermore, the associations between socio-demographic factors and KAB and gaps in knowledge, poor behaviour and attitudes related to WGC and pulses consumption were also determined. The study was conducted among female adults living in Sri Lanka who had access to internet facility. A self-administered online questionnaire was developed, pretested, and used for data collection. Data (n = 416) were analysed using SPSS and AMOS. Results indicated that majority of females had regular knowledge, good attitudes and poor behaviour on WGC and pulses consumption. Lack of knowledge on specific health benefits, inability to distinguish between whole grains and refined cereals, unavailability and poor knowledge on cereal-pulse composited dishes, unacceptable organoleptic properties, longer preparation times, similar tastes and recipes, low availability, high cost and unacceptability of family members were major barriers regarding consumption. Significant correlations ($P < 0.05$) were obtained between total KAB scores of pulses and WGC. Income significantly correlated with total KAB, knowledge, and attitudes on WGC. Education significantly correlated with total KAB on WGC, total KAB on pulses, knowledge of WGC and pulses, and with attitude on WGC and pulses. Province of residence significantly correlated with behaviour on WGC. Ethnicity significantly correlated with attitudes on WGC. Knowledge and behaviour on WGC, attitude and behaviour on WGC and attitude and knowledge on pulses significantly correlated with each other. Thus, addressing the issues through pricing strategies, providing education on specific health benefits and identification, and making related products more available is required to uplift WGC and pulses consumption among Sri Lankans.

Keywords: female adults, socio demographic factors, Sri Lanka

Development of education materials for self-management of type 2 diabetes mellitus

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Lifestyle modification is the key to diabetes management. Self-management education ensures sustainable lifestyle modification important for diabetes management. Therefore, the present study aimed to develop educational materials for the self-management of type 2 diabetes. A diabetes report card, diabetes cookbook, and a video clip promoting the physical activities were developed as education materials. Types of materials & content of the materials were developed based on previous studies and national importance. Content, illustrations, and visuals were designed using MS Word, Photoshop, and Sony Vegas Pro video creation application. The drafts of education materials were reviewed by a panel of health care professionals and patients in the validation phase. Developed materials were perceived as user-friendly, well designed, highly attractive, and interactive by the health care professionals. Contents were further improved using the comments and suggestions received from professionals. Patients' views were considered in improving the readability and understandability of the contents. These materials were characterized by simple and specific messages, providing tips for dietary and lifestyle changes, and appropriate illustrations and visuals to increase the understanding. The revised materials are self-explanatory and interactive hence, can be used by a diabetic patient with a low literacy level. These materials also can be used widely in nutrition education at public health clinics. These findings may contribute to improving education methodology and nutrition therapy in patients with type 2 diabetes. Further, the effect of the developed materials needed to be evaluated by a clinical study.

Keywords: diabetes-management, educational tools, nutrition

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Malabar spinach (*Basella alba)* seed gum as a natural source of edible gum: extraction and it's physicochemical properties

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Spinach (*Basella alba*) is a green leafy vegetable widely grown in Sri Lanka. In the food industry commercially available plant gums are used as gelling agents and stabilizers. In Sri Lanka, most of them are imported and therefore, it is a necessity to look for alternatives. As a substitution, spinach seed gum was scrutinized in the current study to get a better insight regarding this important polysaccharide. It is a non-exudate gum obtained from a hot water extraction process using sun-dried spinach seeds. Extracted mucilage of spinach analyzed for its proximate composition and other physicochemical parameters Extractable mucilage content from seeds was 5.63 ± 0.63% DW. The presence of the mucilage, reducing sugars and starch was indicated by Ruthenium red reagent, Molish's test and Iodine test respectively. Solubility, water holding capacity (WHC), oil holding capacity (OHC), antioxidant activity, stability and the sensory properties of the extracted gum were evaluated and compared with commercial gum/gelatin. The solubility of the isolated gum was $21.07 \pm 0.55\%$. WHC and OHC of the extracted gum were $112.00 \pm 11.75\%$ and $76.26 \pm 8.40\%$ respectively and these properties were significantly different ($P < 0.05$) from that of Xanthan gum. Spinach seed gum has shown a scavenging capacity similar to xanthan gum suggesting it can enhance the antioxidant capacity in the food matrix. The effect of extracted gum as a stabilizer was evaluated in yoghurt and was compared with the commercial xanthan gum. Changes in pH and the occurrence of syneresis were recorded in yoghurt for two weeks. Results revealed that studied edible gums are differently functionalized in yogurts ($P < 0.05$) and the incorporation of 0.5% spinach seed gum resulted in the minimum syneresis. Results of the sensory evaluation proved that there were no significant differences ($P > 0.05$) between spinach seed gum incorporated yoghurt and the gelatin added yoghurt indicating that the sensory attributes have not been altered by comprising extracted seed gum as a stabilizer. Overall, when compared to commercial hydrocolloids such as xanthan, extracted spinach seed gum could be potentially applicable for the food industry as a cheap and eco-friendly stabilizer.

Keywords: edible gum, malabar spinach, mucilage, swelling index, syneresis

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Development of food regulatory recommendations for the new draft Sri Lanka standards on processed grain-based food products.

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This research study was undertaken to assess the compliance of the processed grain-based products, currently available in the Sri Lankan food market, under the categories of Multi-Grain products, Corn Flakes, Rice Flakes and Rolled Oats, with the specifications in the draft Sri Lanka standards. The viewpoint of the study deals with the industrial feasibility of the draft standards, as well as the harmonization level with the other relevant national and international standards & regulations. Thus, it is aimed to develop Food regulatory recommendations to minimize the negative impacts of the standard specifications on the food industry, while ensuring the quality and safety of the products and expanding provisions for future research &development. In this study, regularly consumed market products in Sri Lanka under each evaluated category were analyzed, and the industrial feasibility of the draft standard specifications was determined. Moreover, those specifications were evaluated against the other relevant regulations and standards. Improvement points of the definitions were identified and additional ingredients that should be included were suggested along with the justifications. 74.3% of multigrain products and 62.5% of the corn flakes products were not in compliance with the list of ingredients, while other products complied. The moisture content of 93.3% of multigrain products, 71.4% of corn flakes complied and all the rice flakes were not in compliance. Acid insoluble ash was not detected in any of the products. 30% of the corn flakes products were not in compliance with the recommended protein limits, while all other products complied. The microbiological properties of all products complied. There were significant differences in limits for contaminants in draft standards when compared to other legal frameworks, and draft standards were more product-specific. Consequently, it is concluded that the evaluated draft Sri Lankan standards require further amendments before finalizing, mainly to ensure safety and industrially feasibility.

Keywords: harmonization, industrial feasibility, processed-grains, regulations, standards

Association of coconut fat intake and blood pressure in adult men

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Coconut fat which is the major source of dietary fat in the habitual Sri Lankan diet, is rich in saturated fatty acids (SFA) and most of SFAs are medium chain fatty acids. High intake of SFA is associated with increased blood pressure, as well as medium chain fatty acids have a beneficial effect on blood pressure. The association between coconut fat intake and blood pressure needs addressing. This study was performed as a cross sectional study to examine the association between habitual coconut fat intake and blood pressure among healthy male adults (age 30-60 years) in coconut growing areas. Body weight, height, waist circumference, hip circumference, and blood pressure measurements were taken. A three-day dietary diary (2 weekdays and 1 weekend day) was used to assess habitual dietary intake. An interviewer administered record sheet was used to assess the coconut fat consumption of the participants. Based on the recommended daily total fat intake subjects were categorized into three groups. Means of anthropometric, clinical measurements, and nutrient intake were compared between groups. Mean daily energy intake of subjects was (mean ± SD) 2040 ± 508 kcal/d. Mean macronutrient intake (percentage of energy) of subjects were (mean ± SD); 349 ± 82g (65%), 56 ± 20g (24%) and 57.5 ± 18g (11%) for carbohydrate, fat and protein, respectively. Percentage of energy from SFA was 16.5. The average household consumption of coconut was 1.7 coconut per day. The mean coconut fat intake was 45.0 ± 20.8 (88.6% of fat comes from coconut Fat). Mean intake of coconut milk, coconut oil, and scraped coconut were (mean ± SD); 34 ± 18, 6 ± 5, and 4 ± 3, respectively. The mean systolic and diastolic blood pressure was 127 ± 14 and 77 ± 11, respectively. The correlation coefficients between coconut fat intake and systolic and diastolic blood pressure were 0.005 (P=0.965) and 0.015 (P=0.884), respectively. In conclusion, there was no association between coconut fat intake and blood pressure among adult men.

