



PROCEEDINGS

of the
9th Undergraduate Research Symposium
UReS 2022

**"SUSTAINABLE FOOD SYSTEMS FOR
ECONOMIC RESILIENCE"**

**Faculty of Livestock, Fisheries and Nutrition
Wayamba University of Sri Lanka**



16th February 2023

Wayamba University of Sri Lanka, Makandura, Gonawila, (NWP)



**Proceedings of the
Ninth Undergraduate Research Symposium
UReS 2022**

“Sustainable Food Systems for Economic Resilience”

Organized by the
Faculty of Livestock, Fisheries & Nutrition
Wayamba University of Sri Lanka

February 16, 2023

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Ninth Undergraduate
Research Symposium-
UReS 2022**

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Published by

Faculty of Livestock, Fisheries & Nutrition
Wayamba University of Sri Lanka
Makandura
Gonawila (NWP) 60170
Sri Lanka

Telephone: 0094(0) 312 299 870, 312 299 429

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ISSN: 2465-5821

Cover Page Design: Mr. Prakash Kulathunge

FOREWORD

I am enraptured to write this Foreword to the Proceedings of the 9th 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 144 abstracts under the theme of “Sustainable food systems for economic resilience” 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 Senior Prof. C.V.L. Jayasinghe, the Dean of the Faculty of Livestock, Fisheries and Nutrition for the valuable support and guidance given in organizing UReS 2022. Dr K.A.H.T Kodithuwakku is greatly acknowledged for his utmost contribution as the Coordinator of UReS 2022 to make this event a great success. I congratulate and appreciate all undergraduate researchers who publish their abstracts in this proceedings. I convey my gratitude 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 2022, all academic and non-academic staff of the faculty who assisted in various ways to publish the Proceedings of the 9th UReS 2022.

Dr. (Mrs) H.P. Gunawardena
Editor-in-Chief/UReS 2022
Faculty of Livestock, Fisheries & Nutrition
Wayamba University of Sri Lanka

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Message from the Vice-Chancellor

I am pleased to write this message for the e-Proceedings of the 9th Undergraduate Research Symposium (UReS) 2022 on the theme, "*Sustainable Food Systems for Economic Resilience*", where abstracts of 145 final year undergraduate students of the B.Sc. Honours in Food Science and Nutrition and B.Sc. Honours in Food Production and Technology Management will be published.



Food Production and Nutrition are vital areas that have to be addressed, especially, in the post-pandemic issues, and I expect that the research undergone by the undergraduates will have an impact on the search for solutions. I would like to express my appreciation of the Dean, Heads of Departments and other academic, academic support and non-academic staff of the Faculty as the achievement of the undergraduates would not have been possible if not for the expertise and contributions of the staff.

I take this opportunity to congratulate the undergraduates on their achievement of this final component of their academic career, many of whom will soon be launching into research careers of their own. I am sure that the foundation received at the University will serve to establish them firmly in their careers and provide them an opportunity to serve the next generation in their turn. I wish them well in their future careers.

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

Message from the Dean



It is a great pleasure to issue this message on the occasion of 9th Undergraduate Research Symposium (UReS 2022) organized by the Faculty of Livestock, Fisheries & Nutrition. UReS is an annual event in the academic calendar of the faculty which provides a podium to final year undergraduate students with an outstanding opportunity to showcase their research findings, innovations and inventions and share their insightful ideas with adept. I sincerely believe that participating in the research session will provide the students a strengthening of partnership and a dynamic experience to brighten their path in facing a challenging future.

Further, I'm really pleased to inform that by this year, the faculty has initiated "Best Student Invention Award", in parallel to the symposium, as it may encourage our students to improve their projects up to a marketable level and address the current issues in the country as well as in the world.

We are holding this event when the country has suffered through an economic crisis marked by soaring inflation and depleting foreign reserves. Therefore, this year, the conference is organized around the theme of "Sustainable Food Systems for Economic Resilience". The diversity of the research projects which were guided by the creative and innovative academics of the faculty may open up the opportunities to address the pressing needs in the field of food production and nutrition sectors.

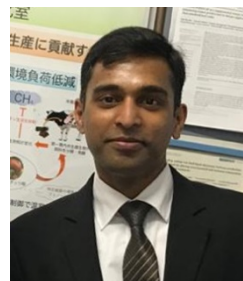
On behalf of the Faculty, I would like to congratulate the authors who are presenting at the symposium today, with special appreciation for their excellent contributions and hard work. Further, I would like to extend my gratitude to the supervisors and other collaborators who have immensely contributed in achieving objectives and successful completion of the research. The success of an event of this magnitude is not possible without a collective and tireless effort by a group of people steered towards a common goal. So, I would like to acknowledge the organizing committee; UReS 2022, academic and non-academic staff members, our sponsors, and all those who worked hard to make this event a reality.

I sincerely hope that this prestigious event will be an intellectually stimulating forum for all participants who joined us in the technical sessions today.

Senior Prof. C.V.L. Jayasinghe
Dean, Faculty of Livestock, Fisheries & Nutrition
Wayamba University of Sri Lanka

Message from the Coordinator

It is indeed with great pleasure that I write this message for the 9th Undergraduate Research Symposium (UReS 2022) of the Faculty of Livestock, Fisheries & Nutrition which has been organized with a timely focused theme of “Sustainable Food Systems for Economic Resilience”. At this year’s UReS, all the final year students present their findings as oral presentations, and the abstracts publish as an e-proceedings.



On behalf of the organizing committee, I wish to acknowledge, Senior Prof. Udith K. Jayasinghe, the Vice-Chancellor of the Wayamba University of Sri Lanka and Senior Prof. CVL Jayasinghe, the Dean of the Faculty of Livestock, Fisheries & Nutrition, for providing continuous encouragement and timely advice for organizing the event successfully. I extend my sincere gratitude to Dr. Manoj Thibbotuwawa, Research Fellow of the Institute of Policy Studies for accepting our invitation to deliver the keynote speech and inspiring our young scientists. Furthermore, I extend my sincere gratitude to all the judges for accepting our invitation to evaluate the research presentations.

The UReS 2022 would have not been possible without the generous contributions made by our sponsors. On behalf of the organizing committee, I extend my sincere gratitude to them. Furthermore, I convey my gratitude to Prof. WJSK Weerakkody, Director, Information & Communication Technology Center, Makandura Premises, Wayamba University of Sri Lanka and his team for the valuable support extended to organize the symposium. My sincere gratitude also goes to the Assistant Registrar of the faculty, the staff of the Deans’ office, the technical officers of the media unit, all the nonacademic staff, and volunteer students of the faculty for supporting the organizing committee in various ways to make this event a great success. I specially acknowledge all the members of the organizing committee, for their hard work, dedication and patience rendered in organizing the UReS 2022.

I wish to thank all the academic staff of the faculty and the external supervisors of the final year research projects for their excellent guidance of the budding scientists until the publication of their research findings. I highly appreciate all the final year students for their hard work in research projects and for their nice communication with the organizing committee of UReS 2022. I also congratulate Mr. UL Hasitha Eranda Perera, for winning the Best student invention award-2022 of the Faculty and Mr. MRT De Silva for been selected as Best School Inventor 2022 during UReS 2022.

While congratulating all the presenters, I wish the UReS 2022 a great success.

Dr. K.A.H.T. Kodithuwakku
Coordinator, UReS – 2022
Faculty of Livestock, Fisheries & Nutrition
Wayamba University of Sri Lanka

Keynote Address

Sustainable Food Systems for Economic Resilience

By

Dr. Manoj Thibbotuwawa

Research Fellow/Head (Agricultural Economics Policy)
Institute of Policy Studies of Sri Lanka



Sri Lanka has shown progress over the last decades on economic development as well as SDGs, reflecting the country's elevation to middle-income status. Despite the progress, the country has been facing many socioeconomic challenges, including hunger and malnutrition. The outbreak of COVID-19 and its containment measures had serious effects on the economy and livelihoods of vulnerable people in Sri Lanka, hindering progress toward achieving the SDGs. The more recent macroeconomic instability has added to the pressures. High inflation, import restrictions, and shortages of critical goods and services have generated public unrest. Rising food prices, in particular, is a cause of major concern. Moreover, food imports are being hampered by rising prices in the world market due to the Russia-Ukraine war and food export restrictions by major producers.

Adding to these is the lingering impact of the government's decision to ban chemical fertilizer imports, resulting in shortages of domestic food production resulting in price hikes. The food crisis seen today, with a sharp increase in basic food prices and food shortages highlights the extreme vulnerability of the current agricultural and food system in the country. Higher food prices have limited the food supply of poor households and led them to switch to less nutritious diets, resulting in both short-term and long-term negative health effects.

This food crisis in the short run is a humanitarian problem and short-term relief issues can be prioritized on the agenda to fulfill the immediate food needs of the people. Relief notwithstanding, the real and sustainable solution to the recurring foodflation and food shortages lies in managing the demand and supply of food in the long run. Thus, the long-term solutions to the food crisis should materialize from developing domestic agriculture which is the main driver of food security, to increase the local production of a diverse group of nutritious foods and strengthening the food system to face future shocks.

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Department of Applied Nutrition

Determination of nutritional knowledge, attitude, behavior and need for a diet planning service center for Customs officers in Sri Lanka

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Worksite dietary interventions have substantial potential for improving employee health and wellbeing. Working in an office setting is characterized as sedentary work associated with development of NCDs along with poor dietary habits. The present study aimed to determine the nutritional knowledge, attitude and behavior of Sri Lankan Custom Department workers and their need for a diet planning service centre. A cross-sectional study was conducted with a convenient sample of 169 officers above 20 years of age working in Custom Department. A self-administered questionnaire was employed via online and the scores for nutritional knowledge, attitude, behavior and need for a diet planning centre were computed and undergone regression analysis. Majority of participants in the study were (92%) males and 47% of the adults were in the 20 – 39 years age category. Mean knowledge, attitude, behavior and need assessment scores were 5.6 ± 2.1 (out of 16), 5.7 ± 2.0 (out of 10), 12.0 ± 3.1 (out of 32) and 3.8 ± 1.4 (out of 7) respectively. Females' score (4.4 ± 1.0) for the need assessment for a diet planning centre was significantly high than that of males (3.6 ± 1.1). Participants' knowledge showed significant relationship between attitudes, but not with the behavior. However, attitude scores were significantly correlated with the behavior scores. Nevertheless, need assessment scores did not show any relationship with scores of knowledge, attitude or behavior. Findings implied that the nutritional knowledge, attitude and behavior of customs officers were not adequate and need to be improved. Subsequently, we can increase their awareness for the need for a diet planning centre to improve and maintain their health in future.

Keywords: Diet planning, food intake, office workers, sedentary lifestyle

Use of diet-related coping strategies by households with preschoolers in Western Province during the current financial crisis in Sri Lanka

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The current financial crisis in Sri Lanka has negatively impacted the nutritional status of the population including preschoolers. A cross-sectional study was conducted among households with at least one preschooler residing in Western Province. A convenient sample of parents or primary caretakers of preschoolers ($n=255$) was recruited from randomly selected nine preschools. A self-administered questionnaire and a single 24-hour recall were used to collect data. The majority of the participants were females (98.9%), middle-aged adults (63.5%) and housewives (65.7%) who have completed 13 years of school education (41%). Most households had a monthly income of less than 30000 LKR (40.7%). The percentage of households with food security was 19.7% whereas, with mild, moderate and severe food insecurity was 33.1%, 37.7% and 9.6% respectively. The mean Coping Strategy Index (CSI) was 13.9 ± 22.9 . Children scored a mean Dietary Diversity Score (DDS) of 4.4 ± 1.2 . Diet-related coping strategies mostly followed were: relying on less preferred and less expensive food (70%), reducing the portion size of meals (43%) and restricting the consumption of adults for small children to eat (33%). Primary caretakers' age, education level and household income showed a significant effect on household food insecurity ($p < 0.05$). Households with middle-aged parents (>30 -50 years) were 0.3 times less likely to be food insecure than that of younger parents (≤ 30 years). The households that had a monthly income of below 30,000 LKR were 2.5 times more likely to experience food insecurity than the households that had a monthly income between 30,000 LKR and 60,000 LKR. In conclusion, the majority of households is food insecure and follows various diet-related coping strategies but provide a moderately diverse diet to their young members in the household. Further studies at rural and estate areas are required to understand the complete situation of Sri Lanka.

Keywords: Child, coping Strategy, dietary diversity score, food insecurity experience scale, urban

Perceptions and factors affecting fruits and vegetables consumption in household women

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Malnutrition is associated with poor diets. Increasing the intake of fruits and vegetables (F & V) is one of the ways to improve diets. The recommended intake of fruits and vegetables is at least five servings per day. In Sri Lanka, F & V consumption is below recommendations. Household women play a central role in deciding diets for the family. This study aimed to assess the nutritional awareness, perceptions and factors affecting fruits and vegetables consumption in household women and to propose initiatives to address the constraints in fruits and vegetables consumption, to promote sustainable healthy diets. This study was conducted as a qualitative study. Focus group discussions were conducted recruiting household women residing in rural, urban and semi-urban areas in Western and North Western provinces. Focus Group Discussion Guide (FGDG) was prepared, including the questions on nutritional awareness, purchasing, preparation, perceptions, motives and barriers to consume F & V. Participants were selected according to their monthly average household income level belong to low, middle and upper income and from Sinhala and Muslim ethnic groups. Total of 16 focus groups (participants = 87) were conducted in Pitipana, Katana, Daluwakotuwa, Minuwangoda, Welihena and Negombo areas located in Western province and Asirigama, Mediriwela, Pannala, Narammala, Alawwa and Elabadagama areas located in North Western province. Codes and themes were developed by inductive data analysis. Mainly the barriers associated with F & V consumption were high price and busy lifestyle. The main factor they consider when purchasing and cooking fruits and vegetables was preference of their children. Household women were aware about health benefits of F & V, but were less aware about the recommendations. Mainly household women and other adults in the family were the ones who motivated F & V consumption in younger children. In conclusion, high prices, busy lifestyle and the preference of children were the main factors associated with low consumption.

Keywords: Barriers, focus group discussions, fruits, nutritional awareness, vegetables

Glycaemic response, satiety index and sensory attributes of animal and plant based protein diabetic nutrition supplement formulas

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Sugars and starches are mostly considered as glycaemic carbohydrates which stimulate an increase in blood glucose after their digestion. Type of carbohydrates taken, the rate of clearance from the blood and the availability of other nutrients (fiber, fat, protein) influence the glycaemic response to foods. Replacing carbohydrates with proteins and fibers help to lower the glycaemic index (GI) of foods while reducing glycaemic response. Low GI diabetic formulas have been shown to control glycaemic response of diabetic patients. This study aimed to determine the glycaemic, and satiety indices, glycaemic load and sensory attributes of two diabetic formulas prepared using whey and soy proteins. This GI study was conducted as a controlled crossover study with healthy 15 participants (8-females and 7-males) aged 23-27 years who were not under any medication. After an overnight fast (8-10 hrs.) participants were given 25 g of glucose (reference) or test formula dissolved in 125 ml water in three occasions. Finger prick blood glucose was measured using the same glucometer at intervals of 0, 15, 30, 45, 60, 90, and 120 min. GI was calculated for each person by dividing their glucose incremental area under the curve (IAUC) for the test formula by their glucose IAUC for the reference food. Final GI value for the test formula was the average GI value of all subjects. A 7-point hedonic scale was used to assess sensory attributes and satiety level at 15 min intervals for 2-hrs. Whey protein based formula had a lower GI (52) compared with soy based (75) formula. Glycaemic load values of whey and soy protein formulas were 13 and 19, respectively. Preference for soy protein formula was higher (ranking; 1.57) compared with whey protein (ranking; 1.43) according to the Friedman mean ranking test. Soy protein resulted in a higher satiety index (105) compared to whey protein (99). In conclusion, whey protein formula elicits much favorable postprandial glycaemic response compared to soy protein formula but less consumer preference and satiety level.