Keywords: blood pressure, cross sectional, coconut fat, saturated fat

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Vitamin D intake of elderly through diet and supplements

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Elderly people are at risk of vitamin D deficiency as a result low cutaneous synthesis and poor absorption in the intestine with aging. Vitamin D is important for the elderly to prevent cognitive impairments, musculoskeletal and immunity-related disorders and other chronic diseases. Limited studies have been conducted in Sri Lanka to determine the vitamin D intake of elders. The aim of this study was to determine the vitamin D intake of Sri Lankan elders through diet and supplements. In addition, this study aimed to identify the factors associated with vitamin D intake and to identify the main food groups contributed to the dietary vitamin D intake of elderly. This is a cross-sectional study of 99 community-dwelling elders. Dietary intake was assessed using semi-quantitative FFQ while socioeconomic, demographic and health related data were gathered using Google form. FFQs were analyzed using FoodBase 2000 software to quantify the dietary vitamin D intake. Mean vitamin D intake of elders from diet and supplements were 3.53 ± 2.55 and 11.25 ± 1.56 μg/day, respectively. Mean total vitamin D intake of the participants was $7.39 \pm 5.45 \mu$g/day. The main sources of dietary vitamin D were fish (22%), meat and meat products (20%), dairy products (19%) and seafoods (17%). Vitamin D intake was significantly higher in male participants compared to female participants ($P = 0.016$). Vitamin D intake was not associated with age, ethnicity, occupation, health status, family income level and education level. Only 4 vitamin D fortified food items (biscuits, fat-spread, milk-powder and breakfast-cereals) were commonly consumed by the participants. Only 12% of the participants used vitamin D supplements and most of the supplements were multivitamins. In conclusion, dietary and supplemental vitamin D intake of elderly people was $7.39 \pm 5.45 \mu$g/day. Fish, milk and dairy products and meat were the main food groups contributed to the vitamin D intake of elderly.

Keywords: dietary vitamin D, food groups, vitamin D fortified foods

Chemical composition of industrially wasted black pepper oil and its usage in developing a mayonnaise dressing

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Black Pepper *(Piper nigrum)* oil has antioxidant, anti-inflammatory, antispasmodic, antifungal, anti-rancid properties. In food industries, important fractions of pepper are removed as by-products. This study was conducted on compounds in industrial wasted pepper oil in comparison with the pepper oil extracted under the laboratory conditions. A dried black pepper sample was used to extract pepper oil in industry and laboratory conditions. The average extraction range was 1.5-2.6% and 2.3-3.5% under laboratory and industrial conditions respectively. Analysis of the chemical profile was conducted using Gas chromatography-mass spectrophotometry (GC-MS). The results revealed that major compounds present in pepper oil extracted under laboratory conditions were not present in the oil extracted under industrial conditions. The total detectable compounds were high in pepper oil extracted under laboratory conditions. Subsequently, different concentration of pepper oil (industrial waste) was incorporated into homemade series of mayonnaise series (M_1-0.8% .M_2-1.66% .M_3-3.3% .M_4-5%) and sensory evaluation studies conducted with 25 untrained panellists revealed that the Mayonnaise sample incorporated with M2 attained the highest rank. According to the 2, 2-diphenyl-1- picrylhydrazyl assay (DPPH) the antioxidant capacity of lab extracted oil sample (IC_{50} - 32.87 ± 0.53mg/mL) is higher than the antioxidant capacity of industrial waste sample (IC_{50} - 34.11 ± 0.46mg/mL).The colour and the pH of the treated, commercial and control mayonnaise samples were measured during refrigerated (4°C) storage conditions for 03 months. The L*, a* and b* values of the treated mayonnaise were 83.06 ± 0.242, $-2.98 \pm 0.623$and $+17.20 \pm 0.238$ respectively and for commercial mayonnaise 86.50 ± 0.261, -5.10 ± 0.419 and $+23.76 \pm 0.229$, respectively. The initial pH values of the treated and commercial mayonnaise were 3.71 and 3.54, respectively. There was no significant change in p^H or colour during storage. The microbial count was tested with the time and there was no significant increase of total plate count throughout 3-month storage time, but the control sample was deteriorated with microbial activity. The results revealed that black pepper oil is efficient in controlling the growth of food spoilage microorganisms. Antioxidants in oil prevented the oxidation of mayonnaise and extended shelf life of mayonnaise.

Keywords: antimicrobial activity, antioxidant capacity, pepper oil

Dietary intake pattern and problem nutrients of preschool children's diet in Sri Lanka

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Understanding the current dietary patterns and nutrients deficient in the diet are important in planning interventions and recommending food based dietary guidelines for populations. The understanding of the deficient nutrients associated with the current dietary patterns of preschool age children are lacking in Sri Lanka. This analysis was conducted to identify the food consumption pattern of preschool children (2-5 years) and specific "problem nutrients" on their habitual diets. Problem nutrients are the nutrients, which are inadequately taken through habitual diets by a specific population. Dietary data were obtained from one thousand 24-hour dietary recalls collected for a previous study conducted in Sri Lanka during 2015-2017 in urban, rural and estate sectors. Secondary data was analyzed using Optifood Linear Program for Absolute Problem Nutrients (APN; nutrient which is not achieved 100% RNI even with RNI maximized diet) and Partial Problem Nutrients (PPN; a nutrient, which is achieved <70% RNI in RNI minimized diets and >100% RNI in RNI maximized diets). Gathered data was analyzed using Optifood Linear Program. The software was updated by compiling latest plant-based food composition data of 139 Sri Lankan food items, chemically analyzed and published between 2015-2020 following. The standards and guidelines provided by International Network of Food Data Systems (INFOODS). Study population consumed 98 food items which belong to 40 food subgroups and 16 food groups. The mean dietary intake data showed that protein, vitamin B6, vitamin B12 nutrients were adequately consumed (>RNI) and energy, fat, Calcium, Iron, Zinc, thiamine, riboflavin, niacin, folate, vitamin C and vitamin A were not adequately consumed (<RNI) by preschool children. Rice (white), fish, dhal, potato, coconut sambol, tea, sugar, milk powder and biscuits were the commonly consumed food items of the study population. Calcium, Iron, Zinc, thiamine, riboflavin, niacin, vitamin A were identified as the APN-s and vitamin C, vitamin B6 and folate were identified as the PPN-s of current diet of preschool children.

Keywords: absolute problem nutrients, food composition data, optifood linear program, partial problem nutrients

Teachers' and parents' perceptions of secondary school food and nutrition education and school food environment

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Food and nutrition education at secondary schools can provide long-term benefits to adolescents and is influenced by the school food environment. This qualitative study aimed to examine the current status of secondary school food and nutrition education and school food environment. The objectives were to explore teachers' and parents' perceptions about secondary school food and nutrition education, and school food environment. The data was collected through focus group discussions (n = 11), from teachers (n = 96) and parents (n = 99) separately, selected through maximum variation sampling technique at secondary schools in Jaffna. The recorded discussions were transcribed and analysed using the Nvivo 12 software after establishing question-based themes. The findings show that almost all participants accepted the importance of food and nutrition education at secondary schools. Most of the students depend on homemade foods and canteens while others depend on foods from bakery, and vendors from where they choose unhealthy meals during school hours. Students' food practices are influenced by schools, peers, parents, westernized culture, attractive unhealthy foods, mass media, and social media. Gardening, instructions by public health inspectors and teachers, health clubs, exhibitions, school food markets, awareness programmes, and food-related competitions are the different ways of receiving food and nutrition information by the students. The participants suggested conducting awareness programmes and seminars, promoting school gardens and healthy foods at canteens, implementing a meal timetable, and introducing food and nutrition as an individual subject as strategies for improving the school food environment. Overall study concluded that food and nutrition education supported by several activities at secondary schools, in which seminars, instructions by teachers, and exhibitions are considered as the most important approaches while both teachers and parents perceived that school food environment lead children to practise favourable as well as some unfavourable food behaviours.

Keywords: adolescents, focus group discussion, food-related practices, school food environment

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Aloe vera (*Aloe barbadensis*) incorporated rice-coconut fermented milk beverage with desired food quality

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Health organizations are increasingly promoting the beneficial effects of food with added live microbes (probiotics) on human health. Today probiotic products available in the markets are typically in the form of fermented milk and yogurts; however, there is also demand for vegetarian probiotic products with an increase in consumer vegetarianism across developing countries. The present study was carried out to develop an Aloe Vera (*Aloe barbadensis* Millar) incorporated rice-coconut fermented milk beverage. In the development of fermented beverages, cereals (rice), nuts (coconut), and herbals (aloe vera) were used due to compatibility and their nutritional and medicinal properties. The current study investigated the possibility of developing novel rice- coconut fermented milk beverage incorporated with Aloe vera at different levels (10%, 20%, and 30%) for commercialization and to evaluate its sensory, nutritional, physicochemical, functional and microbial quality parameters. This study also investigated the capacity of rice-coconut milk for the development of *Lactobacillus acidophilus, Lactobacillus bulgaricus, and Streptococcus thermophilus* inoculated probiotic beverage (PB). The organoleptic properties such as appearance, flavor, aroma, texture, overall taste, and overall acceptability were studied and consumer acceptance was observed. Aloe incorporated rice- coconut fermented milk beverage, which was acceptable to consumers formulated with 72% (v/v) coconut milk, 18% (v/v) rice milk, 10% (v/v) aloe pulp, 8% (w/v) sugar, and with the pH of 4.5. It consisted of 0.71% (WB) of ash content, 2.59 % (WB) of crude protein, 5.22% (WB) crude fat, 8.13% (WB) of total carbohydrate,0.432 (mg GAE/g WB) total phenolic content, 0.224 (mg/mL WB) and it showed good overall acceptability, physiochemical quality, microbial quality, antioxidant activity and shelf life of 14 days without any quality deterioration. The product was acceptable for commercialization in terms of consumer preference and cost.

Keywords: fermentation, healthy beverage, probiotic, vegetarian, yogurt

Role of dietary protein in the sarcopenia of older adults

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Sarcopenia refers to a geriatric syndrome characterized by age-related loss of muscle mass, muscle strength and physical performance. Sarcopenia includes several consensus definitions with different cutoffs and assessing methodologies. Protein intake is positively associated with preservation of muscle mass in the older adults. A community based cross-sectional study was conducted in Kurunegala district with a sample of 152 older adults aged over 65 years to determine the prevalence of sarcopenia, dietary protein intake and dietary diversity of older adults. Height, weight, waist circumference, hip circumference, mid-upper arm circumference, calf circumference and body composition measurements were taken. Sarcopenia is defined as an age-related decline in skeletal muscle mass, with lower muscular strength or low physical performance. Hand-grip muscle strength of prominent hand, 4-meter usual phase gait speed and muscle mass were used to assess the sarcopenia. A single 24-hour dietary recall with multiple pass approach was used to assess dietary intake and diversity of the participants. Prevalence of sarcopenia in the study population was 19.7% with higher prevalence in females (22.4%) over males (17.1%). Mean protein intake of the study population was 29 ± 12g. Mean dietary diversity score of the population was mean ± SD; 7 ± 1.2 out of 12 food groups considered. Majority (94%) of the study population did not meet the recommended daily protein intake. There was a significant positive moderate association of hand-grip muscle strength ($r = 0.47$, $P = 0.0001$) and gait speed ($r = 0.38$, $P = 0.0001$) with dietary protein intake. The odds ratio of sarcopenia with dietary protein intake was 0.92 (95% CI 0.87-0.96, $P = 0.001$). In conclusion, increased dietary protein intake may have favourable effects on sarcopenia of ageing.

Keywords: gait speed, hand-grip muscle strength, lean mass, older adults, protein intake, sarcopenia

Development of a dietary strategic tool for weight management of overweight and obese adults

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Dietary strategy is recommended as a component of weight management. However, available information on dietary strategy for weight management of overweight and obese adults is scanty in Sri Lanka. Hence, the objective of this study was to develop a dietary strategic tool (Booklet) for weight management of overweight and obese adults. This study was conducted under the three phases; collecting dietary-strategy for weight management from reviewing the literature and conducting a preliminary survey; content development on dietary strategy with menus and validation of the content; the development of the booklet and evaluating the effectiveness of the booklet. A total of 50 adults whose Body Mass Index (BMI) ≥ 23 kgm^{-2} and who were willing to provide information was recruited as a study sample. A pre-tested interviewer-administrator questionnaire, a 24-hour dietary recall, food-frequency questionnaire and observations of commonly available foods were used as data collection tools. Eight whole-day meal planning including breakfast, lunch, dinner and two snacks, energy ranged 1200 to 1900 kcal/day were prepared incorporating available low-energy dense foods for overweight and obese adults. Nutrient compositions of developed menus were determined by using Foodbase 2000 software. The planned menus were compiled into a booklet with showing photographs of serving sizes. Content validity of the booklet was done by three experts in Nutrition. Among the total 90% had home-garden and 78% consumed fruits and vegetables from home-garden. Mean daily energy intake of overweight and obese adults were 1731.9 kcal/day and 1867.8 kcal/day respectively. The developed booklet consisted of information on "What is overweight and obesity?", "Causes" "Health consequences", "Tips for preventing overweight and obesity" and "Menus". Five overweight and three obese adults confirmed the understandability, easiness of reading and adequacy of serving sizes of menus. The developed dietary strategic tool (Booklet) may be a useful guide for weight management of overweight and obese adults in Sri Lanka.

Keywords: booklet, dietary patterns, low-energy dense, menus

Study of the energy and macro nutrient composition of common take-away dinner meals in Sri Lanka

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The nutritional quality of take-away meals has become increasingly important in determining the overall nutritional quality of diets. Much evidence has demonstrated that consumption of unhealthy food is associated with many diet-related non-communicable diseases. The consumer has less control and less knowledge of the nutrient composition of foods that are not prepared at home. Not much research has been conducted on take-away dinner consumption patterns and the nutrition quality of the meals in Sri Lanka. Aim of this study was to identify the energy content and the macronutrient composition of common takeaway dinner meals in Sri Lanka. This study was conducted by selecting a convenience sample of food outlets. Ten commonly consumed complete dinner meals that prepared at food outlets were selected. Information of standard recipes of selected meals in ingredient level was collected at the point of food preparation in food outlets and some of them were prepared in the Dietetic Laboratory, Department of Applied Nutrition, Wayamba University of Sri Lanka. Energy and macro-nutrient composition of recipes were calculated using the FoodBase 2000 software and other reliable food composition data. The energy given by analyzed meals was high (average = 998.51kcal per meal, range = 520.68 kcal and 1533.52 kcal per meal). The majority of meals provided more than 50% of the recommended average daily calorie requirement. The major energy source was carbohydrates for nine out of ten meals. All most all meals were given more than half of the recommended value for every macro nutrient (total carbohydrate, protein and total fat) per day just by dinner. In conclusion, the energy content and carbohydrate content were higher in common take-away dinner meals compared to the recommendation given by WHO relevant to the Sri Lankan population.

Keywords: dietary pattern, dinner outing, food composition tables, NCDs

Development of a guide on drug nutrient interactions for healthcare professionals

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Drug-nutrient interactions (DNIs) or food-drug interactions can cause different adverse effects on human health. Knowledge of such interactions is important to avoid their occurrence. This study aimed to improve the knowledge and awareness of healthcare professionals on DNIs by developing a guide booklet. As a first step of this study a preliminary survey was conducted among conveniently selected 10 healthcare professionals; doctors, dietitians, pharmacists and 10 adults to assess the knowledge and awareness of DNIs by using an interviewer administrative questionnaire. Potential DNIs were collected by reviewing the literature and drug related institutional publications in previous 15 years. Collected information on potential DNIs were presented in a tabular form under the different diseases. Their effects, possible prevention strategies and risk factors were also included in the tables. Along with DNIs mechanisms of drug-nutrient interactions, guidelines for counseling patients, medical nutrition therapy for medication side effects associated with nutritional status and micro nutrient food sources were also compiled as a coloured, pictorial, spiral bounded, A5 sized booklet. The booklet consists of 145 potential DNIs under 95 different drugs/drug categories. The majority of identified DNIs are for the drugs taken to cardiovascular diseases, gastrointestinal disorders and infectious diseases. The content of the guide booklet was validated by the healthcare professionals who are dealing with drugs, food and nutrients via an online evaluation questionnaire. The preliminary survey showed that 90% of healthcare professionals considered DNIs to manage such interactions, 70% of them had a "Good "level of knowledge of common DNIs while 16.6% had "Poor" knowledge. Further, 70% of adults heard DNIs while 50% of had been received advices on management of DNIs. The necessity of improving knowledge of healthcare professionals on DNIs may achieve through this developed simple, user-friendly and updated DNIs information having guide booklet.

Keywords: adverse effects, food-drug interactions, guide booklet, preliminary survey

Halloysite nanotubes and ZnO nanoparticles reinforced biopolymer nanocomposite for food packaging applications

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There has been a growing interest in developing novel food packaging materials to extend the shelf life of foods. In recent years significant attention has been devoted to bionanocomposites due to their high performance and biodegradable nature. Nanotechnology has the potential to generate novel food packaging materials with enhanced performances. Employing nanomaterial can improve properties such as mechanical strength, reduce weight, increase heat resistance and improve barrier properties. In this research, novel carboxymethyl cellulose (CMC)-based nanocomposite films containing halloysite nanotubes (HNT) (5% and 10% wt) and zinc oxide (ZnO) (5% wt) nanoparticles (NPs) were fabricated via solvent casting method as a potential biodegradable packaging material. The performances of the prepared nanocomposite packaging materials were studied by evaluating the moisture content, moisture uptake, water-solubility, water vapor barrier properties, opacity, mechanical and antimicrobial properties. In addition, prepared nanocomposite was characterized by Fourier-transform infrared spectroscopy, X-ray diffraction and scanning electron microscopy techniques. The incorporation of 5% wt HNT into the film remarkably reduced the moisture uptake by ~ 108%. In contrast, the addition of ZnO NPs increased moisture uptake. Nevertheless, it was observed that when ZnO NPs content is increased, moisture content was significantly reduced by 10% compared to the pristine CMC film. Consequent to the thermal annealing process, the water vapor permeability properties were drastically decreased in the HNT added nanocomposite films at three different conditions (freezing, refrigeration, ambient) due to enhance the crystalline structure. Furthermore, the addition of nanofillers into the polymer matrix significantly improved the mechanical properties. The addition of ZnO NPs induced the UV blocking property of the film which prevents photocatalytic reactions in foods. ZnO and HNTs showed a synergistic effect on bacterial growth inhibition. These findings revealed that prepared CMC/HNT/ZnO nanocomposite films can be a potential food packaging material.