Keywords: Diabetes, glycaemic index, nutritional supplement formula, sensory attributes, satiety index

Effect of Diabetes self-management education on Glycemic control of type 2 Diabetes patients

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Diabetes self-management is extensively used strategy in creating the self-awareness, improving the self-monitoring of their condition and induces the self-caring for better clinical management. In the absence studies focus on diabetes self-management education (DSME) for diabetes management, current study was conducted with the objective of developing a DSME package and assessing its effect on glycaemic control of type 2 diabetes patients. Sixty ($n=60$) volunteer T2DM patients were recruited as subjects. They were randomly allocated either to receive the DSME programme or general education programme (GEP). GEP consisted of 03 educational sessions dietary management using plate model, foot care, importance of physical activity, stress management and one group dietary counseling session. DSME programme consisted of structured 03 counseling sessions, cooking sessions and interactive discussion sessions in addition to the GEP. They were provided with the education materials as dietary booklet with interactive worksheets, cooking recipe booklet and clinical chart to plot the progress of glycaemic control and other biochemical parameters for one year. Both groups were followed up to 12 weeks on the respective programme. Information on general lifestyle, disease and medication history were obtained using a general lifestyle questionnaire. Anthropometry, blood pressure, fasting plasma glucose and glycated haemoglobin concentration (HbA_{1c}), dietary intake and physical activity level were assessed at the baseline ($t=0$ weeks) and end ($t=12$ weeks) of each study phase. Knowledge on DSME was measured at the baseline and the end of each study phase using a pre-validated questionnaire. T2D patients showed significant ($P<0.05$) improvements in their body weight, waist circumference and DSME score related to glucose management, healthcare use, dietary and physical activity management following the DSME programme for 12 weeks. Glycaemic control of the intervention group has significantly ($P<0.05$) improved compared to the baseline and control group as indicated by reduced HbA_{1c}. Therefore, it can be concluded that the diabetes self-management education was effective in improving the glycaemic control of T2D compared to the GEP.

Keywords: Diabetes self-management, education, glycaemic control, type 2 diabetes

Authors would like to acknowledge the Wayamba University Research Grants Scheme (SRHDC/RP/0419-16) and Medical Staff of Sandalankawa Hospital for their assistance in data collection.

Water consumption among Sri Lankan adults

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The human body is composed of about 60% water. Therefore, water is essential for human existence. Total fluid intake is recommended at 3.7 liters per day for men and 2.7 liters per day for women. A limited number of studies have been conducted to assess water consumption among Sri Lankan adults. But there is a data scarcity of the average daily water intake of adults. Therefore, this study aimed to determine the daily water intake among adults. In this cross-sectional study, a total of 385 healthy male and female adults aged between 18-60 years (mean age 37.58 ± 11.04) were recruited. Demographic details and recall of 24-hour total fluid consumption were taken from a pre-tested, self-administered online questionnaire. Adults with cognitive impairment, pregnant or lactating mothers, adults who engage in extremely fluid-losing activities, and people who had recently experienced diarrhea, vomiting, severe blood loss, or high fever were excluded from the sample. Participants were asked to estimate their total fluid intake during the previous 24 hours using the given tools. Data were analyzed using Microsoft Office Excel 2019 version and SPSS 16.0 software. The Kruskal-Wallis test and the Pearson Chi-square test were performed to test possible associations between age groups, education levels, and total water intake. The average daily total water consumption in the sample was 2.04 liters for adult women and 2.13 liters for adult men. 94% of adult men and 85% of adult women have an average daily total water intake below the recommended level. The total water consumption of both females ($P=0.04$) and males ($P=0.01$) within different education levels were significantly different. There was an association between the age group and education level of both males ($p=0.00$) and females ($P=0.00$) in terms of total water consumption. Both adult males and females had insufficient intake of water. Intervention programs should be conducted to increase the daily water intake of adults to the recommended level.

Keywords: Beverages, cross-sectional study, drinking water, fluids intake, Sri Lanka

Nutrient composition of Lunch packets available in the market

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Unhealthy dietary practices are major causes that lead rising in the prevalence of NCDs globally as well as in Sri Lanka. Most office workers, students, and people who spend most of their time outside from home take their lunch from outside restaurants as lunch packets. Most of these lunch packets are in single portion sizes without considering the individual nutritional requirements. As a practice, Sri Lankan lunch contains a larger proportion of the energy required for the day. The energy density of the food portion is an important determinant of total energy intake. This study was conducted to assess the nutritional composition of lunch packets available in the market and to make suggestions on the changes that must be made to achieve a sustainable healthy lunch model at an affordable price. A convenient sampling, cross-sectional study method was used to collect data. A total of 15 samples were collected from five different townships (3 lunch packets from each) named Panadura, Makadura, Colombo, Matale, and Dambulla areas. Lunch packets were analyzed in terms of major nutrients such as carbohydrates, proteins, fats, fiber, and total energy using Foodbase 2000 software. Mean values for Carbohydrates (145g), Proteins (24g), Fat (25g), Total calories (950kcal) were assessed. Nearly 45% of the daily calorie requirement was fulfilled only by one lunch packet (considering the normal requirement as 2000kcal per day). In conclusion, the food packets available in the market are lower in nutritional quality, and provide higher energy and carbohydrates which are not suitable for most of the lesser active consumers.

Keywords: Carbohydrates, calorie intake, non-communicable diseases, nutrient composition

Exploring the use of digital storytelling in influencing fruit and vegetable consumption among primary school-aged children

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Storybooks are a practical method to reach the young population as child-driven health education. Digital storytelling is an innovative intervention that blends storytelling and digital technology. As technology-driven nutrition education tools are becoming emerging strategies, it is pertinent to evaluate the effects of digital storytelling in influencing healthy eating. This study aimed to develop an interactive and novel digital tool based on digital illustrations and storytelling to influence fruit and vegetable consumption of primary-aged school children named 'Magic Creatures and the Nutri-Garden' along with a digital gaming component. A sequential explanatory mixed method approach was employed. A series of focus group discussions (27 in 9 schools in Uva province) and a pre and post-survey were conducted to identify the current consumption of fruit and vegetables among the selected children. The storybook was developed along with a gaming component with the themes that emerged through the focus group discussions and pretested with 20 parents and their children through pre and post-quantitative questionnaires. The results indicated an increase in the preference for most of the vegetables such as Carrots, Beans, Cabbage, and Bitter guard and fruits such as Banana, Ambarella, Guava, Mango, and Amla after the use of the newly developed digital tool. When considering the pre and post average fruit and vegetable consumption servings per day in children, post average consumption has significantly increased after the use of digital tool. Teachers, parents, and students perceived that digital storybooks offered an avenue to increase nutritional knowledge. Future studies should warrant further investigation of the developed digital storybook along with the gaming component to promote sustainable healthy eating habits in primary school-aged children.

Keywords: Digital storybook, healthy eating, parents, teachers

Diet plans and dietitians' involvement to reduce hospital food waste

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The hospital was one of the major places for food waste, and it is 10%–15% of the solid waste in hospitals. High food wastage in hospitals was associated with reduced nutritional intake of patients. This study was conducted to reduce food waste using tailor-made diet plans and dietitians' involvement in a private hospital in Colombo. A cross-sectional study was conducted. A preliminary survey was conducted to identify hospital food waste. Nutritionally high-risk hospitalized patients were selected based on a nutrition screening test performed in the hospital. Patients' information was collected using a pretested interviewer-administrated questionnaire. A food intake chart was collected during hospitalization, and the energy and protein content were calculated. Patients who are prone to contribute for food waste were identified, and tailor-made diets were prepared according to the patient's nutrition requirements. Individualized nutrition care plans were analyzed. According to the result, all patients must receive food from the hospital. And hospital food and beverage department provide more energy and more protein than their requirements. 88% of patients received more energy from the hospital diet than their requirement. Also, 84% of patients received more protein than the requirement, and data shows that 56% of patients feel that the amount of food offered is excessive. Prepared diet plans containing energy and protein ranging from 1000-1900 kcal to 50–80 g, respectively, and the average time taken to plan a diet according to individual patients' requirements by dietitian was 20 minutes. The current study's findings confirmed that individualized nutrition care plans for patients could minimize food waste by tailoring diet plans.

Keywords: Dietitian, energy, food waste, hospital diet, tailor-made diet

Sensory attributes and glycemic response of novel fruit tea infusions

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Fruit teas are becoming increasingly popular around the world due to appealing sensory attributes and beneficial bioactivities. The present study aimed to determine the sensory acceptance and postprandial glycemic response of fruit teas prepared with six different underutilized growing in Sri Lanka. The sensory evaluation was performed using 50 untrained panelists to determine the level of dried fruit tea powder to be used in the preparation of tea infusion (1.5 g, 2.0 g and 2.5g of tea powder per 200 ml of water) and to determine the most preferred type of tea. Furthermore, the potential single-dose efficacy of selected four tea infusions on the postprandial glycemic response of healthy adults was investigated. A clinical trial was led with 10 healthy adults per tea who consumed 200 mL of fruit tea infusion with 30 g glucose and 30 g glucose in 200 mL water as the control. Glucose fluctuations of blood samples were tested by using a glucometer at the baseline and postprandial at 30, 45, 60, 90, and 120 minutes. The acceptable level of each fruit tea infusions were different from one tea to another. Carambola (*Averrhoa carambola*) was the most preferred type of tea from sensory evaluation. The glycemic response of carambola, java plum, june plum and wood apple teas did not show a significant difference between the post-prandial blood glucose fluctuations after consuming glucose control and four selected fruit tea. In conclusion, novel fruit teas can be used as refreshing acceptable beverages for everyday consumption. Further research is warranted to investigate the bioactivities of fruit teas.

Keywords: Fruit tea infusion, sensory evaluation, post prandial glycemic response

Nutritional awareness and perceptions of different players in the fruit and vegetable supply chain

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Though fruits and vegetables indisputably aid in combatting the triple burden of malnutrition due to their myriad nutritional and functional properties, their consumption has been poor in many communities. Some of the concerns related to this can be attributed to the constraints in availability and affordability in the supply chain. Familiarizing the perceptions of stakeholders involved in the fruit and vegetable supply chain is, therefore, vital in identifying the potential for more nutrition-sensitive supply chains while addressing the constraints within. This study aimed to investigate the nutritional awareness and perceptions of different players in the fruit and vegetable supply chain and to propose initiatives to address constraints in the supply chain to promote sustainable healthy diets. A qualitative study was conducted with farmers, agricultural officers, collectors, transporters, wholesalers, retailers, and agriculture-related researchers covering the Central, Uva, and Southern provinces of the country. Study locations were selected, considering the supply chain players' availability and convenience. Altogether 30 key informant interviews involving different players in the supply chain were carried out. The interviews were transcribed verbatim and then the transcripts were analyzed for common themes that emerged. Based on the study results, several gaps were identified by the fruits and vegetable supply chain players. There was inadequate nutrition awareness among the supply chain players. Their perceptions were mainly focused on profit earning with minimal thought given to nutrition. The lack of dissemination of nutrition information from officials to stakeholders was highlighted. The study further revealed that the majority of supply chain players depended on the price and the perceived of the commodity, misunderstanding the requirements of the consumers. This information provides a valuable baseline to create novel yet sustainable and effective strategies to promote fruits and vegetables in the Sri Lankan diet.

Keywords: Affordability, availability, key informant interviews, qualitative study

The food literacy level of secondary school children in Sri Lanka

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Food literacy (FL) revolves around the food and nutrition related knowledge, skills, and behaviour. FL adequacy will provide them both immediate and long-term benefits where stage of adolescence is considered as nutritionally critical phase. This cross-sectional study was conducted to determine the FL level of secondary school children in Sri Lanka. Already developed FL assessment tool consists of food related knowledge, skills, and practice, was administered to 1088 secondary school children in grade 9 and 10. The schools were selected according to multi-staged cluster sampling representing children in different socioeconomic backgrounds. Thirteen focus group discussions (FGD) were conducted at schools to understand their perception on FL education. The mean Food Literacy Score (FLS) was 66. More than half of the Tamil medium students were below the mean FLS. Educational level of both mother and father showed a positive association with FLS. According to FGD, majority of the school children are keener in engaging practical. They suggested increasing the number of practicals related to food literacy conducted at schools. Majority of them suggested to provide necessary facilities and resources which was the major barrier in teaching and learning FL. Majority of them admitted the importance of food and nutrition and they are aware of nutritional guidelines. Gap was observed in applying the perceived knowledge in real life practicalities. Since the mean FLS is above 50, it can be concluded that the FL of secondary school children is satisfactory. The findings of the study would lead to constructive suggestions to improve FL education in Sri Lanka.

Keywords: Food literacy, food literacy score, secondary school children

Elevating self-reflection and food choice intention toward smart eating using a newly upgraded smartphone application

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SMART eating includes Small, Measurable, and Achievable dietary changes by Reducing unhealthy foods consumption and Trying a wide variety of healthy foods each day. Eating SMART has been widely recognized due to its implications in reducing many non-communicable diseases. With the emergence of digital nutrition tools, much attention is given to examining how meal-tracking apps can encourage self-reflection and SMART eating. This study aimed to explore the use of a meal-tracking app named SnaT (Snap & Track) on self-reflection and food choice intention towards SMART eating in adults while evaluating the acceptability and the upgraded features of the app. Young adults (n = 42; mean age = 24.5 ± 1.2; females = 57.1%; students = 88.1%) were conveniently selected and assigned to use the SnaT for a week including the weekend (7 days). Sequential explanatory mixed-method was used with online pre and post-questionnaires and telephone interviews to collect the dietary data. The results indicated an increase in consumption of a variety of healthy food including fruits ($P=0.00$), vegetables ($P = 0.01$), fruit variety ($P=0.04$), vegetable variety ($P=0.01$) while reducing the consumption of unhealthy food such as salt ($P = 0.00$), oil ($P=0.04$), and sugar & sweet food ($P=0.00$). The busy lifestyle was identified as the primary challenge for SMART eating and also forgetting to capture photos before eating has been identified as the main challenge in using SnaT. The ability to eat healthily and the desire to maintain a healthy body weight were identified as the major opportunities for using SnaT. Future research should warrant further development of the SnaT app to include a digital nudging system to prompt healthy eating while providing more personalized digital nutrition education to encourage and sustain SMART eating.

Keywords: Adults, meal tracking app, non-communicable diseases, sequential explanatory mixed-method

Effectiveness of a website on vitamin D in nutrition education

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In many academic activities, students' success depends upon their ability to envision and manipulate complex multidimensional information spaces. Different types of technological tools have been developed to enhance nutritional knowledge. Websites are used as a nutrition education tool in educating people to recognize how a healthy diet influences well-being and eating habits influence vitamin D levels in the body. Approximately 1 billion people worldwide are affected with vitamin D deficiency and around 50% of the global population has vitamin D insufficiency. According to recent research studies, vitamin D supplementation has not shown a clear benefit. These tools enable the creation of motivation for change among people and to establish desirable food and nutrition behavior for the promotion and protection of good health. Broadly this research aims to the assessment of the effectiveness of a website on vitamin D as an educational tool. In this study, ICT-literate young adults aged between 21- 24 years old are engaged. The selected population was divided into three subgroups each consisting of 36 participants. A well-developed website on Vitamin D, and booklet were used in this study as educational tools. Vitamin D knowledge score was checked before and after introduction of the educational tools. Vitamin D nutrition educational website (75.5%) increased vitamin D knowledge in considerable proportion than the booklet group (44.7%) and control (42.5%). Therefore, the website was confirmed to feature good usability and efficacy. The educational tools prepared for the study benefits for the society to obtain vitamin D knowledge. However, more broad studies are needed.

Keywords: Educational tools, young adults, nutrition education, vitamin D website, website efficacy

Association between sucrose preference and sugar content of favorite foods and beverages among Sri Lankan adults

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Preference for sweeter taste is an important determinant of greater intake of high-calorie sugary foods that leads to an increased risk of obesity & related metabolic disorders. This study aimed to determine the association between sucrose preference & sugar content of favorite foods & beverages among Sri Lankan adults. In a cross-sectional study 64 healthy adults aged between 20-60 years (Mean \pm SD, 25.1 \pm 2.7) were recruited at Wayamba University, Makandura premises. The Monell-Forced-Choice-Paired-Comparison method was used to measure the sucrose preference of adults. A food-liking survey, which contained seven points facial hedonic scale, was used to identify the favorite food and beverage item consumed by the subjects. Sugar content of favorite beverages & foods was determined using refractometer & Foodbase 2000 nutrient analysis software modified for Sri Lankan foods, respectively. A self-administered general questionnaire was used to assess the socio-demographic characteristics of subjects. Height, weight, waist & hip circumferences of the subjects were measured. Body composition was assessed using a multi-frequency segmental body composition analyzer. Level of sucrose preferred ($P=0.037$, $\beta = -3.126$, $R=0.261$) correlated with the sugar content of the favorite beverage but not with food item. Adults who preferred high sucrose levels liked low sugar beverages while male adults preferred significantly higher sucrose level than females ($P=0.044$, $R=0.252$). BMI ($P=0.004$, $\beta = -0.122$, $R=0.600$), waist-to-hip ratio ($P=0.009$, $\beta = -2.171$, $R=0.600$) and visceral fat level ($P=0.027$, $\beta = -0.080$, $R=0.600$) significantly correlated with sucrose preference of adults. Higher proportion of underweight subjects (20.3%) preferred high sucrose levels compared to normal, overweight & obese adults. In conclusion, the level of sucrose preference was associated with the sugar content of the most favorite beverage but not with the food item while males preferred high sucrose levels than females. Larger sample size with better represent of population characteristics is warranted to generalize the findings to Sri Lankan context.