Keywords: antibacterial activity, barrier properties, carboxy methylcellulose

Food Production and Technology Management

Effect of a cocktail enzyme on the nutritive value of coconut poonac and rice polish

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Plant origin feed ingredients are commonly used in poultry feed. Non-starch polysaccharides (NSPs) are the major component of plant cell walls that, reduce nutrient digestibility. Exogenous enzyme products have been widely used in commercial animal feed to break down the NSPs and improve the digestibility. In vitro approaches can be used to determine the effects of exogenous enzymes digestibility of poultry feed. The objective of this study was to determine the effects of an enzyme complex GALZYM-PPB and acidification on the nutrient digestibility of rice polish and coconut poonac. The enzyme complex GALZYM-PPB is composed of xylanase, protease, lipase, amylase, protease, pectinase and phytase. In the experiment, dietary treatments consisted of the control diet without enzyme supplementation, a diet supplemented with GALZYM-PPB at 350 g per ton (T1), a diet supplemented with ZACID 6000 acidifier at 3.0 kg per ton (T2) and a diet supplemented with both with GALZYM-PPB at 350 g per ton and ZACID 6000 acidifier at 3.0 kg per ton (T3). All the treatments were used to two tested ingredients with duplicates in each. Treated samples were filtered after 3 hrs of in-vitro digestion. After 6 hrs of filtration procedure crude protein, crude fat and gross energy were estimated using AOAC method. Based on that data digestibility of crude protein and crude fat was calculated. Data were subjected to ANOVA for a randomised complete block design (RCBD). Gross energy, digestibility of crude protein and crude fat were significantly different ($P < 0.05$) among the treatments. The highest value for digestibility of fat and the lowest value for gross energy in both tested ingredients were obtained with the combination of enzyme complex plus commercial acidifier mixture. In conclusion, the effects of enzyme complex addition of feed ingredients improved the nutrient digestibility, and it may vary, depending on the test ingredient.

Keywords: broiler, commercial acidifier, digestibility, enzymes

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Stomach contents analysis of *Neotrygon indica* captured along the east coast of Sri Lanka

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There is a growing interest in understanding the life history characteristics of elasmobranchs, which are vulnerable to overexploitation due to their low fecundity and late maturity. This study aims to understand the feeding ecology of *Neotrygon indica*, a common ray found in Sri Lankan waters, based on stomach content analysis. The diet of *Neotrygon indic*a is described using the index of relative importance (IRI). Samples (n = 36) were collected from the Pethalai landing site in Valaichchenai from February to September 2020 and were categorized into 4 size classes (under 19 cm, 20 – 29 cm, 30 – 39 cm, over 40 cm). Specimens were frozen at -20^{0}C till further analysis. After thawing for 12 hours, specimens were dissected to extract the stomach contents, which were then stored in a 10% formalin solution for further analysis. Standard measurements such as disc width, disc length, weight, and maturity status based on gonad development were also recorded. Stored stomach contents were filtered through a 1 mm sieve and food items were identified under a dissecting microscope. A total of 295 items were recovered from the stomachs of 36 rays. Prey items were identified and pooled into 3 taxonomic categories for analysis: annelids, crustaceans, and fishes. The percentage IRI was calculated for each category. Crustaceans had the highest IRI% with 59.81%, followed by Annelids with 37.05%. Fishes were the lowest at 0.19%. According to these results, crustaceans appear to be the primary diet of *N. indica*. This data can provide insights into the foraging grounds of these species and determine their trophic level within the ecosystem.

Keywords: diet, Eastern province, elasmobranchs, feeding ecology, rays

Value addition to fish processing offcuts: development of fishballs by using a natural preservative, Malabar tamarind (*Garcinia gummi-gutta*)

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A considerable amount of fish offcuts are generated in fish processing factories and those are used for low-valued products. These fish offcuts are good and safe for consumption when hygiene is given a high priority. This study aimed to develop Malabar tamarind (*Garcinia gummi-gutta* (L.) Roxb) paste (MTP), a good source of bioactive compounds, incorporated fishball using these processing offcuts. Fish samples collected from a fish processing plant in Ja-Ela and Negombo fish market were transported to the laboratory in ice. The total plate count (TPC) was tested for the flesh of two samples immediately after transporting. After conducting a series of preliminary trials, MTP was incorporated into the basic formulation of fishball at 2.5%, 5%, and 7.5% levels replacing 70% fish mince used for the control. The gel strength of fishballs was evaluated by using the folding test. The best formulation was selected through a sensory evaluation at a seven-point hedonic scale using thirty untrained panellists. The cooking yield, moisture, ash content, weight and diameter of fishballs were examined. Results for the TPC for raw flesh from Negombo fish market was 4.6x 10^4 CFU/g while TPC was not detected in the fish obtained from processing plants. The fishball developed with 2.5% MTP had the second preference and the control received the first preference. The folding test values of control and developed product were 4.17 and 3.50 respectively. The cooking yield of control and the developed product was 90.28% and 81.26% respectively. The higher moisture content in the new product and the control were 79.94% and of 70.33% respectively while the ash contents were 2.52% and 2.44% were in the new product and the control respectively. Further improvements on appearance, colour, texture and extension of shelf life should be conducted for MTP incorporated fishball.

Keywords: fishball, fish discards, *Garcinia gummi-gutta*

Isolation of *Escherichia coli* bacteriophages from meat and environmental samples

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Food borne pathogens are one of the major problems in the food industry. *Escherichia coli* is a food borne pathogen that can invade the human gastrointestinal tract and actuate disease with symptoms including abdominal cramping and haemorrhagic diarrhoea. Some *E. coli* strains cause severe food poisoning. Bacteriophages are a group of viruses that are host specific and usually only infect a single bacterial species. Therefore, bacteriophages can be used to control food borne pathogen, multidrug-resistant bacteria and have been identified as a potential alternative for antibiotics. Bacteriophages do not harm to the Eukaryotic cells and, unable to change the nutritional value and the organoleptic properties of foods. This research was conducted to isolate and characterise *E. coli* bacteriophages from environmental and meat offal samples. Firstly, the bacterial growth curve was prepared to identify the time spent to obtain the mid log phase of the bacteria. A total of twenty-five water and the meat offal samples were collected from different areas near the university premises. Next the samples were tested by following the spot plate method to identify the presence of bacteriophages. Then the isolated bacteriophages were enriched and purified. The purified bacteriophages were reassessed using the pour plate and spot plate method to confirm the bacteriophage activity. Bacteriophages were isolated from two chicken intestine samples. The isolated *E. coli* bacteriophages can be effectively used to control the food borne diseases, caused by *E. coli* in the food industry. This study can further explore to determine the characteristics of the newly isolated bacteriophages.

Keywords: bacteriophages, food borne diseases, food industry, host bacteria

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Trace metal composition of selected marine macroalgae species in southern coastal belt of Sri Lanka

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Marine macroalgae are considered as valuable food resource which contains a high amount of minerals, vitamins, essential amino acids and dietary fibre. The biochemical nutrient composition of seaweed and toxic heavy metal levels in seaweed are not well known. This study was performed to investigate the trace metal concentration of Cu, Zn, Fe and heavy metal Cd in seaweed species of *Ulva fasciata* Delile and *Caulerpa racemosa* var. *racemosa* determined from the southern coastal belt, Sri Lanka on September 2020. Samples were collected from Thalpe, Koggala and Dickwalla as follow. Two of same species were collected from each location as triplicate. All samples were washed, cleaned, dried, packed in airtight container and kept in room temperature on the powdered form. Samples were digested by using microwave digester and analyzed by using atomic absorption spectrophotometer. The relative abundance of these trace metals following order: Fe > Zn > Cu. Cd was not detected. Fe concentration of *C. racemosa* var. *racemosa* significantly higher ($P < 0.05$) compared to *U. fasciata* Delile. These two species are potentially rich sources of minerals thus can help to address food scarcity and security. The study revealed that different seaweed species have different affinity for different metals and also elemental compositions showed variations among the same species obtained from different locations.