Keywords: Facial hedonic scale, monell forced-choice-paired-comparison, preferred sucrose level, refractometer, sugar content

Barriers and Perceptions affecting Fruit and Vegetable Consumption of Pregnant women in Sri Lanka

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Despite fruits and vegetables are important in nutrition and health, their consumption is still below the recommended level in Sri Lanka, even among pregnant women. Therefore, it is important to know the perceptions and barriers affecting the fruit and vegetable consumption of pregnant women in Sri Lanka. The main objective of this qualitative study was to investigate the perceptions and barriers affecting the fruit and vegetable consumption of pregnant women. A total of sixteen focus group discussions with 109 participants were conducted. The participants were pregnant Sinhala, Tamil, and Muslim women. Participants were selected from maternal and child health clinics under Medical Officer of Health (MOH) areas; Negombo, Nallur and Pannala. The recorded discussions were transcribed to standard English and analyzed using the qualitative research data analysis software NVivo after establishing the question-based themes. Study findings showed lack of awareness regarding fruit and vegetable consumption among pregnant women and several barriers to fruit and vegetable consumption. Barriers included: high cost, myths, personal preference, poor quality, use of pesticides and chemicals, low income, low availability, influence and preference of family members, shelf life, medical reasons, climate, long preparation time, seasonal variation, household size, the distance between home and market and inadequate storage facilities. As the suggestions for improving fruit and vegetable consumption, promoting home gardening, conducting sessions to provide awareness regarding fruit and vegetable consumption, farmers market and financial support to low-income families were suggested by the participants. In conclusion, several barriers and constraints were identified among pregnant women in consuming fruits and vegetables. The study suggested that effective interventions to improve fruit and vegetable consumption among pregnant women are needed. They should address a wide range of barriers mentioned by participants and bring nutritional awareness about fruit and vegetable consumption to improve fruit and vegetable consumption among pregnant women.

Keywords: Barriers, fruit and vegetables, perceptions, pregnant women, Sri Lanka

Food consumption pattern during the food crisis situation in urban setting of Sri Lanka

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Sri Lanka is currently experiencing severe economic crisis since independence. It has led to food insecurity due to the increased food and non-food related inflation. Urban population is more vulnerable to the existing food crisis in their resource limited livelihoods and dependence on external resources. There is a timely necessity to assess the changes in food consumption patterns of the urban dwellers in this crisis situation. Thus, studying the food consumption pattern and consumer behavior of the urban setting during the crisis situation was the main objective of the present study. A cross-sectional study was carried out with two hundred and two ($n=202$) adults in urban areas all over the country. Telephone survey was conducted using an interviewer administrated questionnaire which consisted of questions related to socio-demographic information and qualitative food frequency questionnaire to assess their food consumption pattern over last month. Food Consumption Score (FCS) was used to determine the dietary diversity. Patterns of the consumption were analyzed using the categorical data analysis, principle component analysis and cluster analysis. Study participants were in the age range of 45-60 years and majority (73%) of them were females. According to the FCS, 88%, 10% and 2% of the households had adequate, borderline and lower dietary diversity respectively. Out of the food groups studied, more than 60% reduction in the consumption of bread, bakery products and milk powder and nearly 40% reduction in fish, meat, milk products like yogurts, curd consumption were observed among the urban dwellers. However, the rice, vegetables, roots, sugar and oil consumption was not significantly reduced during the crisis. Therefore, it can be concluded that the food crisis has affected the food consumption pattern, dietary diversity and access to nutrient dense foods of urban population.

Keywords: Dietary diversity, food consumption pattern, food crisis, food insecurity, urban setting

Underutilized accompaniments to improve nutritional quality of Sri Lankan breakfast meals

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Sri Lanka is currently experiencing worst food security situation since independence as a result of rising inflation and prices of foods. There is a high possibility to change the food consumption patterns among Sri Lankans during the food crisis and they are vulnerable to malnutrition due to inadequate consumption on nutrients. Underutilized food items are a good replacement for this issue due to their nutrition quality as well as low price. In this study, Sri Lankan breakfast meal were improved using underutilized accompaniments and photographic database was developed for an artificial intelligence based mobile application. Usual Sri Lankan breakfast meals were monitored through a mini survey with the participation of 30 participants. Five control meals were selected based on the obtained data and five test meals were developed by incorporating underutilized accompaniments. Nutrition composition of control meals and test meals were estimated using Foodbase 2000 software. Nutrient composition of each meal was compared with RDA values to find the contribution of meal for the daily requirement. Paired t-test was used to compare nutrient composition mean values of control meals and test meals. Each meal produced to 3 portion sizes and each portion captured in 7 different angles using a mobile phone. These images were used to create a photographic database. There was a difference between mean values of macronutrient in control meals and test meals but the difference was not significant ($P=0.83$). However, there was a significant difference between micronutrient mean values of control meals and test meals ($P=0.005$). Micronutrient composition of Sri Lankan breakfast meals was significantly increased when consumed with underutilized accompaniments. In conclusion, underutilized accompaniments are cost effective value addition in breakfast meals to reduce the micronutrient deficiencies among Sri Lankans.

Keywords: - *Lasia, Musa, Alternanthera, Carica, Colocasia*, underutilized foods

The relation of insulin resistance to risk of cardiovascular disease among adult men

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Cardiovascular disease (CVD) has been the leading cause of death around the world for many years. During insulin resistance (IR), several metabolic alterations induce the development of CVD. Identification of the modifiable CVD risk markers strongly associated with IR is indispensable to reducing the CVD risk among adult men. Further, quantifying the risk of CVD at a community level is important in planning early preventive strategies, but such data is limited and inconclusive in Sri Lankan context. This study aimed to investigate CVD risk and the relationship between IR and CVD risk among Sri Lankan adults. In a cross-sectional study, 174 healthy adult men aged between 30-60 years (Mean \pm SD, 43 \pm 7.9) were recruited. CVD risk score was calculated using the QRISK[®]3-2018 risk calculator and it calculates the risk of developing CVD over the next 10 years. The human Insulin ELISA Kit was used to quantify insulin in serum. IR was determined using the HOMA-IR index. The height, weight, and waist circumference of the subjects were measured. Body composition was assessed using a multi-frequency segmental body composition analyzer. Dietary intake was determined using a 3-day diet diary including two weekdays and one weekend day. Nutrient intakes were analyzed using Food Base 2000 nutrient analysis software, modified for Sri Lankan foods. Spearman's rank correlation tests were used to determine the associations while Kruskal-Wallis and Mann-Whitney tests were used in categorical data. Based on the QRISK score, the low, medium and high CVD risk of the participants was 78.2 %, 16.7 % and 5.2 % respectively. Based on the HOMA-IR, 22.4 % of the participants were in insulin resistance and 77.5 % were normal. IR was significantly positively associated with CVD risk ($p=0.032$, $r=0.163$), BMI ($p=0.001$, $r=0.537$), total body fat percentage ($p=0.001$, $r=0.444$), waist circumference ($p=0.001$, $r=0.497$), and visceral fat level ($p=0.001$, $r=0.494$). In conclusion, IR induced the CVD risk by increased total body fat, visceral adiposity, and central obesity among adult men.

Keywords: ELISA, insulin, HOMA-IR, insulin resistance, QRISK calculator

Factors influencing preschool children's diet of upcountry urban areas in Sri Lanka

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Better diet quality in preschool children is associated with many positive health outcomes and poor diets lead to a significant risk of malnutrition, including micronutrient deficiencies, which are a public health threats in Sri Lanka. Understanding the factors that influence food choices in children is necessary to promote healthy food choices. Since the preschool teachers are the second closest contacts of preschool children, this qualitative study aimed to investigate their views on the factors influencing the diet of pre-school children. Five focus groups were conducted with 30 preschool teachers, working in an upcountry urban area (Badulla) in Sri Lanka. Focus group questions were aimed to assess the views of preschool teachers, regarding the meaning of healthy eating; factors influencing the diet of pre-school children; and strategies to improve children's healthy eating. Responses were discussed as groups and audio recorded discussions underwent content analysis. Participants expressed six main themes regarding healthy eating: presence of all nutrients and balance diet, addition of a fruit to the meal, refrain foods from outlets, drink adequate water, reduce intake of foods added with salt and sugar and engage in exercise/activities. Participants stated thirteen factors as influencing preschool children's diet, which were classified into three main levels: individual; family and peer; and community level. Majority discussed family and peer level factors including work engagement of parents, their busy schedule, family size and inability to implement preschool menu effectively as most influencing. Under the individual level, Child food preference was identified as the core driving factor, whereas in community level, the country's economy, social media influences were recognized. Participants proposed a need for building good communication and trust between teachers and parents to improve healthy eating in children. Findings suggest that effective food interventions should consider the family and peer level factors and child's food preferences using proposed strategies.

Key words: Child, focus group discussion, preschool teacher, urban population, Sri Lanka

Direct and indirect costs of diabetes care among individuals with type 2 diabetes

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Type 2 diabetes mellitus (T2DM) exerts a substantial burden on individuals as well as the country's economy. Early predisposition of T2DM in most productive midlife period, adversely affects productivity and economic development of the country. However, there is limited number of studies conducted to assess both the direct and indirect cost of T2DM in Sri Lanka. Therefore, the current study was conducted to assess the healthcare cost of diabetes management by estimating direct and indirect cost of Type 2 diabetes patients in Sri Lanka. This descriptive, cross-sectional cost-of-illness study conducted from August 2022 to November 2022. Hundred and seventy-two ($n=172$) T2DM individuals were recruited from government and private hospitals. Interviewer administered questionnaire was used to collect socio-demographic, clinical data and healthcare expenditure. Direct and indirect costs were calculated and summarized using descriptive statistics. Inferential statistics were used to analyze the association between variables and cost factors. Cost factors were compared with socio-demographic and clinical factors using 'Kruskal Wallis' and 'Mann Whitney U' tests. T2DM individuals were in the age range of 40-65 years with the majority of them had their income less than of The estimated total cost for a T2DM individual was 11, 114 LKR per month. Direct cost (7,717 LKR per month; 69%) was two folds higher than that of the indirect cost (3,397 LKR per month; 31%) for the T2DM individuals. Cost of oral hypoglycaemic agents (3, 972 LKR) accounted for the largest share (51%) of direct cost followed by cost of dietary management (16%). The highest proportion of indirect cost (LKR) was from temporary unemployment (36%) followed by cost due to absenteeism (LKR 27%). Diabetes management expenditure was higher among male with higher educational level and high monthly income. Urban residents and full time employees borne more cost compared to rural residents with part-time employments. With the increased number of chronic complications and longer diabetes duration, T2DM had spent more on diabetes management. Nearly 16% of the monthly income of T2DM has spent on the diabetes management. Therefore, it can be concluded that the substantial proportion of T2DM patients' income is spent on diabetes care thus it imposes a significant financial burden on the individuals, families as well as healthcare systems of the country.

Keywords: Direct and indirect cost, income, management, type 2 diabetes mellitus

Dietary counseling resources and menus for women with Hyperglycaemia in Pregnancy

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Hyperglycaemia in Pregnancy (HIP) affects both the mother and the newborn. Women with HIP are at risk of hypertension, abortions/miscarriage and/or a pregnancy resulting macrosomal newborn, preterm birth and/or perinatal death. Nutrition education during pregnancy is an integral part in assisting the women with HIP to modify their dietary and physical activity behavior to attain the proper glycaemic control and to reduce accompanied risks. Therefore, current qualitative study was conducted with the objective of developing simple, accessible and user-friendly educational materials for assisting the women with HIP in achieving proper glycaemic control. This study consisted two phases as content identification and development. Individual interviews were conducted with sixty-five ($n=65$) women with HIP to obtain their perceptions on dietary and physical activity management, requirement of education materials for dietary and physical activity management and contents for each material. A 3-day diet diary and 3-day physical activity diary were used to assess their usual dietary intake pattern. The data analysis was performed using Nvivo 12 software and major themes were derived. Main themes were the daily calorie requirement, physical activities, blood glucose monitoring, access to educational booklet. Majority (68%) of women with HIP perceived the education booklet on diet as supportive source. In addition, they suggested to include an activity booklet and some online activities to acquire more knowledge on HIP management. Based on the perceptions, suggestions and current dietary practices of women affected with HIP, dietary education booklet, booklet with interactive activities and digital games on dietary modifications to attain proper glycaemic control were developed. It is expected that the developed materials and resources will assist the women with HIP in improving the food and nutrition literacy to achieve the good glycaemic control, their responsibilities, motivation and attitudes to better pregnancy outcomes.

Keywords: Educational materials, diet, glycemic control, hyperglycaemic in pregnancy, physical activity

Factors influencing the diet of preschool children in rural areas in Sri Lanka: parents' perception

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Child malnutrition is one of the health threats in developing countries like Sri Lanka. Preschoolers under the age of five are in a vulnerable stage of development, and the diet they consume during early age affects their development and growth, and their future health. Also, dietary habits developed in this stage long last for their whole life. Parents are the “gatekeepers” of young children's food environment and understanding their perception on factors influencing children's diet is necessary. Parental perception of rural area children was not studied yet. Therefore, this study aimed to explore the parents' perception on factors influencing the diet of preschool children in a rural area. Seven focus groups adopting the partial nominal technique were conducted with 47 parents of preschool children in rural communities in Anuradhapura District, Sri Lanka. Parents were given a list of 25 potential factors and asked to rank the six most influential and select the six least influential for their children's diet. Factors selected by the majority within the group were further discussed. Based on verbatim written transcription of the focus groups, qualitative data were extracted by content analysis. Proposed factors were categorized into three levels: individual, family and peer, and community level. Child preferences (belonging individual level), family food budget, maternal control, peers eating behaviors (belonging family and peer level), and community level factors of food price and accessibility of the shops were ranked as most influential factors. Child's gender, nutrition knowledge of the child, family size, availability of foods in shops and community cultural beliefs were selected as least influential. Family income showed significant association with food price and accessibility to food shops ($p= 0.03, 0.04$). Additionally, lengthy mealtime and television advertising were also suggested as influential factors by the participants. Individual child, family and identified community factors should be focused when developing future eating interventions in rural locations.

Keywords: Child diet, malnutrition, parental perception, rural population, Sri Lanka

The effect of *Garcinia cambogia* in metabolic syndrome risk factors

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Garcinia cambogia has been widely used as a dietary supplement in weight management. Hydroxy citric acid (HCA), an active ingredient present in *Garcinia*, plays a key role in inhibiting the synthesis of fatty acids, cholesterol, and triglycerides. The aim of the study was to identify the effect of using *G. cambogia* as a dietary supplement in metabolic syndrome risk factors. The study was a convenient sample control intervention study. The overweight or obese adults (BMI $\geq 23\text{kgm}^{-2}$ or body fat percentage; male $> 25\%$ & female $> 33\%$ or waist circumference; male > 85 cm or female > 80 cm), assigned in intervention ($n=17$) and control ($n=15$) groups, received (2000 mg 3 \times /day) of *G. cambogia* incorporated black tea or black tea (2000 mg 3 \times /day) during the 4 weeks of study period, respectively. Anthropometry, biochemical and clinical parameters were evaluated. Waist circumference and systolic blood pressure were significantly reduced in intervention group ($P<0.05$) and the post intervention waist circumference was significantly reduced compared to the control group ($P<0.05$). LDL cholesterol was significantly reduced in both intervention and control groups ($P< 0.05$). When comparing the individual changes, post intervention waist circumference and systolic blood pressure were significantly reduced compared to the control group respectively ($P<0.05$). No significant response was observed on other variables during the study period. Therefore, it can be concluded that short-term consumption of *G. cambogia* was effective in reducing certain metabolic syndrome risk factors, more particularly blood pressure and abdominal obesity (waist circumference).

Keywords: Adenosine triphosphate citrate lyase, hydroxy citric acid, lipogenesis

Sun exposure questionnaire to estimate vitamin D status in young adults

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Vitamin D is a fat soluble vitamin that is important in musculoskeletal health. Cutaneous synthesis upon sunlight exposure is considered as the main source of vitamin D for humans. Use of sun exposure questionnaire is a low cost method to assess the vitamin D status in a community setting. However, there is no validated questionnaire to assess the sun exposure in Sri Lanka. The aim of present study was to develop & validate a sun exposure questionnaire to assess the sun exposure that can be used as a proxy indicator of vitamin D status. This research was a cross sectional study conducted in Pannala Divisional Secretariat by recruiting 75 young male and female adults of 18 to 44 years old. Sun exposure behaviours were identified based on the sun exposure questionnaire which included the questions on sun exposure duration, skin exposure area, clothing habits, nature of occupation, mode of traveling, skin colour, sun avoidance and use of sunscreen. Serum 25(OH)D concentration was measured using Enzyme Linked Immunosorbent Assay (ELISA) method. Sun exposure questionnaire was analyzed using a scoring system to get a Sun Exposure Score (SES). All statistical analysis was done using SPSS software. Nature of the occupation ($P=0.021$), duration of sun exposure ($P=0.003$), sun avoidance behaviour ($P=0.050$) and skin exposure area during weekdays ($P=0.019$) and weekend days ($P=0.043$) were significantly associated with serum 25(OH) D concentration. Accordingly, the sun exposure score was developed by considering the factors that were significantly associated with serum 25(OH) D concentration. There was a positive correlation between SES and serum vitamin D concentration ($r=0.323$, $P=0.005$). In conclusion, the sun exposure questionnaire which gather the information on occupation, sun exposure duration, sun avoidance behaviour and skin exposure area can be used as a tool to estimate vitamin D status of young adults.

Keywords: Serum 25(OH)D, sun exposure behaviors, sun exposure questionnaire, sun exposure score

Acknowledgement: Wayamba University Research Grants Scheme (SRHDC/RP/04/20-21-03)

Nutrient intake and nutritional status of institutionalized older adults

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The risk for the nutritional problems among the institutionalized older adults because due to separation from their families, and insufficient meal services. Aims of this study were to identify the nutrient intake and nutritional status of institutionalized older adults. Total of 80 older adults whose age was higher than 65 years were selected from an elderly home located in Badalgama *Grama Niladhari* division located in Pannala divisional secretariat. The older adults who were mentally and physically disabled were excluded from the study. Dietary intake and functional status were measured. Three-day weighted food records were used to gather the dietary intake. Timed up and Go test (TUG) and Hand Grip test (HG) were used to measure the functional status of older adults. Mini Nutritional Assessment (MNA) was used to identify the level of malnutrition. General questionnaire was used to gather the demographic and economic details of the study participants. The details related to their health was gathered from the medical unit of the elderly home. The mean age of the participants was 75.7 ± 6.3 years. Total energy intake of older adults was 1267.88 ± 226.19 kcal/day, which is below the required average energy intake of 2200 kcal/day. Energy intake of from carbohydrates, fat, and protein were 205.6 ± 47.7 kcal/day, 29.7 ± 47.7 kcal/day, and 35.7 ± 7.0 kcal/day, respectively. Based on MNA, about 28% of older adults were belong to the category of optimal nutritional status. About, 50.0% of the older adults were at risk of malnutrition while, 22.3% were malnourished. The average HG was 13.4 ± 5.5 kg (114.9 ± 3.1 kg for women and 11.63 ± 7.2 kg for men). According to the HG test 40.2% of older adults were at risk for sarcopenia. According to TUG test majority of older adults (88.7%) had fallen risk while, only 11.3% were in the normal category. In conclusion, the energy intake of older adults was below the WHO recommendation. Considerable proportion of older adults were malnourished, sarcopenic, and high level of fallen risk.

Keywords: Energy intake, institutionalized older adults, nutrient intake, nutritional status

Association between food literacy level and fruit and vegetable consumption of school-going adolescents in Sri Lanka

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Adolescents are in a nutritionally critical stage and their food consumption patterns are highly influenced by the external environment. Food literacy is a key factor that determines the food consumption. Many adolescents do not consume fruit and vegetables on a daily basis, which may increase the risk of micronutrient deficiencies and non-communicable disease risk. This study aimed to determine the association between food literacy level and fruit and vegetable consumption of school-going adolescents and to identify the attitudes, practices, and challenges in relation to fruit and vegetable consumption of adolescents. A sample of 1088 school children in Grade 9 and 10 representing different types of schools in Sri Lanka participated in the study. A self-administered questionnaire was used to measure food literacy levels. A frequency table was used to determine fruits and vegetables consumption in the previous week. Eighteen (18) focus group discussions were conducted to investigate perceptions of fruit and vegetable consumption with 108 school children and data were thematically analyzed with NVIVO 10 software. It was found that there is a significant association between greater vegetable consumption with high food literacy scores but not with fruit consumption. Sinhala female students were more likely to eat both fruit and vegetables compared to Tamil and Moor ethnicities. The qualitative data showed that sensory perception, gender and self-confidence are powerful consumption drivers. The identity and the creativity of the person who prepares the meals as well as household consumption habits were also found to have a major impact on attitudes toward consuming vegetables among these adolescents. Availability, affordability, parents' education level, and peer influence were the challenges for fruit and vegetable intake. These findings indicate that adolescents' vegetable intake was more likely associated with high food literacy levels. Both fruit and vegetable intake of the adolescents supported by socio-environmental, personal, and behavioral determinants.

Keywords: Adolescents, food literacy, fruits, Sri Lanka, vegetables

Teachers' Confidence in teaching Food Literacy

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Food literacy is the scaffolding that empowers individuals, households, communities, or nations to protect diet quality through change and strengthen dietary resilience over time. Teachers play a major role in teaching food literacy in schools. Hence, teachers' confidence in teaching food literacy is important for better food literacy education. The objective of the present study was to investigate the teachers' confidence in delivering food and nutrition-related knowledge and skills to the students. This study was conducted as a cross-sectional study. A nationally representative sample of secondary school teachers who are involved in teaching food, nutrition, and health subjects *e.g.*: Home-science (n=103), Health science and physical education (n=45), Practical technical and skills (n=85), and Science (n=33) was recruited employing multi-stage stratified sampling. Teachers' perceived self-efficacy in teaching these subjects and beliefs in nutrition-related topics were explored using a questionnaire tool using 216 teachers (Males 35, females 181) from schools Chi-square analyses were used to examine bivariate associations between categorical variables. The majority of teachers had high or very high levels of confidence in subjects that they teach and topics related to food literacy topics. Around 50% of the teachers were confident about technological applications in teaching. Around 50-60% of the teachers said that they received adequate support from principals, education authorities and parents. Of the teachers, around 75% thought that school food environment is conducive for food literacy except school canteens and around 75% said that additional teaching tools will help in delivering food literacy effectively. The main barrier is a lack of material and financial resources. The findings concluded that teachers had high self-confidence in teaching food and nutrition education, but there are gaps in the teaching process to meet the diverse needs of students and teaching broader food-related topics.

Keywords: Food Literacy, secondary school teachers, teacher's confidence

Validity and reproducibility of a food frequency questionnaire to assess nutritional intake among Sri Lankan preschool-aged children

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Sri Lankan preschool children do not consume a varied and balanced diet, which has resulted in the prevalence of malnutrition among preschool age groups for several decades. An accurate assessment of children's diets is necessary to identify the current diet and evaluate the effectiveness of dietary behavior interventions. Currently, no validated food frequency questionnaire (FFQ) exists to measure the habitual dietary intake of Sri Lankan preschool-aged children. Therefore, a validated dietary assessment method is necessary to evaluate the validity and reliability of an adapted food frequency questionnaire (FFQ) to assess energy and nutrient intake in preschool-aged children. A cross-sectional study was conducted among the preschoolers in Ruwanwella division, Kegalle district, Sri Lanka. A total of 52 preschoolers aged 2–5 years participated in the validation study, while a subsample of 15 participants joined the reliability study. The FFQ is modified from the validated FFQ for adults in Sri Lanka and comprises 114 food items from 8 food groups. A three-day estimated dietary record (3DR) was used as a reference, and reliability was assessed through a second administration of the FFQ (FFQ2), four weeks after the first administration (FFQ1). Spearman's correlation analyses were conducted to determine the validity and reliability. The findings showed a very weak relationship between the FFQ and 3DRs ($r = -0.029$ to 0.192) except for vitamin D ($r = 0.215$), energy ($r = 0.217$), calcium ($r = 0.234$) and vitamin C ($r = 0.339$). The results indicated that FFQ overestimated the intakes of 3DR for energy (2572.1 ± 1 vs 1025.9 ± 289.5 kcal) and all selected nutrients, including protein (72.6 ± 3.4 vs 31.3 ± 1 g/day). The portion sizes of FFQ need to be reconsidered and the food list has to be modified to improve the validity of FFQ in future studies.

Keywords: Food frequency questionnaire, preschoolers, reproducibility, Sri Lanka, validation

In Vitro Starch Digestion Inhibitory Activity of Fruit Tea Infusions

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Long-term exposure to postprandial blood glucose spikes caused through the consumption of starchy foods with a high glycemic index increases the risk of developing type 2 diabetes. Tea and other herbal beverages that are rich in phenolic compounds can reduce the postprandial blood glucose levels by inhibiting starch digestive enzymes. This study aimed to identify the effect of fruit tea infusions on starch digestion inhibitory activity *in vitro*. Java plum (*Syzygium cumini*), wood apple (*Limonia acidissima*), carambola (*Averrhoa carambola*), and Ambarella (*Spondias dulcis*) fruit tea infusions were studied in the present work. Black and green teas were used to compare their effect with fruit tea infusions on starch digestion inhibitory activities. The inhibition of rice and wheat flour starches were investigated. Both rice and wheat flour were co-digested with fruit tea, black tea, and green tea infusions. The free glucose content of digested samples was determined using the diagnostic enzymatic kit and the inhibition percentages of tea infusions were calculated. Total phenolic content and antioxidant activity by DPPH radical scavenging assay of digested tea samples were determined. All tested tea infusions showed a significant inhibitory effect on the digestion of starch from both rice and wheat flour. Java plum and wood apple tea infusion showed the highest inhibition of starch digestion. There was no significant effect of the brewing method and total phenolic content on inhibitory activity of starch digestion. However, this study showed a strong positive relationship between total phenolic content and DPPH radical scavenging activity. In conclusion, fruit tea infusions may have the potential to serve as a functional beverage in the prevention and treatment of type 2 diabetes.

Keywords: Antioxidant, hot and cold brewing, polyphenols, postprandial blood glucose, type 2 diabetes

Effect of hot and cold brewing on phenolic content, antioxidant and enzyme inhibitory activities of novel fruit teas

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Fruit tea is becoming more popular in the world due to its antioxidant properties, taste and aroma. The incorporated fruit teas used in this study were Wood apple (*Limonia acidissima*), Java plum (*Syzygium cumini*), Ambarella (*Spondias dulcis*), and Star fruit (*Averrhoa carambola*), and black and green tea (*Camellia sinensis*) were used as reference teas. This study aimed to determine the phenolic content, antioxidant and alpha-amylase inhibitory activity of fruit teas underwent hot and cold brewing. A sensory evaluation was conducted with 50 untrained panelists to confirm the intensity level of fruit tea powder. The total phenolic content (TPC) was examined using the Folin-Ciocalteu method. The total flavonoid content (TFC) and proanthocyanidin content were determined by using the spectrophotometric method and anthocyanin content was measured using the spectrophotometric pH differential protocol. The antioxidant properties of fruit teas were examined using the DPPH radical scavenging activity (DRSA), reducing power (RP) and ferrous ion radical scavenging activity (FICA). Enzyme inhibitory activity was determined using the alpha-amylase inhibition assay. There were significant differences of TPC, TFC, proanthocyanidin content, anthocyanin content, DRSA, RP, FICA and alpha-amylase inhibition assay among different teas. The highest TPC, TFC, proanthocyanidin content, DRSA and RP were determined in green tea but alpha-amylase inhibitory activity was high in black tea. Anthocyanin content was high in java plum and FICA was high in star fruit. From fruit teas TPC, anthocyanin, DRSA and RP were high in java plum and TFC and FICA were high in star fruit. In conclusion, there was a considerable TPC, TFC, anthocyanin, antioxidant and alpha-amylase inhibitory activity in the respective fruit teas used. The proanthocyanidin content of fruit teas was lower than green tea and black tea. Therefore, the findings emphasize the benefits of fruit teas for promoting health.

Keywords: Alpha-amylase inhibition activity, antioxidant capacity, bioactive components, brewing, fruit tea

Vitamin D status and its determinants of young adults in Sri Lanka

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Vitamin D is an important nutrient involve in musculoskeletal health. It is important to identify the vitamin D status and its determinants in order to take remedial action to improve the vitamin D status. However, there are no studies have been conducted in Sri Lanka to identify the vitamin D status and factors associated with vitamin D status in young adults. This study was aimed to identify the vitamin D status and its determinants in young adults. Total of 75 young adults (18-44 years old) were recruited from three different Grama Niladhari Division in Pannala divisional secretariat located in Kurunegala district by stratified random sampling method. Socio-demographic, life style, dietary and anthropometric data and knowledge about vitamin D were gathered. Three-day diet diaries were used to gather the dietary information to identify the vitamin D intake. Sociodemographic, life style information and knowledge about vitamin D were gathered using interviewer administrated questionnaire. Serum 25(OH)D was measured using enzyme-linked immunosorbent assay (ELISA). Mean serum 25(OH)D concentration of the participants was 19.87 ± 7.27 ng/mL. According to the recommendation of Institute of Medicine (IOM), prevalence of vitamin D sufficiency, insufficiency and deficiency were 39% ($n=29$), 53% ($n=40$) and 8% ($n=6$), respectively. Vitamin D status was associated with gender ($P=0.01$), where the mean value of serum 25(OH)D for males (22.19 ± 8.42 ng/mL) was higher than females (17.61 ± 5.09 ng/mL). Age ($P=0.013$) and vitamin D intake ($P=0.032$) showed significant positive association with serum 25(OH)D concentration. However, the significant association between vitamin D intake and serum 25(OH)D was disappeared when the association was adjusted for energy intake. Ethnicity, religion, monthly income, anthropometric data, education level alcohol use, and tobacco usage were not significantly associated with serum 25(OH)D concentration. In conclusion, more than half of the population was vitamin D insufficient. Vitamin D status of young adults was influenced only by age and gender.

Keywords: Determinants, serum 25(OH)D, vitamin D status, young adults

Acknowledgement: Wayamba University Research Grants (SRHDC/RP/04/20-21-03)

Developing a healthy and sustainable diet model for lunch packets to the Sri Lankan market

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Food insecurity in Sri Lanka has increased dramatically in the recent past due to poor harvests, foreign exchange shortages, and reduced household purchasing power. The nutritional quality of the lunch packets available in the market plays a major influence on the consumers, which can significantly change the consumer consumption pattern and decision-making behavior. The objective of this study was to develop locally available, low-cost nutritionally balanced sustainable dietary models for to the Sri Lankan market. The study was conducted by observing and analyzing several existing lunch packets in the market. identified the issues and changes in the current lunch menus. Major issues of the current lunch menus are higher calorie amounts, higher cost, and inappropriate macronutrient distribution. These data were collected by direct observation, market survey and key informed interviews. Based on these results nine-lunch models were developed by incorporating locally available, nutritionally rich, lower-cost food alternatives using different carbohydrates and alternative protein sources to increase the lunch packet's dietary diversity. The amounts of each cooked portion were determined, and the prices of each model were calculated. Nutrient compositions of models were determined by using Foodbase 2000 software consisting of Sri Lankans recipes. The dietary models were compiled into a booklet. Nine lunch models were developed to maintain the basic nutritional requirement of the general consumers. The eBook consists of a comparison of current market lunch packets and developed lunch models, consisting nutrient compositions. It can be concluded that it is possible to develop sustainable, comparatively lower-cost, nutritious lunch models, using locally available food ingredients.

Keywords: Dietary diversity, low cost, lunch packet model, nutrition composition, sustainable

Development of a photographic food atlas while providing metadata for modeling an AI-assisted dietary assessment in the Sri Lankan context

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Novel mobile and photographic dietary assessment tools are becoming popular presently. A food atlas is a set of food photograph series, which can be used to describe portion sizes, while FRANI (Food Recognition Assistance and Nudging Insight) is an AI-assisted dietary assessment tool that accurately estimates nutrient intake among adolescent girls in low and middle-income countries. This study aimed to develop a food atlas of commonly consumed food in Sri Lanka while providing metadata to model FRANI to track and influence the quality food choices of adolescent girls. From 15 different food groups, 319 food items that are commonly consumed in Sri Lanka were prioritized. Out of these priority food items, certain food items were prepared based on a standard recipe book while other items were purchased from the local market to include in the Food Atlas. White color crockery with a gray color background was used to present the food items and they were photographed using a smartphone with a 13-megapixel camera. The photographs were taken from 45 and 90-degree angles. Out of 319 priority food list total of 250 foods with different portion sizes (6 portion sizes ($n=138$ foods), 4 portion sizes ($n=68$ foods), 2 portion sizes ($n=14$ foods), and single foods ($n=30$ foods)) that are commonly consumed by Sri Lankan adolescents were included in the Food Atlas. Consequently, for modeling FRANI, real-world food images were captured according to the prioritized food list. The photographs were then provided to train the FRANI AI model for image recognition and influence the quality of food choices of adolescents. In conclusion, the Food Atlas will be a valuable source for dietary assessment and surveys in Sri Lanka while the FRANI is an AI-based, gamified self-monitoring app that aims to help adolescents in low and middle-income countries improve their diets.

Keywords: Adolescents, AI model, dietary assessment, smartphone

Authors would like to acknowledge the financial assistance received from International Food Policy and Research Institution.