Keywords: elemental analysis, microelements, seaweeds

Determination of nutritional properties and palatability of locally manufactured dry cat food

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Dry cat food is the most preferred type of food among cat owners. Developed countries lead the market share of the cat food sector. Due to the high price, cat foods are not much popular in developing countries. However, a substantial volume of cat food is being imported to Sri Lanka annually, without making a sufficient effort to produce locally. Therefore, this study was carried out to determine the nutritional properties and palatability of locally manufactured dry cat food to compare the characteristics and performance with imported commercial dry cat food. A total of 05 kittens, between 04-08 weeks of age were used for feeding trail as 1st 4 weeks formulated feed, one-week flush out followed by a 4-week period on commercial feed. Body weights and daily feed intakes were measured using a weighing scale. First approach and first choice were monitored. Sensory evaluation was performed for cat skin and coat. The formulated feed contained 3483 kcal Metabolizable Energy (ME)/kg DM, 19.2% of protein, and 5.9% of fat whereas commercial feed contained 3580 kcal ME/kg DM, 30 % of protein, and 12% fat. The mean growth rate of kittens that were fed with the formulated feed in the first 4 weeks was 6.98 g/day $\pm$ 2.3 whereas 17.77 g/day $\pm$ 2.0 was the mean growth rate of kittens that were fed with the commercial feed in the last 4 weeks. The two - pan, a free choice test showed 62.86% as the first approach for commercial feed and 77.14% as the first choice of commercial feed. Sensory attributes of skin and coat did not show significant differences ($P > 0.05$). In conclusion, commercial cat food had adequate nutritional properties and higher palatability than formulated cat food.

Keywords: cat food, kittens, nutrition, palatability

Identification of phosphate solubilising microorganisms

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Phosphorus is ample in soils in both inorganic and organic forms; however, it is unavailable to plants. Consequently, the soil becomes phosphorus (P)-deficient, making Phosphorus one among the essential nutrient elements limiting crop productivity and growth. Soil microorganisms having the phosphate solubilising capacity are called Phosphate Solubilizing microorganisms. They convert the insoluble phosphate into a soluble form producing organic acids and making it available for plant uptake and nutrition. The objective of the study was to identify the phosphate solubilising microorganisms previously isolated from root-soil samples collected from various climatic zones in Sri Lanka. A total of eighteen different phosphate solubilising bacteria (n = 15) and fungi (n = 3) were used for this study. From the reserved stock culture, fresh culture was prepared in the NBRIP agar media. As the first step in bacteria identification, gram and morphological characteristic tests were carried out. Next biochemical tests were conducted to identify the microorganisms. The isolates were identified as three *Aeromonas spp*. (one from the dry zone, two from the wet zone), seven *Acinetobacter spp.* (two from the intermediate zone, five from the wet zone), one *pseudomonas spp.* (intermediate zone), three *Enterobacteria spp*. (two from the dry zone, one from the wet zone), one *Neisseria spp.* (from the wet zone), *one Aspergillus spp.* (from the dry zone),one *Fusarium spp.* (from the dry zone), and one *yeast spp*. (wet zone), This study has revealed that the phosphate solubilising ability of the isolated species might be used to solubilise a higher amount of phosphates found within the soils and make it a fertile one.

Keywords: microorganisms, NBRIP agar media, phosphorus, phosphorus solubilisation

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Determination of nutritional property of locally manufactured dry fish feed

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The fish food industry has well established markets in developed countries like the United States, but it plays a minor role in developing countries like Sri Lanka. Therefore, the objective of the present study was to formulate a fish feed using locally available materials in Sri Lanka, at lower price level; determine the nutritional composition and its influence on growth rate. A total of 40 Tilapia (*Oriochromis niloticus*), at the same age, were selected for the feeding trail. Fish weight was determined every week using a weighing scale. The body weight had no significant difference between group ($P = 0.307$). The mean growth rate of fishes fed using formulated feed was 3.04g/weeks $\pm$ 1.121 whereas 3.54 g/weeks $\pm$ 0.635 was the mean growth rate of fishes fed using the commercial feed in this trial. The sample analysis and growth rate were subjected to two sample t-test. As per the proximate analysis results, there was no significant difference in the protein, moisture, carbohydrate, and energy and Ash level between the commercial feed and formulated feed. The moisture content of the formulated feed was $9.3\% \pm 2.7$ there was a significant difference with that of commercial feed which was $15.625\% \pm 2$, the formulated feed's ash content was $9\% \pm 0.25$ and the commercial $11\% \pm 0.66$ while the crude protein content of the commercial feed was $39\% \pm 2$ and that of the formulated was $20.7\% \pm 1$, fat content for commercial feed was $7\% \pm 0.433$ and formulated was $1.8\% \pm 0.3$, carbohydrate for formulated was $58\% \pm 2$ and commercial $23.375\% \pm 3$.The energy content of the commercial feed was 312.5 Kcal/100g $\pm$ 2 and formulated feed 331kcal/100g $\pm$ 2. The crude fibre content of the commercial feed was $4\% \pm 3.04$ and the formulated$1.2\% \pm 0.36$. The crude fibre was significantly different ($P = 0.027$) between the commercial and formulated feed. Here, there is no significant difference in bulk density and colour (L*, a*, b*) among different fish feed (commercial and formulated) ($P > 0.05$). In conclusion, growth rate, nutritional composition, colour and bulk density had no significant different between the formulated and the commercial feed.

Keywords: dry fish feed, local fish feed, nutritional composition

Trophic interactions of commonly available fish species in Deduru oya reservoir

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Fish has various trophic interactions and relationships with their surrounding aquatic environment. These relationships are very important to understand the various biological aspects of reservoirs which are important in relation to fisheries and other aquaculture activities. The current study was carried out in Deduru Oya reservoir in Sri Lanka to study about food resource partitioning/ overlapping, trophic positions and other biological aspects of commonly caught fish species in the reservoir. Samples were collected in three hours interval for 24 hour time period. Lengths and weight were recorded and samples preserved in 5% formalin for further laboratory analysis. Most commonly found fish species are *Labeo dussumieri, Rasbora daniconius, Etroplus maculatus, Oreochromis niloticus Puntius bimaculatus*. It is found that species trophic level values show small fluctuations for some species with time and their niche breadth values also have some fluctuations for some species with time. Niche overlapping shows that a higher number of species shows higher levels of niche overlapping while moderate and lower level niche overlapping species are considerably minimum. Stomach fullness of species shows fluctuation with the time and are changed with the different length classes of species. It can conclude that niche breadth and trophic values observed are lower than values for the same species in literature. Higher overlapping values observed for species indicating that species competition for limited resources is high. It needs to consider these higher overlapping before if going to introduce new commercial exotic fish species to the reservoir for fisheries purposes.

Keywords: length, niche breadth, overlapping, weight

Effect of parity and breed on postpartum body condition score, milk yield and calving to first service interval in dairy cows

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Early postpartum dairy cows experience a rapid increase in milk yield and mobilisation of body fat reserves. Therefore, the early postpartum period considered as crucial period for the sustainability and productivity of dairy management. The aim of the present study was to compare postpartum body condition score (BCS), milk yield and calving to first service interval (CFSI) in multiparous and primiparous cows and Jersey and Jersey-Friesian crosses. Altogether thirty-two (n = 32) intensively managed Jersey and Jersey-Friesian cows in early lactation were selected from a large scale National Livestock Development Board (NLDB) farm located in dry zone, Sri Lanka. Cows were fed with a total mixed ration (TMR) during the study period. BCS was determined at the time of parturition and every 2 weeks until two months after parturition. The daily milk yields were also obtained for the same period. All tested parameters were compared using the independent-samples t-test. According to the results, BCS was significantly different ($P < 0.05$) between the two parity groups from parturition to 8 weeks postpartum. Primiparous cows showed a significantly lower BCS (Average BCS from parturition to 8th week: 2.76±0.44, 2.82±0.39, 2.71±0.47, 2.59±0.51 and 2.59±0.51) compared to multiparous cows (Average BCS from parturition to 8th week postpartum: 3.27±0.59, 3.33±0.62, 3.20±0.68, 3.13±0.64 and 3.07±0.59). Meanwhile, the effect of parity was significant for CFSI ($P < 0.05$) where multiparous cows showed shorter CFSI (52.88±24.01 days) than primiparous cows (75.59±15.24 days). No significant difference was observed in BCS and CFSI between the two breeds and no significant effects of the breed and parity were detected on milk yield in tested animals. These results suggest that the postpartum BCS change could be a breed-independent and a parity-dependent indicator and extra attention should be given to primiparous dairy cows during the early lactation period.