Pumpkin Soup (*Cucurbita maxima*) as a Strategic Weight Loss Meal Replacement

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Obesity is an alarmingly increasing global public health issue including in Sri Lanka. Obesity prevention is a critical factor in controlling obesity-related non-communicable diseases (NCDs). Weight reduction in obese adults lowers the risk for NCDs. Maintaining a negative energy balance by providing low-calorie meal replacements is a widely used strategy for weight management. *Cucurbita maxima* is a low-calorie nutritious commonly available vegetable in the local Sri Lankan market with blood glucose and cholesterol-lowering effects. This study aimed to evaluate the effect of consuming pumpkin soups as a low-calorie dinner meal replacement on the weight and metabolic parameters of overweight and obese adults. A parallel, randomized controlled community intervention trial was conducted in 44 adults with mean \pm SEM age and BMI 37.7 ± 11.2 years and 28.8 ± 4.0 in kg/m^2 , respectively for a period of 8 weeks. Participants were randomly assigned to the test and control groups on a 1:1 ratio. The intervention group ($n=22$) was provided with a low-calorie meal replacement 'pumpkin soup' prepared using 250g of whole pumpkin as a dinner four times per week, and the control group ($n=22$) were asked to continue their habitual diets. Both groups received general food-based dietary guidelines before starting the trial. Weight, height, waist and hip circumferences, and body composition measurements were taken at 0, 4, and 8 weeks. Fasting blood glucose, lipid profile, blood pressure, and arterial stiffness in terms of pulse wave velocity were assessed during the baseline and the last visit. There were no significant differences in baseline characteristics between the two groups. There was a significant ($P=0.001$) weight reduction in the intervention group (2.7kg) than in the control group (1.3kg). A significant reduction in fat mass ($P=0.003$), visceral fat level ($P=0.029$), waist circumference ($P=0.001$), total cholesterol ($P=0.002$), and LDL cholesterol ($P=0.001$) were observed in the intervention group than in the control group. In conclusion, the use of pumpkin soup as a dinner meal replacement showed favorable effects on weight reduction and improving cardio-metabolic parameters in overweight and obese adults.

Keywords: Dietary fiber, intervention, low-calorie, obese, overweight

Glycemic Index and Satiety Index of a cereal and legume-based formulated breakfast cereal

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Foods with high satiety index, are useful in managing weight and obesity which is a condition contributes to the occurrence of several non-communicable diseases such as type 2 diabetes. The aim of this study was to determine the satiety index (SI) and the glycemic index (GI) of a cereal and legume-based formulated breakfast cereal. This randomized cross-over clinical trial was conducted with 17 healthy normal-weight adults (11 females, 6 males) aged 23 - 27 years. Anthropometric indices of the participants were measured in the first day. In the next two days, participants consumed two isocaloric 1255.2 kJ (300 ± 5 kcal) servings of test and reference meals to check the SI. They consumed the breakfast cereal (40 g) as the test food and glucose as the reference in another 02 days, which is equivalent to 30 g of available carbohydrate. Satiety ratings were obtained every 15 min over 2 hours using a 7-point scale and their blood-glucose levels were monitored for 2 hours for the glycemic index. The glycemic index of the breakfast cereal was 61 ± 21 and the satiety-index was 152 ± 35 %. There was a significant reduction in blood glucose levels at 30, 45, 60, 90 minutes after having the test food. No significant correlation between GI and SI was observed. In conclusion, cereal legume breakfast cereal is medium GI and high SI breakfast option.

Keywords: Anthropometric indices, diabetes, isocaloric, obesity, randomized cross-over clinical trial

Introduction of energy saving high protein meal preparation techniques for elderly surgical patients

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Introducing energy-saving high-protein meal preparation techniques is an important solution for the current economic crisis and fuel crisis. The objectives of this study were to identify high-protein sources for surgical patients and the introduction of energy-saving preparation techniques for high-protein meal preparation. A cross-sectional study was conducted in one of the private hospitals in Colombo for selected 30 elderly surgical patients. The hospital meal ordering system was analyzed for a week. Pretested interview administrative questionnaires were used to identify preferred protein meals and meal preparation techniques in the hospital. Selected most preferred high-protein meals were prepared in the dietetic lab under various preparation techniques and a sensory evaluation test was done for university students. Energy consumption values by cooking devices and ingredient costs for a portion of each high-protein meal were calculated. Meals with lower energy consumption, lower ingredient cost, more preference, and high protein quantity contained in 100g of meals were selected to introduce the hospital meal ordering system. From fish preparations, fish red curry (997.44kJ, 27g), fish grilled (467.55kJ, 26.59g), fish steamed (311.7kJ, 25.83g), fish baked (935.1kJ, 30.03g), from chicken preparations, chicken sautéed (218.19kJ, 20.96g), chicken roasted (1028.61kJ, 21.78g), chicken grilled (685.74kJ, 15.12g), chicken baked (1246.8kJ, 18.50g), chicken *masala* (1246.8kJ, 13.12g), from egg preparations, egg omelet (187.02kJ, 26.92g), boiled egg (311.7kJ, 7.79g), from milk preparations, corn flakes and muesli with milk (155.85kJ, 5.25g) and from plant sources, dhal curry (623.4kJ, 13.27g), chickpea boiled (623.4kJ, 11.96g), green gram curry (1246.8kJ, 10.68g), winged beans *mallum* (623.4kJ, 6.24g), soy meat curry (1402.65kJ, 13g) were selected as energy saving high-protein meals. Introducing energy-saving high-protein meals suggested from this study's findings to the hospital meal ordering system could be supported to reduce the total hospital meal preparation cost.

Keywords: Economic crisis, energy saving, high protein meal preparation, hospital meal ordering system, sensory evaluation test

Effect of *Garcinia cambogia* on visceral fat accumulation

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Prevalence of obesity is increasing in all parts of the world including, Sri Lanka. Obesity is caused by visceral fat accumulation, is a serious risk factor for chronic diseases such as type 2 diabetes, cardiovascular disease (CVD), and hypertension. While weight-loss medications play a minor role, diet, exercise, and behavior modifications remain the main options for obesity treatment. Several studies showed that positive effect of Hydroxy Citric Acid in *Garcinia cambogia* on weight loss treatment. This study was aimed to determine the effect of *G. cambogia* consumption on visceral fat accumulation in overweight and obese adults. A convenient sample control intervention clinical trial was conducted for four weeks period within 32 overweight or obese adults (aged 18-65 years) with Body Mass Index (BMI) ≥ 23 kg/m² and/or body fat percentage; male > 25% and female > 33% and/or waist circumference; female > 80cm and male > 85cm. Subjects were assigned to the treatment group ($n=17$) and control group ($n=15$), treated with *G. cambogia* incorporated tea bags (2000mg 3 \times /day) or black tea bags (without Garcinia) (2000mg 3 \times /day) for a period of four weeks, respectively. Anthropometric and biochemical parameters were evaluated at the baseline and endpoint. The results revealed after the four weeks of study, the mean value of weight, BMI, waist circumference, waist- to- hip ratio, visceral fat level, and body fat percentage were significantly reduced in the treatment group ($P<0.05$) compared with the control group. LDL was significantly reduced in both treatment and control groups ($P< 0.05$). When comparing the individual changes, post - intervention weight, BMI, and waist circumference were significantly reduced in the treatment group ($P<0.05$) compared with the control group. Therefore, it can be concluded that the short-term treatment with *G. cambogia* was effective in weight reduction and reduction of waist- to -hip ratio, visceral fat level, and body fat percentage.

Keywords: *Garcinia cambogia*, hydroxy citric acid, obesity, visceral fat, waist to hip ratio

Opportunities and challenges of school-based gardens as a tool for promoting food literacy among secondary school students

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School gardens are an integral part of promoting food literacy and nutritional education among children in many countries worldwide. Proper food literacy education in secondary school settings could provide immediate and long-term health benefits for adolescents. The exploration of multiple stakeholders' perceptions of school gardening and its influence on food literacy could provide recommendations for further improvement. Therefore, this study aimed to review the current status of school gardens by assessing the opportunities and challenges of school gardens to promote food literacy and identifying the best strategies to promote and sustain the effective conduct of school gardens. A series of key informant interviews were conducted with teachers and principals of a sample of 10 schools in Western and North-western provinces in Sri Lanka. Also, three In-Service advisors (ISA) in zonal education offices and five professionals from different expertise fields were interviewed. Altogether, 36 key informant interviews (participants = 36) were conducted. The interviews were transcribed verbatim and the transcripts were analyzed by thematic analysis. Based on the results, the school gardens were mainly initiated to provide agricultural knowledge and skills, but not to promote food literacy. Many participants indicated the significance of skill-based food literacy education through school gardens, referring to low food-related knowledge, skills and practices among adolescents and contemporary consumers. Key members perceived improvements in preference towards fruits and vegetables, cooking skills and numerous practical experiences through school gardens. Time constraints, the negative attitudes of teachers and students and lacking resources were the main challenges. Suggested recommendations included allocating a specific time period for gardening, incorporating a considerable proportion of food literacy lessons into the school curriculum, proper teacher training on the delivery mode and facilitating resources. This study suggests recommendations for the effective use of school gardens as a learning tool for food literacy while addressing the identified opportunities and challenges.

Keywords: Adolescents, gardening, nutrition, secondary schools

Acknowledgment: This research was funded by the Nestle Foundation Research Grant 2022.

Association of insulin resistance with cardiovascular disease risk among female adults

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Cardiovascular disease (CVD) is the number one killer in women globally including Sri Lanka. Although, insulin resistance (IR) by itself is a major CVD risk factor, the association between IR and CVD risk among adult women is less researched. This study aimed to investigate CVD risk and the relationship between IR and CVD risk among healthy adult women. In a cross sectional study 149 healthy adult women aged 30-60 yrs (Mean \pm SD, 41.4 \pm 8.1) were recruited. CVD risk score was calculated using the QRISK[®]3-2018 risk calculator which calculates the risk of developing CVD over the next 10 years. Fasting serum insulin level was assessed using ELISA method. HOMA-IR index was used to determine IR. Height, weight, and waist circumference of the subjects were measured. Body composition was assessed using a multi-frequency segmental body composition analyzer. Pulse wave velocity (PWV) was measured using an oscillometric PWA Monitor device. Dietary intake was determined using a 3-day diet diary including two weekdays and one weekend day; were analyzed using Foodbase 2000 software, modified for Sri Lankan foods. Socio-demographic, lifestyle, physical activity, and menopausal status were collected using an interviewer administrated questionnaire. There was no association between IR and CVD risk score ($r=0.041$, $P=0.616$). Low and medium level of CVD risk were 98.7% and 1.3%, respectively. Prevalence of early and significant IR was 25.6% and 22.1%, respectively. There were significant positive associations with waist circumference ($r=0.194$, $P=0.018$), visceral adiposity ($r=0.246$, $P=0.002$), PWV ($r=0.895$, $P=0.000$), total cholesterol ($r=0.298$, $p=0.0001$), and LDL-cholesterol ($r=0.373$, $P=0.0001$) with CVD risk. Dietary intake of fiber, cis-polyunsaturated fatty acids, iron, folate and vitamin E showed significant negative associations with CVD risk. In conclusion, there was no association between IR and CVD risk among female adults while waist circumference, visceral adiposity, PWV, total cholesterol and LDL-C, positively associated with CVD risk. Healthy eating may reduce the CVD risk.

Key words: Body composition, HOMA-IR, insulin resistance, lipid profile, q risk

Smartphone app for managing the glycaemic control of women with Hyperglycaemia in Pregnancy

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Hyperglycaemia in pregnancy (HIP) remains a significant public health problem in South Asia and particularly in Sri Lanka. It impacts on maternal, newborn and child health and the future burden of type 2 diabetes and cardio-metabolic disorders. Majority of the affected women can be managed effectively with the proper glucose monitoring and intensive lifestyle modification counseling through the provision of self-awareness and self-care. Therefore, the current study was conducted with the objective of developing a smart phone app as a novel tool to assist the women affected with HIP in monitoring and self-managing the condition. This cross-sectional descriptive study was conducted in three phases as need analysis, design and development of the app. Individual, semi structured interviews were conducted with 65 women with HIP to identify their perceptions on usability content identification for the app. Perceptions were analyzed using NVivo 12 software and themes were generated. Majority of the participants (97%) perceived a smartphone app as an effective tool in assisting their blood glucose monitoring and managing their glycaemic control. Risk factors and complications of HIP, blood glucose monitoring, dietary management, physical activity guidelines, answers for the frequently asked questions and reminders were six main functions identified for app. A database was developed using the data from initial and follow up assessments. Algorithms were developed to link tailored recommendations with user's data. User interfaces were designed by the Figma user interface development software. Flutter Android or IOS based smartphone app was developed using the PHP/Flutter and Java Script as programming languages. Knowledge and tailored recommendations provided through this study may enhance the self-motivation and self-efficacy of pregnant mothers with HIP to achieve proper glycaemic control and better pregnancy outcomes.

Keywords: Glycaemic control, hyperglycaemia in pregnancy, glucose monitoring, lifestyle modification, smartphone app

**Department of Food Science and
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Antimicrobial and biodegradable packaging for uncut fresh fruits, from banana pseudo-stem pulp and stem bark extract of Sri Lankan endemic plant, *Hal* (*Vateria copallifera*)

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In Sri Lanka, annually, 30-40% of fruits and vegetables are lost as post-harvest losses and it causes a loss of approximately LKR 20 billion to the Sri Lankan economy. From all the possible causes, microbial spoilage remains a primary reason for fruit spoilage. The primary objective of this study was to formulate an antimicrobial and biodegradable food packaging against fruit spoilage microorganisms. Banana pseudo-stem pulp was obtained through a soda-pulping process and the *Vateria copallifera* stem bark extraction process was optimized using five different solvents: distilled water, 70% acetone, 99.9% acetone, 70% ethanol, and 96% ethanol. The tensile properties and biodegradability of the packaging material with four different pulp concentrations were evaluated. The antimicrobial activity of *V. copallifera* extract was screened using the agar well diffusion method, against four common gram-positive and gram-negative bacterial strains and two fungal strains: *Staphylococcus aureus*, *Streptococcus pyogenes*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Penicillium* spp., *Aspergillus* spp. The bacterial strains which showed significant inhibition zones were used to determine the Minimum Inhibitory Concentration (MIC). The soda pulping process yields $44.08 \pm 2.81\%$ pulp with $4.86 \pm 0.03\%$ lignin content. 99.9% acetone ($10.50 \pm 0.08\%$) and 96% ethanol ($10.35 \pm 0.10\%$) showed the highest phenolic content per dry matter, with no significant difference between the two. Only *S. aureus*, *S. pyogenes*, and *penicillium* spp. showed significant inhibition zone diameters with 18.47 ± 0.76 mm, 20.47 ± 0.50 mm, and 15.27 ± 0.61 mm respectively. MIC of *V. copallifera* for *S. aureus* and *S. pyogenes* was >0.25 mg/mL and >0.125 mg/mL respectively. Together, the results depicted, that the formulated packaging material has the potential to be an effective antimicrobial and biodegradable packaging, mainly against gram-positive bacteria and some fungi. Somehow further studies should be carried out to evaluate the actual performance of the formulated fruit wrapping package.

Keywords: Fruit wrapping, minimum inhibitory concentration, solvent extraction, tensile properties, well-diffusion

Bioactive and physicochemical properties of Palmyra (*Borassus flabellifer linn*) fruit pulp collected from several region of Sri Lanka

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Borassus flabellifer Linn. (Palmyra Palm) is widely distributed mainly in the Northern parts of Sri Lanka as well as several other regions around the country and the Palmyra fruit pulp (PFP) is used in preparation of many traditional and commercial food products. External factors such as climate, soil can cause changes in plant composition and thus the composition of the fruit pulp. Therefore, a better knowledge in compositional variation of PFP in different geographic locations will help to choose the correct samples for product development purposes. Current study intended to determine the physiochemical composition, antioxidant activity and availability of bioactive compounds in PFP collected from 3 different regions of Sri Lanka. Samples were collected from Hambantota, Puttalam and Jaffna to determine the physicochemical properties, antioxidant activity, quantify the flavonoid compounds and qualitatively analyze the phytochemicals in PFP. By using the pulp physiochemical properties were determined and freeze-dried pulp was sequentially extracted into petroleum ether, acetone, and methanol separately to determine antioxidant activity and analysis of phytochemicals. The total polyphenolic content, DPPH scavenging assay, total flavonoid content and total carotenoid content were determined under antioxidant activity and bio active compounds. The result was analyzed using SPSS and it was given that three variety of Palmyra fruit pulps were significantly different ($P < 0.05$) in pH, moisture content, fat and total sugar content under physicochemical properties. For the total phenolic content, Puttalam methanol extract showed the highest value (24.13 ± 0.93 mgGAE/g) while total flavonoid content was seen highest in the Hambantota acetone extract (7.49 ± 1.05 mgRE/g). Puttalam methanol extract showed highest value for the total antioxidant capacity (82.254 ± 1.667 mgAE/g). Unless Alkaloids, all other phytochemical tests were positive for Hambanthota methanol extract. This study indicates that there is a difference in bioactive compounds and the physiochemical properties between each region of Palmyra fruit pulp.