Keywords: body condition score, dairy cows, parturition

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Plankton assemblages in a tropical lake

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Kurunegala reservoir is an ancient tropical water body locates in Kurunegala city (7° 29′ N, 80° 21′ E), and the main source of water for the municipal area of Kurunegala, Sri Lanka. Water spread area of the reservoir is 37 ha with 2.50m maximum depth. There is no regular outflow of the reservoir and the water retention time of the reservoir very high and it becomes more or less a stagnant water body with poor fluxes. This change may have a significant influence on plankton communities. The present study attempted to generate baseline information on plankton assemblages of Kurunegala tank in the north western province. Samples were collected using a plankton net using a 50µm sized mesh with 31.5cm diameter and samples were added with formalin and Lugol to preserve zooplankton and phytoplankton respectively. Planktons were identified using standard keys and other published information including plankton guides and AlgaeBase website. The total number of seven phytoplankton species and six zooplankton species were recorded form four sampling locations of the reservoir. Phytoplankton species belonged to four classes. Class Cyanophyceae was represented by four species namely; *Aphanocapsa grevillea, Merismopedia punctata, Anabeana solitarie, and Microcystis aeruginosa*. There was a single species belong to the Class Trebouxiophyceae and was identified as *Closteriopsis longissimi*. Class Dinophyceae was represented by the species *Peridiniopsis pygmaeum. Aulacoseira granulata* was the single species belonging to the Class Coscinodiscophyceae. Among all phytoplankton *Closteriopsis longissimi* were the most abundant species. Six zooplankton species reported in the reservoir were belonged to two Classes; Eurotatoria and Hexanauplia. Four species; *Keratella valga*, *Brachionus foficula*, *Brachionus calyciflorus,* and *Filinia longiseta* were reported from the classes Eurotatoria. Class Hexanauplia was represented by two species; *Heliodiaptomus viduus and Eucyclops serrulatus. Brachionus foficula* is the most abundant species reported during the study. This study revealed that the low diversity of phytoplankton and zooplankton in Kurunegala reservoir.

Keywords: phytoplankton, species diversity, zooplankton

Effect of a cocktail enzyme on the nutritive value of soya bean meal and wheat offal

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The growing population often increases the demand for food, especially of animal origin. Globally, the poultry makes a substantial contribution to food security and nutrition, providing essential energy and nutrients to humans, with short production cycles. The poultry industry is the fastest-growing livestock industry in Sri Lanka and the only well-established livestock sector. The production of broilers depends on many factors and, feed is an essential factor. Broilers should be fed with high protein feed to support rapid growth and reach market weight efficiently. Generally, high protein feeds are more expensive. In order to reduce the wastage of feed, the poultry industry is required to find an alternative method. Soybean meal and wheat offal have been reported to be poor digestibility of several limiting amino acids and high dietary fibre. In this study evaluated the effects of the cocktail enzyme on the nutritive value of soy meal and wheat offal and determined the suitable conditions to optimise enzyme digestion of soy meal and wheat offal. The soybean meal and wheat offal were ground separately and underwent four different treatment stages (T). The control diet (T1) and three test diets were prepared at T2- Enzyme; T3-Acidifier; T4- Acidifier + Enzyme. The treated samples were analysed to determine the protein, fibre, fat and energy contents. The average value of samples was taken and compared with reference levels. Digestibility percentage of four different treatments increased in the range of T1 toT4. T4 showed higher digestibility percentage and T1 showed the lowest. Acidifier mixture also increased the digestibility of protein and fat. The lowest value for gross energy was obtained from the T4. The data were subjected to one-way analysis of variance in a completely randomised design using the general linear model procedure of SPSS software. Digestibility of protein, fat and gross energy were significantly different ($P < 0.05$) among the treatment groups. In conclusion, the effect of the enzyme and acidifier complex addition of feed ingredient improved the nutrient digestibility and may vary, depending on the test ingredient.

Keywords: commercial acidifier, digestibility percentage, enzyme, soy meal, wheat offal

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Status of minerals of forages in coconut triangle, wet zone, and dry zone dairy production regions in Sri Lanka

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Minerals are a key component of dairy cow nutrition and dairy animals obtain most of the required minerals from the feed they consume. Hence forages represent the major part of livestock feeding ration, information on the total concentration of minerals in different forage varieties is important to predict the mineral problems among livestock and minimise the cost of mineral supplementations. The present study was conducted to evaluate and compare the mineral status of forages in three different dairy production zones. Twenty pasture and fodder varieties were collected from Kotadeniyawa fodder resource centre under coconut triangle, Animal husbandry Development & Training Center, Undugoda under the wet zone, and Animal Husbandry Training Center, Seeppukulama under the dry zone. Altogether 132 samples were analysed by AAS to determine some macro (Ca, K, Na, Mg) and micro minerals (Fe, Mn, Cu, Co, Se, Zn, Cr). Evaluated forage Ca, K, Mg and Na levels ranged between 0.66-18.85 g/Kg DM, 8.35-11.09 g/Kg DM, 0.66-0.87 g/Kg DM and 0.02-0.59 g/Kg DM accordingly. The micro mineral content of tested samples ranged between 22.95-390.43 mg Fe/Kg DM, 20.63-272.70 mg Mn/Kg DM, 2.52-14.45 mg Cu/Kg DM, 0.10-0.35 mg Co/Kg DM, 0.12-0.24 mg Se/Kg DM, 16.42-93.33 mg Zn/ Kg DM and 0.44-1.92 mg Cr/Kg DM. Collected data were subjected to analysis of variance (ANOVA) and the results revealed that the tested mineral contents of forages from three different zones were not significantly different ($P > 0.05$) except K, Se and Co. However, further studies should be conducted to investigate the factors affecting mineral content of forages under local conditions.

Keywords: fodder, macro minerals, micro minerals, pasture

Reproductive and productive performances of exotic dairy cows managed under intensive system in dry zone in Sri Lanka

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This study was conducted to assess the reproductive and productive performances of exotic pure and crossbred dairy cows managed under intensive management system in dry zone Sri Lanka. A total of 436 Jersey and 664 Jersey – Friesian cows were selected from large scale National Livestock Development Board (NLDB) farm. Reproductive and productive parameters were determined using data obtained for the period of 2015- 2020. Age at first service (AFS), age at first calving (AFC), average calving interval (ACI), number of services per conception (NSC) and calving to first service interval (CFSI) were the reproductive parameters considered. Meanwhile, total milk yield per lactation (TMYL) average daily milk yield (ADMY) and lactation length (LL) were tested under productive parameters and assessed using General Linear Model (GLM). The results indicated that both AFS and AFC were influenced by breed and year of birth ($P<0.05$). The values of AFS and AFC were higher in cross bred cows (15.53±0.25 months, 25.80±0.60 months) compared to purebred cows (15.34±0.09 months, 24.44 ± 0.22 months). AFC of both breeds was in accordance to the international standards. There was a significant effect on both breed and parity ($P<0.05$) for ACI and NSC while CFSI is independent of both breed and parity. Jersey breed had higher ACI and NSC (634.78 ± 14.06 days, 5.29±0.11) than cross breed animals (505.25±4.44 days, 4.04±0.15). For all milk production related parameters except ADMY significant effects of breed and parity were found. Jersey cows showed a higher LL and TMYL (418.91 ± 10.38 days, 5116.66 ± 211.69 L) compared to cross bred cows (353.11 ± 3.35 days, 4312.07 ± 68.20 L). The highest LL and TMYL were recorded in cows at 2nd parity. The present findings of higher NSC and extended ACI indicate poor reproductive performances of exotic dairy cows managed under an intensive management system. Therefore, appropriate actions should be taken to resolve this issue.

Keywords: exotic dairy cows, milk yield, reproduction

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Study of perception on fish oil among school students, university students and teachers in Sri Lanka

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Fish oils are generally processed mainly from pelagic (from the open ocean) fatty-fish species. Fish oil rich in polyunsaturated fatty acids (PUFA) especially omega 3 fatty acids. Omega 3 fatty acids are essential fatty acids. Fish oil is one of the major sources of omega 3 fatty acid. The most important omega 3 fatty acids contained in fish oil are Docosahexaenoic acid (DHA) and Eicosapentaenoic acid (EPA) which are long-chain omega-3 fatty acids. Fish oil has a lot of beneficial effects. Fish oil can influence many aspects of cardiovascular disease, brain development, diabetes, eye disorder, immunity, prevent cancers, etc. Fish oils are used not only for human consumption but also as a nutritional supplement to animals in livestock and aquaculture farming. The objective of the present study was to determine the perception of fish oil among school students, university students and teachers. This cross-sectional descriptive study was done among school students, university students and teachers. A self-administered questionnaire was used to assess the perception. The analysis was done by using SPSS 16.0 and Microsoft excel. Twenty-four school students, 60 university students and 26 teachers were included in this study. Most participants in university students and teachers have heard of fish oil and know about its importance, nutrient compounds, omega 3 etc. Although most school students heard of fish oil, most were unaware of its importance, nutrient compounds, omega 3 etc. The perception of fish oil among university students and teachers are adequate. But the perception of fish oil among school students need to be improved. Most participants in all three categories need to be aware of the possible side effects of fish oil.