Keywords: Antioxidant capacity, flavonoid content, phenolic content, physicochemical property solvent extract.

Development of composite flour incorporated with banana pseudo-stem flour and application in an edible food container

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In Sri Lanka, *Embul* banana, *Musa acuminata*, is a widely grown and frequently consumed fruit. The banana plant's pseudo-stem produces just one bunch of bananas before withering and leaving behind a considerable amount of residue. Due to Sri Lanka's continuous economic crisis, the cost of wheat flour and related products has periodically gone up. The purpose of this study was to develop composite flour using banana pseudo-stem flour as a wheat flour substitute for usage in edible food containers like waffle cones. Banana pseudo-stem flour was prepared by treating pseudo-stem pieces with citric acid and sodium metabisulphite followed by drying (60 °C for one day). Thirty semi-trained panelists participated in a sensory evaluation (7-point hedonic scale) to choose the best waffle cone made from three different flour combinations. The product was evaluated for appearance, color, texture, taste, smell, and overall acceptance. The sensory-accepted product contained 10% of banana pseudo-stem flour and it was used for further analysis. The major nutrient composition of the ice cream cone was determined by proximate analysis (AOAC, 2000). The shelf life of the developed product was done by determining the total plate count, yeast and mould count, moisture content, and water activity. Water activity and moisture content of banana pseudo-stem flour were changed to 0.46-0.53 and 7.05%- 7.07%, respectively during storage. The developed cone was analyzed for proximate composition; carbohydrates (69.23 ± 0.14%), crude fiber (2.34 ± 0.10%), crude protein (12.92 ± 0.18%), crude fat (13.43 ± 0.25%), and Ash (1.63 ± 0.12%). The water activity, total plate count, and yeast and mold count of the cone were not significantly ($P > 0.05$) changed during the storage. Developed pseudo-stem flour and composite flour have comparatively high fiber content and could be used as a wheat flour substitution in processed foods.

Keywords- Banana pseudo-stem, gluten free flour, waffle cone, wheat substitution

Development of a synbiotic beverage with palmyra fruit pulp and evaluation of nutritional and functional properties

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Recently, Probiotics are used as a novel viable ingredient in functional food. Due to growing consumer demand and health benefits, there is a commercial interest in the value addition of already existing products with probiotics. Palmyra (*Borassus flabellifer*) fruits rich in nutrients in Sri Lanka which contains sugar, dietary fibre, carotenoids, vitamin C and minerals. However, its usage is limited. This study investigated to develop a synbiotic beverage with palmyra fruit pulp (PFP). Beverages were prepared with four different formulations by incorporating 5%, 10%, 15% and 20% fruit pulp and four different fermentation times 1, 2, 4 and 6 h. The most preferred beverage was chosen by sensory evaluations. It contains 15% fruit pulp and was fermented for two hours at room temperature ($30 \pm 2^\circ\text{C}$). The proximate and functional properties of PFP and beverages were analyzed. Also, the synbiotic beverage was compared with the commercially available palmyra fruit drink. Moisture, protein, fat, crude fibre, ash and carbohydrate content of the final product was $89.27 \pm 0.25\%$, $0.17 \pm 0.01\%$, $0.80 \pm 0.01\%$, $0.94 \pm 0.13\%$, $0.12 \pm 0.05\%$ and $8.72 \pm 0.24\%$ respectively. Total phenolic content, total flavonoid content, total carotenoid content and antioxidant properties of synbiotic beverage were 49.88 ± 1.89 mg GAE/L, 12.58 ± 3.87 mg RE/L, 175.72 ± 25.68 mg/L, and $19.35 \pm 1.08\%$ respectively. Physico-chemical properties (pH, titratable acidity, total soluble solid (TSS)) and viable bacterial counts, were observed throughout the four weeks of storage time under the refrigerated ($5 \pm 1^\circ\text{C}$) conditions. The lactic acid created by the probiotic caused the pH to decrease from 3.72 to 3.30 and titratable acidity increase significantly ($P < 0.05$). There was a significant reduction in TSS from 10°Brix to 9°Brix. Probiotic count within standard range (10^7 to 10^8 cfu/ mL) and prebiotic properties were maintained until end of 21 days. The synbiotic beverage with PFP showed better quality attributes when compared with the commercial palmyra drink.

Keywords: Functional food, palmyra, prebiotics, probiotics

Effect of added tea waste extracts on color stability of chicken meat burger

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Antioxidants are added to fresh meat and meat products to delay lipid oxidation, emergence of off flavors, and enhance colour stability. As natural antioxidant agent black tea extracts are added to improve the red colour stability of chicken burger. Chicken patties were incorporated with different black tea waste extract 0.05% (w/w), 0.1% (w/w) as different concentrations. Prepared burger samples are stored separately refrigerated and frozen conditions for respectively 8 days and 12 weeks and measured L, a & b values for 1-day intervals and 1-week intervals. Also control sample was prepared. pH value of all the samples were measured on respective days as previous. There was a significant red colour (a* value) found in black tea waste extracts applied samples compared to control and 0.1% sample showed higher colour stability compared to Control and reference ($P < 0.05$). Colour difference compared to day 1 to day 3 and week 1 to week 2 significant difference can be found in treated samples compared to controls ($P < 0.05$). TPC was conducted for different storage conditions and results showed that less microbes in treated samples compared to control ($P < 0.05$) and treated samples have higher pH value than the control ($P < 0.05$). According to sensory analyzed results treated samples Significantly differ in color preference and overall acceptability with control and reference ($P < 0.05$). Theaflavin and Thearubigins like antioxidants agents in black tea reduce the lipid oxidation and decrease rate of colour depletion in treated patty samples. Tea extracts were totally soluble in the minced chicken formula with cold storage conditions and that improve the colour retention.

Keywords: Antioxidant, concentration, control, extract, sample

An estimation of protein adequacy in the diet of female lactovegetarians in Nallur, Jaffna

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There has long been a debate on how much protein should be consumed through vegetarian and vegan diets. Many residents of Jaffna are vegetarians and vegans, and out of this group, lacto-vegetarians were selected for this survey. Protein intake of lacto-vegetarian females (Between the ages of 20 to 60 years) in Nallur, Jaffna was evaluated using a survey questionnaire supported by a food diary. This cross-sectional study included 165 female lacto-vegetarians. Dietary intake was assessed using a pre-tested, structured type questionnaire. The protein content consumed daily was calculated using Food Base 2000 software and protein adequacy was associated with the Recommended Daily Allowances (RDA) for Sri Lankans. Participants were grouped according to the age as follows; 21 to 30 years, 31 to 40 years, 41 to 50 years and 51 to 60 and the mean protein intake was analysed using SPSS 16.0. The mean protein intake of the age group 21 - 30 ($n = 15$), 31- 40 ($n = 10$), 41 - 50 ($n = 81$) and 51 to 60 ($n = 59$) were 46.3 ± 7.1 g/day, 52.7 ± 8.8 g/day, 53.6 ± 6.7 g/day and 53.7 ± 7.4 g/day respectively. As the RDA value for protein for females between the age of 20-60 with moderate physical activity is 52g/day, it was concluded that the mean protein intake of female lacto-vegetarians who participated in this study (53.0 ± 7.4 g/day) was adequate to meet the RDA. Out of the total group, 70.9% were consuming an adequate amount of protein but, the age group between 21-30 years consumed less amount of protein as compared with RDA value. Their diet consisted mostly of milk, grains, and legumes and their food choices were influenced by their busy life style. Additional scientific evidence-based protein sufficiency studies will be necessary to provide further information regarding the protein sufficiency of vegetarian and lacto-vegetarian diets.

Keywords: Food culture, Jaffna, lacto vegetarian, protein adequacy, protein intake, RDA value

Development of Lentils substitute using Jack fruit seeds

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Jack fruit (*Artocarpus heterophyllus*) is a well-known fruit in many Asian countries including Sri Lanka. Jack fruit seeds are underutilized and less acknowledged by the consumers leading to a huge quantity of wastage. Jack fruit seeds have considerable nutritional benefits and functional properties. This study aimed at developing a substitute for red lentils (*Lens culinaris*) using jack fruit seeds subjected to several treatments such as dehydration, blanching & dehydration, steaming & dehydration, and roasting. The effect of above treatments on the developed product was determined. According to the sensory test, blanched & dehydrated product showed the higher mean score values for the tested sensory attributes. Proximate composition of the selected lentil substitute showed 15.49 (± 0.10), 1.62 (± 0.14), 2.61 (± 0.31), 3.49 (± 0.11) and 68.55 % of protein, crude fat, crude fibre, ash and carbohydrates respectively. In comparison to lentils the substitute was 15% and 4 % lower in proteins and crude fibre respectively while the carbohydrates were 12% higher with slight higher levels of ash and fat content. The physical properties revealed 69.06% (± 1.04), 141.5 (± 1.08) and 314.21% ± 0.12 for oil absorption capacity (OAC) and water absorption capacity (WAC) respectively whereas lentils showed higher OAC (77.56% ± 0.08 g/g) and SP (364.12% ± 0.08 g/g), and lower WAC (136% ± 0.12 g/g). The functional properties were 0.157 ± 0.00 (GAE mg/g) of total phenolic content (TPC) and 21.11 ± 0.25 (of antioxidant activity (AO)), whereas in lentils higher values of TPC (0.278 ± 0.01 (GAE mg/g) and lower value of antioxidant value (20.34% ± 0.90) were shown. Jack fruit seeds can be considered a potential substitute for lentils.

Keywords: Jack fruit seeds, lentils, oil absorption capacity, proximate analysis, water absorption capacity

Development of a stabilizer from pectin, extracted from *Citrus crenatifolia* (heen naran) as a substitute for gelatin in drinking yogurt

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Gelatin is a major stabilizer and a thickening agent that is used in drinking yogurts. It is an animal-based product. Major sources of gelatin are beef bone, hides, pigskin, and pig bone. Vegetarian, halal and kosher markets have emerged during the past few decades and forced the market to find alternatives to gelatin. Therefore, there are many alternatives coming up in the industry that can be used instead of gelatin as a stabilizer in Yogurt drinks. One such alternative is pectin. Therefore, this study was carried out in order to find a pectin stabilizer from “heen naran” *Citrus crenatifolia* a tangerine native to Sri Lanka that is to be used in drinking yogurt along with modified starch. Pectin was extracted by acid hydrolysis method. The extracted pectin yield was 4.67%. The extracted pectin was qualitatively and quantitatively analyzed. An FTIR image was taken of the extracted pectin to confirm whether it is similar to the commercial pectin that was used in this study. The degree of esterification of the extracted pectin was 70.95% making it a high methoxy pectin. A drinking yogurt was formulated with a constant amount of modified starch and varying amount of pectin extracted pectin. After measuring the viscosity and through observations formulations having 0.1% and 0.2% extracted pectin powder was finalized as best formulations. These along with the 0.1% commercial pectin added and gelatin added drinking yogurt formulation was subjected to a sensory evaluation. The panelist did not find any significant difference among the formulations for thickness and texture from the evaluated attributes. This study revealed that with further improvements pectin extracted from *Citrus crenatifolia* can be effectively used as a substitute for gelatin in drinking yogurt along with modified starch.

Keyword: Acid extraction, degree of esterification, modified starch, pectin yield, viscosity

Effect of Sodium Alginate- rice bran encapsulation on viability and storage stability of *Lactobacillus rhamnosus* GG (LGG) in cold Bael (*Aegle marmelos* L. Corrêa) flower drink

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Plant-based probiotic drinks have recently been developed to be consumed by vegetarians, people with lactose intolerance and dairy allergy. They provide health benefits due to the presence of both probiotics and phytochemicals. The availability of anti-microbial and antioxidant properties in herbal drinks reduces the viability of probiotics and microencapsulation can be used to improve probiotic survival in herbal drinks. The study intended to investigate the impact of sodium alginate encapsulation with rice bran extracts on the viability of *Lactobacillus rhamnosus* GG in a cold bael beverage. The beads were produced according to extrusion technology. The encapsulation efficiency, size, shape and bulk density of the beads were investigated. Then Bael drink was developed by incorporating encapsulated beads (SA+ 2% BG406) which have the highest encapsulation efficiency. Chemical, physical, sensory and microbial analysis of herbal drink was performed over 21 days at 4°C. The encapsulation efficiency and diameter of the beads were increased, while the sphericity and bulk density were reduced when concentrations of rice brans were increased. Higher survival rates were observed after freeze-drying and exposure to simulated gastrointestinal conditions when rice bran was incorporated into the encapsulation formulation. The viability of probiotics beads in the drink was reduced only by 0.34 log cycles. Results of the properties of Bael drinks suggested that there was significantly higher preservation in color, total phenolic content, total antioxidant capacity and tannin content in drinks with encapsulated LGG compare to the drink with non-encapsulated LGG during storage. Encapsulated LGG did not exert any negative impact on the sensory attributes of Bael drink under refrigeration. In conclusion, this study shows that the application of encapsulated LGG (SA+ 2% BG406) for Bael drink could be a promising strategy to develop a functional beverage with less significant deterioration of the functional properties of the beverage.

Keywords: Antioxidant capacity, encapsulated *Lactobacillus rhamnosus* GG, encapsulation efficiency, simulated gastrointestinal conditions

A *Pittu* mix containing defatted desiccated coconut kernel and rice flour

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Defatted coconut kernel is the major by-product of the dry method of Virgin Coconut Oil (VCO) processing. Defatted Coconut Kernel can be utilized to produce food products like Bread, *Rotti*, *Pittu* as a flour substitute or in desiccated form. The aim of this research to Develop a *Pittu* mix using Defatted Desiccated Coconut Kernel (DDCK) and Rice Flour (RF) and determine its chemical, physical and nutritional characteristics. *Pittu* Mixes were made incorporating 20% (T1), 30% (T2), 40% (T3) and 50% (T4) of DDCK. Bulk Density, Tapped Density, Water Absorption, Oil Absorption and Swelling Capacity of each *Pittu* mix were evaluated as physical properties. Sensory properties of *Pittu* made by each *Pittu* mix and Conventional *Pittu* made by scrapped coconut (CP) were evaluated by 27 untrained panelists using five-point hedonic scale (Appearance, Smell, Taste, Texture, Overall). There was no significant difference between T2, T3 and CP in taste, texture and overall and T2 and T3 were the most desirable according to the sensory evaluation. *In vitro* Digestion was carried out for *Pittu* made by T2, T3 and CP to evaluate the Glycemic Index using white bread as the reference sample. Predicted Glycemic Indexes (PGI) were 54.18, 51.30 and 45.21 respectively. Between two *Pittu* mixes, T3 had the Lowest GI compared to T2. Proximate composition of *Pittu* made by T2 and T3 evaluated using standard methods and compared with the CP. Incorporation of DDCK affected significantly ($P < 0.05$) for the crude fat, crude protein and crude fiber content. Incorporation of DDCK have increased the fiber level of *Pittu* from $2.07 \pm 0.41\%$ (CP) to $3.92 \pm 0.04\%$ (T2) and $4.02 \pm 0.73\%$ (T3). Proteins have increased from $2.79 \pm 0.72\%$ (CP) to $5.02 \pm 0.11\%$ (T2) and $5.10 \pm 0.08\%$ (T3). Fat levels have reduced from $28.70 \pm 0.20\%$ (CP) to $3.21 \pm 0.10\%$ (T2) and $2.48 \pm 0.24\%$ (T3). Due to having lower GI, higher fiber and protein content, T3 was selected as the most suitable *Pittu* mix.

Keywords: By – product, *in vitro* digestion, predicted glycemic index (PGI), virgin coconut oil (VCO) processing

Coconut Milk based product vegan claim implementation

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Over time, consumer behavior in the food market has evolved drastically and consumers in Sri Lanka are becoming more aware of the health benefits, nutrient content and food quality. Therefore, consumption of plant-based products has increased and the market has become increasingly attractive. In this study Vegan claim for coconut milk based product was successfully implemented complying with national regulations and international standards. Requirements from different organizations and certification bodies in Sri Lanka and internationally were identified. Requirements from SLSI, SGS, Control Union, and European Union were evaluated and Step by step, European Vegetarian Union requirements were fulfilled and approved annual license was obtained for 1year period validity to use V-Label. Direct consumer market survey is done to analyze the market demand for the vegan product in Sri Lankan market. Data were collected from a sample of 100 consumers selected from random supermarkets located Colombo, Kurunegala, Negombo, Chilaw, Kandy cities. Market for Vegan labeling is identified by exploring data and willingness-to-pay for Vegan Label on food item is evaluated. Market demand for vegan and plant based products in European Union countries was evaluated by obtaining data from a survey done by International organizations (ProVeg) to evaluate export market. In Sri Lanka survey results shows 70% of older population is vegan or prefer to change dietary pattern in to vegetarianism. But within young and adult population willingness to pay for vegan product is 16%. In Europe countries 76% of people mainly plant based eaters. While 24% people who are reducing or trying to reduce their consumption of meat and/or other animal-based products. Accordingly, it could be stated that declaration of Vegan label in the package would enhance the demand for food products while having high demand in European countries.