Keywords: beneficial effects, fatty acids, fish oil, omega-3

Improvement of ammonia contaminated groundwater for aquaculture

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Groundwater is commonly used by ornamental fish farmers. However, the groundwater is contaminated with ammonia and it's becoming unsuitable for aquaculture. High ammonia concentrations (over 0.1 ppm) critically affect fish metabolism by shifting the acid-base equilibrium, disturbing glucose tolerance. Currently, fish farmers use the reverse osmosis (RO) system to remove higher ammonia concentrations in groundwater. However, RO system is an expensive water treatment system with high operational cost. Moreover, around 50% of the water is wasted due to the low recovery rate. Thus, the present study attempted to evaluate alternative methods of ammonia-removal from contaminated groundwater. Electrolysis using different electrodes, different products of *Terminalia catappa* and aeration technology were used to remove ammonia in contaminated groundwater. Electrolysis experiments were conducted with carbon, titanium base metal sintered with platinum/stainless steel, stainless steel, stainless steel/aluminum electrodes. Under an initially set voltage of 14 V, a constant current of 10 A was applied and different retention times were used for ammonia-removal experiments. The same amount of *T. catappa* powder and pellets were used in ammonia-removal experiments. Aeration experiments using an aquarium aeration-pump were also conducted. Ammonia contaminated groundwater samples were collected from Miracle Pets International Pvt Ltd Galaya, Pannala and brought to the laboratory for ammonia-removal experiments. Water samples were collected at regular intervals from each experiment and total ammonia concentrations were measured. Results showed that except carbon electrodes all other electrodes were able to remove ammonia and maintain below the standard level in 5-25 minutes of treatment time. *T. catappa* powder and pellets also effectively removed ammonia in 2-3 days, but levels were higher than the standard limit whereas aeration was not sufficient to remove ammonia from water. It can be concluded that electrolysis using different electrodes is an effective alternative technology to remove ammonia from contaminated groundwater.

Keywords: ammonia-removal, electrolysis, reverse osmosis, *Terminalia catappa*

Preliminary trials for culturing upside-down jellyfish

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Jellyfish has become one of the most popular attractions in public aquariums because of their light-producing ability and tentacle coloration. Upside-down jellyfish (*Cassiopea andromeda*) is a good example of Jellyfish with different colours and tentacle shapes. Jellyfish are commonly considered as difficult animals to keep in captivity because of their weak swimming ability and fragile body. Although jellyfish breeding has become a common research platform for scientific research institutions, there has only been a few institutions made available for jellyfish breeding because of the difficulty of acquiring the specific demands and lack of adequate design flaws and filtration methods. Therefore, this study aims to evaluate the growth performance of the Upside-down jellyfish (*Cassiopea andromeda*) in different salinity levels. The experiments were conducted in glass tanks and nine treatments of different salinity levels (15 ppt, 20 ppt, 25 ppt, 30 ppt, 35 ppt, 40 ppt, 45 ppt, 50 ppt, 55 ppt) with two replicates. In every week two days tank-water was replaced and adjusted for salinity and further jellyfish were fed with *Artemia*. In each week the growth, with respect to the bell diameter, was measured. There was a significant difference between treatments in 5th, 6th and 7th weeks ($P = 0.0048$, $P = 0.0035$ and $P = 0.0002$ respectively). The relatively higher growth was achieved in 25 ppt, 30 ppt, 35 ppt and 40 ppt than other treatments in these weeks even though bell sizes of the jellyfish were reduced in every treatment tank with time. In conclusion25 ppt, 30 ppt, 35 ppt and 40 ppt salinity levels were found to be best for the culture upside-down jellyfish, further studies need to be conducted in identifying the other optimum conditions to rare these animals as an ornamental species.

Keywords: *Cassiopea*, growth performance, salinity

Age and growth of *Neotrygon indica* from the eastern coast of Sri Lanka

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The blue-spotted mask ray (*Neotrygon indica*) is a common ray species occurring in the eastern coast of Sri Lanka where it is often caught as bycatch in bottom-set gillnets and longlines. This species is a slow-growing and long-lived elasmobranch which is similar to other ray species. It is vulnerable to fishing pressure because of their slow growth rate and is often landed as by-catch in this area. Estimating the age at capture is essential to determine the impact of being removed as bycatch. Hence, age and growth of the *N. indica* was studied by examination of bands on the vertebral centra removed from 162 specimens (76 males ranging in size from 17 to 40 cm disc width (DW) and 86 females ranging in size from 19 to 45 cm DW) collected between October to November 2019 and between July to August 2020 at the Pethalai landing site of Kalkudah. Growth band pairs (including translucent and opaque bands) were counted with the assumption that each growth band is deposited annually and represents a growth cycle (a year's growth). Band pairs were not clearly visible in all samples. Age estimates derived from band counts within sectioned vertebrae ranged between 0 to 13 years. The annual nature of band deposition was verified by centrum edge analysis. The von Bertalanffy growth model provided the best fitting growth model for both sexes between observed DW and age data. Males have attained maturity at the size between 30.5 and 40 cm disc width. Disc width at birth was between 17 cm and 21 cm which was the minimum size. Maximum age was 11 years for males and 13 years for females. It is important to conduct further studies to link the captured age with maturity to ensure; sustainable fishing practices and make informed decisions regarding conservation.

Keywords: age and growth, centrum edge analysis, *Neotrygon indica*, vertebral band counting, von Bertalanffy growth model

Possibility of using waste egg shell powder as a calcium supplement for livestock

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Disposal of massive amounts of egg shells from food processing plants and commercial hatcheries is a great challenge. In recent years, there has been a focus to reutilise these waste resources in the production of different marketable value added products. The present study was conducted to determine the possibility of using waste egg shell powder as a calcium supplement for livestock. Eggshell waste were collected from hatchery operated at Animal Husbandry Training Centre, Kotadeniya and local small scale restaurant at Makandura. Both egg shells were separated in to two groups as, with or without membranes [Hatchery waste egg shells with membrane (HWM), Hatchery waste egg shells without membrane (HWOM), Food waste egg shells with membrane (FWM) and food waste egg shells without membrane (FWOM)] and powdered thoroughly. The moisture, ash and $CaCO_3$ content were analysed for all the powdered eggshell samples. The same parameters were tested for commonly used animal feed calcium supplements, shell grit powder (SGP) and calcite powder (CP) and compared using one-way ANOVA. According to the result, there were significant differences in all the tested parameters ($P < 0.05$). The highest moisture content was recorded in FWM (6.25±0.18) and the lowest was recorded in CP (0.04±0.03). Meanwhile, SG was reported with the highest ash content (99.21%±0.22). The $CaCO_3$ contents of HWM, HWOM, FWM, FWOM, CP and SGP were 91.58±2.58%, 95.76±0.31%, 81.72±0.59%, 85.10±0.41%, 96.55±2.2% and 98.10±0.78% respectively. HWOM had higher $CaCO_3$ than that of other egg shell powders. The reported $CaCO_3$ contents of egg shell powders were slightly lower than the commercially available calcium supplements. But there is a possibility of using waste egg shell powders as low cost alternative calcium sources in animal feed. Further studies are required to determine the bioavailability of calcium from eggshell powder.

Keywords: calcium, egg shell powder, hatchery waste

Trends in skipjack tuna (*Katsuwonus pelamis*) catches reported from a fishery harbor in Kalutara in Western Sri Lanka

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Skipjack tuna (*Katsuwonus pelamis*) fishery gained high attention due to its significant contribution for the marine capture production. In 2018, skipjack tuna became the most dominant species in the catch contributing 13% to the total Sri Lankan marine production. Sri Lankan fishers target migratory stocks of tuna in the offshore fishing grounds located around the country throughout the year by using gillnets, longlines and ring-nets. However, scarcity of the detailed analysis on skipjack tuna fisheries of Sri Lanka limits the data and results provided for the Indian Ocean Tuna Commission (IOTC) for managing the fishery. Thus, the present study attempted to evaluate the abundance and the seasonality of the skipjack tuna resources caught by Sri Lankan fishers. Catch data collected from the Department of Fisheries and Aquatic Resources, Beruwala fishery harbor from 2015-2019 were analyzed for the seasonal variation of total production, catch per unit effort (CPUE) and gear-wise production. The mean CPUE was 21,657 t trip^{-1} while the highest and lowest CPUE were reported in 2016 (34,546 t trip^{-1}) and in 2019 (2,661 t trip^{-1}) respectively. Monthly ln (CPUE + 1) showed a more or less similar pattern throughout the five consecutive years having highest catches from February-March and September-November periods. This peak fishing season coincide with the northeast monsoon (February-March) and southwest monsoon period (September-November) in Sri Lanka. Similar pattern of production trend was also observed by indicating relative abundance of the species during the respective periods. Ring-net catches were accounted for the highest percentage contribution followed by the gillnet. As most of the multi-day fishing vessels have the vessel monitoring system (VMS), if information on the respective fishing grounds are available, a comprehensive analysis could be conducted with respective to location and size distribution of Skipjack tuna because such information will be important regionally in managing these shared stocks.

Keywords: CPUE, fishery production, *Katsuwonus pelamis*

Microbial and physiochemical properties of bael (*Aegle marmelos*) incorporated probiotic goat milk beverage

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Fermented dairy products of bovine-origin have traditionally been utilised as carrier foods for probiotic delivery. However, there is increasing popularity for goat milk due to its hypoallergenic effect, better digestibility and nutritional profile. The addition of fruity bases into dairy matrices has been viewed as an effective strategy to maintain probiotic viability. Therefore, the current research aimed to determine the microbial and physiochemical properties of bael-incorporated fermented goat milk (FGM) containing the exopolysaccharide (EPS)-producing probiotic, *Lactobacillus rhamnosus* GG (LGG) over 21 days of refrigerated storage (4 °C). Accordingly, the probiotic viability, pH and colour changes (L*, a* and b* values) of four treatments: FGM containing 0% (CON), 5% (5FGM), 10% (10FGM), and 20% (20FGM) bael were evaluated at 1, 7, 14 and 21 d of storage. Statistical differences among the treatments and storage time points were analysed using a series of mixed ANOVA at $\alpha = 0.05$. The lowest decline in pH over the storage period was observed in 10% and 20% bael-incorporated samples. Whereas, the highest pH decline was observed in the sample without having bael (CON). Brightness values (L*) observed among the treatments over the storage were not significant ($P > 0.05$). The viability of LGG in all four treatments was decreased significantly over the storage period ($P < 0.05$) although the viable counts remained $> 10^6$ cfu/mL. After 21 days of storage, the viable counts in the bael-incorporated samples were significantly higher ($P < 0.05$) than that of the sample without bael (CON). The highest viable counts ($> 10^7$ cfu/mL) were observed in the sample having 20% bael (20FGM). Results concluded that the fermented goat milk is an adequate matrix to deliver LGG at sufficient quantities to confer health benefits on the host even after 21 days of refrigerated storage. Moreover, the addition of bael fruit extract had a positive effect on probiotic viability and post-acidification.

Keywords: bael, goat milk, *Lactobacillus rhamnosus* GG, probiotics, probiotic viability

Effect of dietary supplementation of probiotics, prebiotics, synbiotics, and essential oils on growth performance of broiler chicken

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This study was performed to investigate and compare the effect of dietary supplementation of probiotics, prebiotics, essential oils and synbiotics on growth performance of broiler chickens. A total of 800-day-old Arbor acres broiler chickens of either sex were randomly assigned into four dietary treatments. Each treatment had four replicates of 50 birds and raised for over five weeks. The dietary treatments were basal diet supplemented with probiotics as the control group (T1), basal diet supplemented with essential oils (T2), basal diet supplemented with synbiotics (T3), basal diet supplemented with prebiotics (T4). The birds were provided with *ad libitum* feed and drinking water during the entire experimental period. There was no significant ($p > 0.05$) difference in live body weight, total feed intake and feed conversion ratio (FCR) of broilers in prebiotic, synbiotic and essential oil groups compared with probiotic supplemented control group. Out of the four treatments, most efficient feed conversion ratio and highest body weight was given by the probiotic-supplemented group. The present experiment results showed that the evaluated natural growth promoters might be promising alternatives for antibiotic growth promoters. In conclusion, body weight and feed conversion ratio did not show any significant increase by the dietary inclusion of prebiotic, synbiotic and essential oils compared with probiotic supplemented control in commercial broiler chicken.

Keywords: broiler performance, feed conversion ratio, feed intake, growth promoters

The best microscopic designs of plankton in selected water bodies of Sri Lanka and their applications

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Marine, brackish and freshwater resources of Sri Lanka have high plankton diversity with a wide range of attractive microscopic designs. There is a great potential to incorporate them into clothing designs but such designs are not yet been done. This study tried to set the baseline information on the abundance and diversity of plankton in selected water resources and to identify the best microscopic designs for t-shirts designing. Plankton samples were collected from four sampling points of each water resource (brackish, marine and freshwater) with two replicates at one-week intervals. Water quality parameters were measured. Plankton was identified and counted under the light microscope. Total cell abundance and Shannon-Weiner diversity index were calculated. Clear photographs of the microscopic view of plankton were taken by using an inverted phase-contrast microscope with the imaging system. The best fifteen microscopic designs of plankton were selected for t-shirts designing. The most preferable three t-shirt designs were selected using a questionnaire distributed among 74 respondents. Results revealed that a total of 88 plankton: 58 phytoplankton and 30 zooplankton species were discovered from three different water sources. All water sources showed higher phytoplankton diversity than zooplankton. Diatom was dominant phytoplankton group in brackish water (42%) and marine water (46%) resources while green algae dominated in freshwater (72%) resource. Copepods was dominant zooplankton group in brackish water (32%) and marine water (45%) resources while rotifers dominated in freshwater (67%) resource. Among fifteen t-shirt designs 11, 12 and 13 were identified as the best three t-shirts. Majority of respondents prefer to wear t-shirts with plankton designs (95.95%) and they willing to pay Rs 1500.00 per such t-shirt (45.95%). Most of them prefer cotton t-shirts (79.93%) with white background (41.89%). Attractive microscopic designs of different water sources could be incorporated to design t-shirts. This unique product may provide some scientific knowledge about plankton.

Keywords: abundance, phytoplankton, t-shirt, zooplankton

Determination of nutritional properties of locally manufactured dry dog food

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Dry dog food is a trending industry in Sri Lanka, however limited literature is available on the nutritional properties of these local food. Therefore, this study was done to accomplish a nutritional based comparison between one imported food and one locally manufactured food. The proximate composition, energy estimation and extrude characteristics were evaluated between the imported food and locally manufactured food. Comparative growth performance between the two groups of puppies (n = 5) fed with the imported and locally manufactured food was evaluated. A sensorial evaluation to determine the feed effect on the hair coat condition was performed. The results of the proximate analysis revealed 18% (SD ± 0.30) protein, 6.4% (SD ± 0.09) fat, 9.70 (SD ± 0.08) moisture, 0.8% (SD ± 0.03) crude fibre, 9.3% (SD ± 0.07) ash, 55.8% (SD ± 0.55) carbohydrate and 352.8 (SD ± 0.34) kcal$100g^{-1}$ of energy in local food while imported food reported same parameters as 24.1% (SD ± 0.19), 10% (SD ± 0.19), 12.1% (SD ± 0.06), 2.8% (SD ± 0.05), 0.7% (SD ± 0.10), 44% (SD ± 0.56) and 362.4 (SD ± 0.27) kcal$100g^{-1}$ respectively. Extrude characteristic results indicated 515.8 gl^{-1} bulk density, 10.05% water solubility index, 3.12 water absorption index and 103.55N hardness in local food while imported food revealed the same parameters as 390.66 gL^{-1}, 11.1%, 2.76 and 69.23N respectively. The imported food showed significant growth performance (paired sample t-test, $P < 0.05$) of 0.595 kg/week (SD ± 0.03) in puppies than the locally manufactured food; 0.43 kg/week (SD ± 0.03), probably attributed by high protein content former. A better impact from both and no significant difference (paired sample t-test, $P > 0.05$) was revealed on hair coat condition by two food types. In conclusion, imported dog food had better effect on the growth of puppies than locally manufactured food. The latter may exhibit better performance in adult dogs owing to its nutritional composition more compatible with adult dog requirements.

Keywords: extrude characteristics, growth performance, proximate composition

Microbial, physiochemical and sensory properties of bael (*Aegle marmelos*) incorporated probiotic buffalo milk yoghurt

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Dairy products are considered an ideal food matrix to deliver live probiotics in sufficient quantities. Among milk from different species, there is an increasing demand for buffalo milk as an alternative to cow milk mainly due to its higher nutrient content than cow milk. On the other hand, there is an increasing trend among the food manufacturers to produce functional foods containing both fruits and milk as it delivers additional health benefits. This study aimed to investigate the impact of incorporating bael fruit extract on microbial, physiochemical and sensory characteristics of buffalo yoghurt containing the exopolysaccharide (EPS)-producing probiotic bacteria, *Lactobacillus rhamnosus* GG (LGG) during 21 days of refrigerated storage (4 °C). Accordingly, the pH, syneresis, titratable acidity, hardness, probiotic viability and sensory attributes were evaluated at 1, 7, 14 and 21 days of storage in four buffalo milk yoghurt formulations: a control yoghurt prepared with conventional yoghurt culture without LGG (CON), a probiotic yoghurt containing *Lb. rhamnosus* GG (PY), a probiotic yoghurt containing 5% (w/v) bael (PY5), and 10% (w/v) bael (PY10). Statistical differences among the treatments were determined using mixed ANOVA in SPSS (α = 0.05). Control yoghurt showed significant post acidification, a higher syneresis rate, and lower hardness value ($P < 0.05$). Whereas, incorporation of LGG had a positive effect on post acidification, syneresis rate and hardness. Addition of bael did not affect post-acidification, but significantly decreased the level of syneresis. All probiotic formulations maintained LGG counts more than 10^7 cfu/mL over the 21 days of refrigerated storage and the highest viable probiotic counts ($> 10^8$ cfu/mL) were observed in the 5% bael incorporated yoghurt (PY5). Sensory attributes of CON, PY and PY5 were comparable and preferred over the PY10. Results concluded that buffalo yoghurt is an ideal matrix to deliver LGG and 5% bael incorporation level would be ideal for symbiotic product development.

Keywords: bael, buffalo milk, *Lactobacillus rhamnosus* GG, probiotic delivery, yoghurt

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