Key Words: Consumer preference, vegan, vegetarian claim, vegetarian market, vegetarian requirements

Anti-nutritional factors, *in vitro* nutrient digestibility, bio-accessibility, techno functionality, molecular and structural interactions of biologically processed finger millet (*Eleusine coracana*)

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The impact of different processing techniques on the characteristic changes of finger millet flour was assessed. It provides additional knowledge of the functionality of finger millet and will increase its utilization and potential in the food industry and contribute to better food security. Anti-nutritional factors, *in vitro* protein and starch digestibility and their bio-accessibility, molecular and structural interactions of soaked, germinated, fermented and a combination of aforesaid treatments of grains were studied here. Alterations of bio-processed finger millet's techno-functional properties were determined as water absorption capacity, water solubility index, oil absorption capacity, paste clarity, swelling power, emulsion activity, emulsion stability and viscosity. Scanning Electron micrographs, Fourier Transform Infrared spectroscopy and X-ray diffraction patterns revealed structural variations and macromolecular arrangement of processed flours of finger millet. Soaking, fermentation and the combination of soaking, germination and fermentation treatments showed a reduction pattern of tannin and phytate contents. But saponin content was increased ($P < 0.05$) with time in the germinated finger millet samples (2.03 – 2.50%). All processed techniques increased *in vitro* starch digestibility (6.18 to 9.95g / 100g) and a combination of soaking, germination and fermentation treatments exhibited increased *in vitro* protein digestibility. Soaking, Germination, fermentation and treatment combinations significantly increased ($P < 0.05$) water sorption isotherm and oil absorption capacity than the control sample and slightly modified the swelling power, emulsion capacity and emulsion stability of finger millet flour while water absorption capacity, paste clarity and viscosity decreased. Among all treatments, the combination of soaking, germination and fermentation greatly improved most of the functional properties of flour with reduced anti-nutrients. A combination of treatments could enhance the use of finger millet in novel food product development. And the results are suggesting that processed flour could serve as potential ingredients with improved techno and bio functionality in value-added cereal products.

Keywords: Fermentation, germination, saponin, soaking, tannin

Foodies Edict, an android application to provide information about food regulations and certifications in Sri Lanka

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Food regulations and certifications are considered as one of the sub-sections of the food industry. But they are very descriptive. Smartphones are very popular gadgets in the current world. Therefore, the combination of these two is a novel trend in the food industry. This paper describes the process of developing and pilot testing the app which aims to provide information about food regulations, food system, and product certifications, import and export procedures related to the food industry to the general public of Sri Lanka. As the initial step, an online survey study ($n=100$) was conducted to find general knowledge about food regulations and certifications among the general public in Sri Lanka. All the app details were collected from the official websites of food regulatory institutes in Sri Lanka. The mobile application was developed using Android Studio and its performance was tested using an online questionnaire with 20 participants. The app was subsequently published on its own dedicated website for public reference. Assessment using the online questionnaire revealed that 47% of the participants have poor knowledge, 36% have average knowledge and only 18% have good knowledge about food regulations and certifications. According to the results, half of Sri Lankans don't have enough knowledge about food regulations and certifications. Therefore, a method to improve their knowledge is necessary. This app was developed in an easy to understand and user-friendly manner including information about food regulations, food certifications, public health, and information technology. Evaluation using the online questionnaire reported 100% positive responses to the app from a range of potential users, and qualitative comments manifested broad interest in its use. The app was viewed by participants in the study as an innovative support system to improve knowledge about food regulations and certifications and as a trustworthy resource for awareness about Sri Lankan food regulatory systems.

Keywords: Android, certifications, food, regulations, smartphone

Formulation of Purple yam (*Dioscorea alata* var. *purpurea*) and Kaluheenati rice (*Oryza Sativa* L.) based multigrain nutri-bar

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Consumption of wholesome and healthy diet is the most effective way to combat protein-energy malnutrition and micro-nutrient deficiencies. The country's ongoing economic crisis has hampered the people's access to a nutritious, well-balanced diet while increasing the prevalence of local malnutrition. Based on that fact, present research was carried out to formulate a nourishing and cost effective nutri-bar from selected locally available yams, cereals, legumes and oil seeds. Four formulas were done containing purple yam flour of 20% (F1), 15% (F2), 10% (F3), and 0% (F4) and only Kaluheenati rice flour content was changed accordingly. Since the formula with 0% purple yam flour wasn't feasible with required organoleptic properties of product, study was proceeded with other three formulas. Selected 3 formulas contained same composition of rest of ingredients (without purple-yam and Kaluheenati) and they were evaluated for physicochemical, antioxidant, microbial and sensory properties. Proximate composition of ash, protein, fat, crude-fiber, carbohydrate and calorie contents of three products were varied in the ranges of 1.26-1.37%, 11.20-12.02%, 6.57-7.29%, 2.69-3.58%, 73.28-73.41% and 397.57 kcal/100g - 406.81 kcal/100g respectively. Except crude-fiber and carbohydrate contents, F3 showed the highest values for above nutrients. The highest values for total sugar, crude-fiber, potassium, sodium, calcium were recorded in F1 with $20.06 \pm 0.12\%$, $3.55 \pm 0.08\%$, 3903 ± 2.83 mg/kg, 396.50 ± 10.60 mg/kg, 305.0 ± 29.7 mg/kg respectively. F1 was ranked best regarding appearance, taste, texture, aroma and overall acceptability in sensory evaluation being most consumer acceptable product. Among three formulas, F1 had the highest TPC- 4.1203 mg GAE/g (SD-0.1), TFC- 0.1790 mg QE/g (SD-0.05), anthocyanin content- 0.22470 mg/g (SD-0.0) and antioxidant potential through DPPH assay- 3.1418 mg TE/g (SD-0.7) followed by F2 and F3. The anthocyanin content of three formulas showed positive correlation with antioxidant capacity ($r=1.00$, $p<0.05$). Based on findings, it can be concluded that nutri-bars are excellent source of nutrients especially for undernourished population.

Key words: Anthocyanin, antioxidant capacity, cost-effective, malnutrition, undernourished

The use of protein from agro-industrial by-products as an animal protein substitute in food product development

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The annual production of agro-industrial by-products exceeds 250 million tons globally. A significant quantity (40%) of these are from crop residues that still lack sufficient, sustainable long-term methods to recover their valuable compounds and reintroduce them into the food production line. The present study assessed the feasibility of proteins from three agro-industrial by-products: rice bran, instant tea waste, and dhal skin waste, to be used as an animal protein substitute in food product development. The three by-products collected from the commercial food processors were initially assessed for their crude protein content. The extraction pH for each by-product protein was then optimized by changing pH in the range of 9 to 12. The other parameters which affect yield: temperature, extraction time, and solute: solvent ratio were kept constant at 70°C, 2 h, and 1:20, respectively. The extracted protein under optimized pH conditions for each byproduct was then substituted for egg white in egg white pound cake and was compared for their textural properties. The results showed that rice bran, instant tea waste, and dhal skin waste have their respective crude protein contents in the order $14.36 \pm 0.33\%$, $11.45 \pm 0.25\%$, and $3.83 \pm 0.58\%$ and their extraction yields in the order 9.96%, 14.24%, and 59.53%. The pH significantly affected the protein yield ($P=0.001$), which increased with the increasing pH. The pound cake from instant tea waste protein had no significant difference to control (egg white pound cake) in terms of all four tested textural properties: hardness ($P=0.973$), chewiness ($P=0.770$), gumminess ($P=0.218$), and cohesiveness ($P=0.813$). Therefore, it can be stated that the pH 12 in the tested pH range maximizes the protein yield and that the instant tea waste protein, in terms of its textural properties, has high feasibility to be used as an animal protein substitute in food product development.

Keywords: Crude protein content, egg white substitute, optimum extraction, protein yield, textural properties

The effect of Whey protein on rice noodles

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People who are suffering from coeliac disease are allergic to wheat-based products including noodles. Rice flour is considered as a good alternative source for preparation of gluten-free noodles since it is having specific features such as being non-toxic, having a low glycemic index and being tasteless. Whey protein is considered as a good quality protein in terms of nutrition, containing all the essential amino acids for the growth and development. Noodles were prepared from rice flour by enhancing the protein quantity by 0%, 5%, 10%, 15% and 20% of its weight respectively. Tests for final viscosity, cooking time, cooking loss, color of the noodles, final viscosity and sensory evaluation were conducted. Results suggested that 5% protein incorporated noodles sample has significant effect of shortening the cooking time ($P < 0.05$) and when increasing whey protein up to 5% and 10%, it has significant effect on reducing cooking loss compared to the control sample. All samples have resulted in significant difference in final viscosity and 5% protein incorporated sample resulted in the highest final viscosity. Rice noodles prepared with 5% of whey protein content showed better overall acceptability on the basis of sensory evaluation. When compared to the control there was no significant difference in final viscosity of five samples.

Keywords: Essential amino acids, Coeliac disease, final viscosity, gluten, glycemic index,

Development of healthy herbal tea from Jamun seeds for Diabetes Mellitus

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Tea is one of the most widely consumed beverages in the world next to the water. The study aimed to develop healthy herbal tea from Jamun seeds for diabetics. The seeds are claimed to contain glycoside jambolin which halts the diastatic conversion of starch into sugar. The investigation assesses the total phenolic content, total flavonoid content, anti-diabetic, anti-inflammatory, antioxidant properties of Jamun seeds. Further sensory profiles of herbal tea were also analyzed. Herbal tea was made with different formulations by incorporating Jamun seeds powder at 30%, 40% and 50%. Sensory analysis was conducted with 20 trained panelists using 9 hedonic scales. 40% Jamun seeds powder tea was selected. The phenolic, flavonoid, anti-diabetic, anti-inflammatory, antioxidant properties of Jamun seeds are 0.62 ± 0.004 mg GAE/g, 7.37 ± 0.144 mg RE/g, $66.67 \pm 2.89\%$, $72.11 \pm 0.37\%$, 53.02 ± 1.10 . When comparing 40% Jamun seeds substituted herbal tea with the control, the 40% herbal tea had a slightly higher percentage of phenolic, flavonoid, antioxidant, anti-diabetic and anti-inflammatory properties. Accordingly, the phenolic, flavonoid, antioxidant, anti-diabetic, and anti-inflammatory properties of herbal tea with 40% Jamun seeds are 1.37 ± 0.005 mg GAE/ml, 0.73 ± 0.02 mg RE/ml, $63.61 \pm 0.78\%$, $49.35 \pm 0.51\%$, $51.54 \pm 0.59\%$ respectively. Results indicated that Jamun seeds with 40% in the preparation of herbal tea possess bioactivity comparatively.

Keywords: Anti-diabetic property, herbal tea, jamun seeds

A study of leaching of metals and perfluorinated compounds from cookware made of Aluminium, clay, stainless steel and metals with nonstick coatings in different cooking environments

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Material transfer from cooking utensils to cooking medium has gained some interest in recent decades because of the health impacts of the food contact materials. In the present study, cookware made out of low grade steel, aluminum, clay and non-stick coatings were selected as they are the commonly used cooking utensils. The cooking pots used in the study were of two categories as new and old. In the study, leaching heavy metals like Pb, Cd, Cr and other metals like Cu, Fe were quantitatively determined under four different simulated cooking environments such as water, acidified water (0.5% citric acid), coconut oil and coconut milk. Samples were drawn from the pots in different time intervals and analyzed by AAS after microwave digestion. Fe was detected as most significantly leaching metal out of tested metals and the highest detection concentration was 31.848 ± 0.451 ppm in old clay pots with the acidified water simulant. The next highest leachate was Pb and all pots were exceeding the Specific Release Limit of Pb. The highest mean concentration for Pb was 0.365 ± 0.008 detected with low grade steel new pot in acidified water simulant. Cd also was detected in almost every pot with exceeding SRL of Cd and highest mean concentration was identified as 0.0258 ± 0.0027 in aluminum new pot with acidified water simulant. Even though Cr/Cu was detected they were below to respective SRLs'. Samples taken from non-stick cookware were analyzed for perfluorinated compounds by UV-Vis spectrophotometer. PFOA and PFOS were detected as leachates at 200-280 nm wavelength range. This study showed that some materials which have been used to manufacture these four types of cookware can leach in harmful levels to different types of cooking mediums. Metals had a higher tendency to leach to acidified water while perfluorinated compounds leach mostly to oily mediums.

Keywords: Cooking utensils, heavy metals, perfluorinated compounds, specific release limits

Development of an instant ice cream mix with *Dioscorea alata* L. (Purple yam) and *Lasia spinosa* (Kohila)

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Ice cream is one of the delicacies in the form of frozen food product. Increasing consumer demand for healthy, convenient and plant based foods has led to innovative product development. An instant ice cream mix was developed using coconut milk, purple yam (*Dioscorea alata* L.) and Kohila (*Lasia spinosa*). Six different formulations were prepared using blanched and dehydrated *D.alata* yams and *L.spinosa* powder combined with coconut milk powder. Proximate compositions, physical, functional properties and microbial tests were conducted on the ice cream. Formulation containing 16% of coconut milk powder, 10% purple yam and 1% kohila powder with total solids (40%), fat (11%), and stabilizer (0.5%) showed highest scores for all the sensory characters and selected for further studies. Ice creams was prepared using solids from the prepared mix at 40:60 solid: water ratio. The ice cream showed energy content of 141 Kcal/100g. Proximate composition for the prepared ice cream showed 9.49% of ash, 4.39% of protein, 6.76% of fat, 8.67% of fiber and 65.36% of carbohydrates. The functional properties revealed an anthocyanin content of 2.59mgL⁻¹, 2.67ppm of phenolic compounds (GAE mg/g) and 1.4 total flavonoid content (RE mg/g). The melting rate was 0.019gs⁻¹ considerably lower than the commercial ice cream. Average diameter of air bubbles after 6th intermittent foaming was 0.81µm. The viscosity of the ice cream mix was was 408.1mPas and the overrun of the product was 42.9%. Instant ice cream mix showed improved characters in stability of foam and potential market with improvement in the over run.

Keywords: *Dioscorea alata* L., ice cream, instant, *Lasia spinosa*, underutilized

Development of nutritional mix malt powder with locally available cereals and legumes

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Sri Lanka is facing an acute shortage of importing milk powders, and raw materials such as malt. As a solution for malnutrition, it has essential to carry out a new development using cereal and legumes that are available locally. Developing of malt powder using locally available cereals and legumes and analyze the product. In this study the nutritional mix malt powder was developed mixing 5 varieties of locally available cereals and legumes (Rice, finger millet, soya bean, mung bean and cowpea) in different ratios. Physicochemical, Functional & Sensory Properties were evaluated. The organoleptic properties; appearance, flavor, aroma, texture, taste, after taste and overall acceptability were studied and overall acceptance was observed. Cereal & legumes incorporated malt powder, which was acceptable to consumers formulated with 20% (w/w) rice (*Oryza sativa*), 50% (w/w) finger millet (*Eleusine coracana*), 10% (w/w) soybean (*Glycine max*), 10% (w/w) mung bean (*Vigna radiata*), and 10% (w/w) cowpea (*Vigna unguiculata*). It consisted of 2.66% (WB) of moisture content, 3.91% (WB) of ash content, 8.26% (WB) of crude protein, 1.93% (WB) crude fat, 8.58% (WB) of crude fiber, 74.66% (WB) of total carbohydrate, Total energy 349.05 kcal, water activity 0.258 at 31°C, bulk density 0.67 gcm⁻³, water solubility 16.01%, powder solubility 80.06%, colorimetric analysis L* 68.74, a* 4.19, b* 16.64, antioxidant 988.3µgg⁻¹, microbial profile after 21 days were 577.5 CFUmL⁻¹ of total plate count, 1900 CFUmL⁻¹ of yeast mold count. Results showed good overall acceptability, physiochemical quality, microbial quality, antioxidant activity. The product was acceptable for commercialization in terms of overall preference and cost. The product closely resembled commercial malt powder.

Keywords: Antioxidant, cowpea, finger millet, mung bean, rice

Raja ala (*Dioscorea alata*) yam based chips supplemented with mung bean flour

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Malnutrition is reported in Sri Lanka in more than the early days and many people are unable to get proper nutrients due to the economic crisis. Yam is an affordable and underutilized food source. It can be used to overcome that situation with mung bean because it is a good nutritional source of protein. The purpose of this study was to develop nutritionally value-added chips from raja ala and mung bean to increase the nutrient content in yam-based products while preserving the sensory properties and the shelf life. In this study, raja ala flour supplemented with mung bean flour was studied. A survey was conducted to find the yam consumption preference and the type of product that people like to find in the market. 48.6% selected raja ala as the preferred yam type and 45.7% selected chip as the preferred product among five types of yams and six types of products. Raja ala and mung bean were turned into flour using standard methods. Different ratios (10, 20, 30, 40 w/w%) of mung bean flour were added to raja ala flour to make chips. One of the flour ratios was selected according to textural and color properties and the chip with the relevant flour ratio was prepared by supplementing raja ala flour with mung bean flour. The shelf life was determined by the water activity for chips in the temperature of 26 °C, 35 °C, and 45 °C with metalized polyethylene terephthalate packaging resulting in 24, 20, and 23 days respectively. The prepared chips were assessed for proximate analysis and crude protein ($6.33 \pm 0.05\%$), crude fat ($4.62 \pm 0.62\%$), crude fiber ($6.62 \pm 1.19\%$), ash ($5.30 \pm 1.00\%$), carbohydrate ($76.63 \pm 0.35\%$), and moisture ($0.74 \pm 0.20\%$) resulted. There was a high amount of protein and minerals. Therefore, raja ala chips can be considered a good quality and nutritionally supplemented product.

Keywords: Nutrition, raja ala chips, shelf life evaluation, supplementation, underutilized yams

Extraction, characterization, and encapsulation of Betalain from *Basella alba* fruits as a natural food colourant

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Natural food colourants have become more popular since consumers avoid synthetic colourants due to adverse health effects exerted by them and as a result, natural colourants have drawn considerable attention recently. Betalains are nitrogen-containing, water-soluble, plant-based, natural pigments that contain red-violet betacyanins and yellow betaxanthins. In this study betalain-rich extract obtained from *B. alba* fruits was encapsulated using malto-dextrin by freeze-drying to produce a natural food colourant. This colorant was exposed to different environmental conditions, including pH, storage conditions, and various temperatures. The results showed that the encapsulated colourant powder contained 1927.89 ± 5.56 mg of betalain 100g^{-1} of colorant powder. This includes 1634.46 ± 3.23 mg of betacyanin and 293.43 ± 2.33 mg of betaxanthin per 100g of colorant powder. The flavonoid content was 11.79 ± 0.22 mg RE/g and the phenolic content was $1.94 \pm 0.02\%$ GAE. The colourant was stable at pH between the range of 3 and 9, and increasing temperature decreased the betacyanin content. The refrigerated temperature (4°C) showed the lowest degradation of betalain compared to room temperature ($28\text{-}35^{\circ}\text{C}$). The colourant powder reflected an antioxidant activity (inhibition percentage, by DPPH assay) of $81.10 \pm 4.45\%$. The moisture content of the encapsulated colourant powder was $5.47 \pm 2.13\%$ and the water activity ranged from 0.51 to 0.67, which is suitable for food applications. The microbial analysis revealed that this powder contains 4.58 log CFU/ ml of total plate count. In conclusion, the maltodextrin encapsulated colourant powder produced with betalain which was extracted using *B. alba* fruits can be a promising approach to use as a natural food colourant.

Keywords: *Basella alba*, betacyanins, betalain, betaxanthins, encapsulation

Development of an oil-based natural food colorant from marigold flower (*Tagetes erecta*) and evaluate its yield, stability and sensory characteristics

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Marigold flower (*Tagetes erecta*) is a natural source rich in lutein; a carotenoid pigment with potential as a natural food colorant. However, this is challenging because natural colorants are usually less stable and provide low yield. The aim of this research was to develop an oil-based natural food colorant from marigold flowers which are extracted using different pathways and evaluate its yield, stability & sensory characteristics. In this study, carotenoids in marigold flowers were extracted using different pathways and evaluated the suitability of them as a natural food colorant. Ascorbic acid and sodium-hydroxide pre-treatments, different drying methods, as extraction methods; sonication and Soxhlet methods, as solvents water and ethanol were used in this process. The colorant was prepared by dissolving extract in two different oil types; coconut oil and sunflower oil. Finally, colorant was added to margarine and compared sensory characteristics with “motha” coloring which is yellow in color. According to the lutein concentration of each extract, ascorbic acid added extracts gained higher lutein concentration compared to extracts without ascorbic acid. In water extractions sodium-hydroxide pretreatment is increased water solubility of lutein. This pigment showed stability between pH 5-6. The retention of yellow color in baked cupcakes at 180°C was showed thermal stability of colorant. In shelf life determination, highest shelf life was obtained for sunflower oil-based colorant stored at 4°C. Sensory evaluation indicated that there is no significance difference among three types of colorants (sunflower oil-based colorant, coconut oil-based colorant and “motha” yellow coloring) in terms of sensory characteristics. This study showed that marigold flower extract can be used as natural food colorant oil based products such as margarine. Future studies can be conducted to evaluate its suitability as a Vitamin A source for the same.

Key words: Ascorbic acid, coconut oil, lutein, shelf life, sunflower oil

Functional properties and physiochemical characteristics of coconut poonac protein isolate

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The recent trend has been set toward the consumption of plant-based proteins. Coconut poonac is a low-cost by-product of coconut oil extraction. Therefore, an effort is needed to identify the potential applications of poonac as a source of plant protein. Religious concerns, an increasing number of vegetarians in society, and environmental impacts are the reasons for the further utilization of plant-based protein sources in many food applications. This study evaluated the functional properties and physiochemical characteristics of coconut poonac protein isolate (CPPI) and the results were compared with soy protein isolate (SPI). Soybeans contained about 33.94% proteins whereas coconut poonac contained 17.7% proteins. Protein content in CPPI and SPI were found to be 68.6% and 79.6%, respectively. The isoelectric point of CPPI and SPI was confirmed by the observation of minimum solubility at pH 4. In comparison to SPI, CPPI exhibited significantly higher water absorption capacity (4.09 g/g), oil absorption capacity (5.56 g/g), emulsifying activity (73.33%), emulsion stability (46.67%), and foaming capacity (71.33%). SPI and CPPI both had 14% least gelation capacity. *In-vitro* digestion of SPI was significantly higher ($p < 0.05$) than CPPI. Veggie meatballs were produced with baby jackfruits and the incorporation of 0%, 2%, 4%, and 8% CPPI. Protein content for meatballs containing 0%, 2%, 4%, and 8% CPPI was 1.33%, 2.72%, 4.15%, and 6.82%, respectively. All meatball groups exhibited pH values between 5.64-5.06 and water activities between 0.61-0.81. According to the results, CPPI has good functional properties which can be explored as a source of plant-based alternative protein for food applications. Sensory evaluations revealed that meatballs with 4% CPPI were overall acceptable. The results confirmed that CPPI has great potential in food applications, especially in the development of meat alternatives.

Keywords: Food applications, plant-based protein, solubility

Development and quality evaluation of functional instant smoothie powder using Jamun Plum (Maa dan) (*Syzygium cumini*) and selected local fruits and vegetables

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Due to the modern busy lifestyle and the current economic crisis in Sri Lanka, achieving a good health status through nutritious food is, challenging for consumers. Thus, a food/beverage that provides the most of the body's nutrient requirement and functional compounds that can be taken instead of a meal would be a smart approach. In this study, a novel, instant and nutritive smoothie powder was developed using locally available fruits and vegetables and the physicochemical, microbial, and sensory qualities of the product were studied. The major ingredient used, Jamun plum (*Maa Dan*) (*Syzygium cumini*), a locally underutilized fruit which is high in nutrients and functional properties such as anti-diabetic and anti-inflammatory activity. The powder forms of dehydrated fruits and vegetables were mixed with most acceptable formula. The instant smoothie powder was analyzed for proximate composition, carbohydrate ($45.86 \pm 0.21\%$), crude fiber ($35.36 \pm 0.60\%$), crude fat ($5.42 \pm 0.05\%$), crude protein ($3.31 \pm 0.00\%$), moisture ($6.11 \pm 0.00\%$) and ash content ($3.94 \pm 0.03\%$). The physicochemical properties of the instant powder and powder properties were evaluated. And vitamin C (94.63 ± 0.23 ppm), total antioxidant capacity (156.35 ± 2.64 AAE mg/g), total phenolic content (36.04 ± 2.26 mg *GAE, /g), total flavonoid content (54.90 ± 0.51 mg *RE/g), anti-inflammatory (56.56 ± 4.34 % inhibition) and anti-diabetic ($39.70 \pm 2.05\%$ inhibition) properties were analyzed to identify the functional properties of the instant smoothie powder. Using the changes of microbial quality with time (for 4 weeks), a shelf-life determination was done. This instant smoothie powder, which has acceptable sensory qualities, better microbiological stability, and excellent powder properties, can be provided as a more practical and healthful option for customers.

Key words: Dehydrated, detox smoothie, fruits and vegetables, functional, instant powder

Fatty acid profile, conjugated linoleic acid, and health lipid indices in selected commercial dairy products

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Milk and milk products are considered as well-balanced and nutritious food in the human diet. Milk fatty acids (FA) play vital biochemical, structural, and functional roles in the human body. Among those FA, Conjugated Linoleic Acids (CLA), a mixture of octadecadienoic acid isomers mainly *cis9*, *trans11*-C18:2 or “Rumenic acid” has numerous positive effects on health. The lipid indices such as Atherogenic Index (AI), Thrombogenic Index (TI), *etc*, calculate using FA composition data and indicate the health effect of the fatty acids in dairy products. The study aimed to investigate the total FA composition in selected dairy products, to evaluate the contribution of these dairy foods to the daily intake of CLA, and to evaluate health lipid indices in dairy products available to consumers in retail sales. Samples were selected by a consumer survey conducted in the Western province, mainly considering products/brands with high consumer preferences. Fat was extracted from dairy samples by Bligh and Dyer method. Then, fatty acid methyl esters were prepared using the BF₃-Methanol transmethylation process. GC-FID was used to analyze the FA profile and CLA content. Cow milk contained SFA 68.72%, MUFA 27.40%, and PUFA 4.05%. Also, cow milk contained CLA content of 4.5 mg/g of fat. Butter contained the highest CLA content of 6.1 mg/g of fat and the highest AI and TI values. Processing technologies have a significant impact on the FA profile of dairy products. However, all dairy products are highlighted as offering the best opportunity to increase CLA consumption. In addition, AI and TI values provide information on different health effects in particular, on the likelihood of an increased incidence of atherosclerosis, the development of atheroma, blood clots, and thrombus. In conclusion, fatty acids profile and CLA content varied among the analyzed dairy products and have a differential effect on health.

Keywords: Atherogenic index, fatty acids, gas chromatography, milk, thrombogenic index

Acknowledgment: Financial assistance by Wayamba University of Sri Lanka research grant (SRHDC/RP/04/19-09)

Effect of arrowroot (*Maranta arundinaceaz*) flour as the binding agent on chicken meat balls and determine physicochemical, textural and sensory properties

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Arrowroot (*Maranta arundinaceaz*) is an alternative crop-source of carbohydrate with underexploited tuber starch but having potential digestive, binding and medicinal properties. The present study was undertaken to evaluate the binding effect of three types of arrowroot flour on the quality characteristics of chicken meatball. Meatballs were binded with whole arrow root flour, arrowroot flour without extracting fiber and arrowroot flour with extracting fiber at level of 10%. Three types of arrowroot flour and control with wheat flour were analyzed for flour properties. Raw and cooked meatballs were analyzed for various sensory, proximate, textural and physicochemical attributes. The sensory (color, flavor, tenderness, juiciness and overall acceptability), proximate composition- dry matter (DM), fat content (FC), crude protein (CP) and ash, physicochemical (raw pH, cooked pH, juiciness, color and cooking loss) properties were analyzed. According to the results arrowroot flour without extracting fiber contained higher amount of juiciness (6.5333 ± 0.59) than arrowroot flour with containing fiber 6.1367 ± 0.11) and whole arrowroot flour (5.6033 ± 0.52). The water holding capacity of arrowroot flour with containing fiber, without extracting fiber and whole arrowroot flour (1.4940 ± 1.37), (1.2900 ± 1.28) and (1.4012 ± 0.54) respectively. Results of the proximate analysis revealed that moisture, ash, protein, fat, carbohydrate, crude fiber content of arrowroot incorporated meatballs were significantly different. There is a significant decrease in cooking loss and pH in whole arrowroot containing flour of meatball. The final sensory evaluation results showed that overall acceptability of the meatball with arrowroot flour of without extracting fiber were recorded as the highest scores. Texture analysis indicated the cohesiveness, gumminess and chewiness of meatball increased when the substitution of arrowroot flour.

Keywords: Arrowroot flour, meatball, physico-chemical characteristics, sensory evaluation

Designing a web app for identification of beef marbling types based on USDA standards

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Marbling in beef is a prominent quality-determining character and the mouthfeel, as well as flavour extraction at the mastication, is increased significantly due to the presence of intramuscular fat. According to the USDA as Prime, Choice, and Select, the price difference and usability difference of beef belonging to different marbling grades are considerable (Primal loin- choice quality beef is 13.2 % pricier than its select quality [SP1] in 2022 November 25). It is difficult to grade beef based on marbling, using the naked eye, within a small observation time. A survey has been done at the beginning of the research to get an idea about the efficiency of marbling categorization using the naked eye. A quiz was held in which the participants had to grade/categorize beef using the naked eye, within 15 seconds. Only 18% of participants were able to correctly perform their categorizing. Further questioning showed that most of the participants did not have a clear idea about the quality of beef marbling and their mouth-feel when it came to cooking and consumption. This app has been developed to categorize beef marbling according to USDA grades which are the most popular beef marbling categorizing parameters. The app was written using python programming language. The corresponding deep learning model was built in the Google-Colab environment. Then the model and the corresponding code were uploaded to the GitHub and hosted as a web app using Streamlit Cloud. The model in used in the web app gives 90% (better than the marbling standard handbook method [SP2]) validation accuracy which can be further improved using a bigger dataset. The app can be readily accessed via the internet using any of the major web browsers.

Keywords: Beef marbling, deep learning, Google-colab, python and web-app

Process optimization for cold brew ice tea developed using cinnamon powder

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Tea is one of the most popular and widely consumed beverages in the world due to its appealing flavour and taste and has also been linked to a variety of health benefits. Recent trends include the increased use of cold-brew processing for ready-to-drink products to avoid harsh flavour compounds that are extracted during hot water extraction. Water extract of cinnamon has a potential to be used in beverages due to its therapeutic properties and has a pleasant flavour and aroma. The non-alcoholic beverage market is expected to grow in the coming year, with a greater emphasis on health and wellness. This study focused on developing a cinnamon infused iced tea as a functional beverage. Response surface methodology (RSM), based on a four-level, three-variable box-Behnken design, was employed to obtain the best possible combination of brewing temperature, brewing time, and tea amount to get the highest sensory score. According to the results obtained by RSM, the best brewing conditions were as follows: 21.33°C brewing temperature, 5 hours of brewing time, and 1.68 g of tea. Under these conditions, the experimental sensory score was 7.76, which corresponded well with the predictive sensory score. Iced tea was then analysed for total phenolics, total flavonoids, total tannins, colour and total soluble solids. During shelf-life evaluation for a period of three weeks, the total phenolic content recorded has ranged from 97.67 ± 0.18 to 118.03 ± 0.37 GAE/g, total flavonoid content has ranged from 21.94 ± 0.18 to 31.41 ± 0.36 RE/g, and total tannin content has ranged from 27.24 ± 0.19 to 35.34 ± 0.36 TAE/g in the cold brewed iced tea developed using tea leaves and cinnamon powder.

Keywords: Box-Behnken design, cinnamon tea, iced tea, ready-to-drink tea, response surface methodology

Functional properties of rice and coconut milk based beverage enriched with Aloe Vera (*Aloe barbadensis millar*)

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The advantages of probiotic bacteria and vegan foods in human health are being emphasized by health experts giving rise to consumer demand for such foods. The most popular foods with probiotic effects are yogurt and curd in the local market hence there is a need for novel food to fulfill consumer needs. The present study was carried out to develop an aloe vera incorporated rice-coconut fermented milk beverage and to evaluate its physiochemical, probiotic, and functional properties. This study also investigated the capacity of rice-coconut milk with *Lactobacillus* culture (*Lactobacillus rhamnosus*, *Lactobacillus bulgaricus*, and *Streptococcus thermophilus*) and aloe vera's effect in lowering blood sugar by measuring the postprandial blood sugar levels. The physicochemical properties such as color and pH value variation with the time of the final product were studied at four different temperatures (0°C, 25°C, 27°C, and 45°C) for shelf-life study. Aloe vera showed great potential as a functional beverage containing probiotics and aloe vera incorporated rice-coconut fermented milk beverage, showed good probiotic properties with a survival of 10×10^9 CFU/ml of *Lactobacillus* culture on the 17th day of storage under 0°C. The sensory evaluation revealed the best product to have 72% (v/v) coconut milk, 18% (v/v) rice milk, 10% (v/v) aloe pulp, 8% (w/v) sugar, and with a pH of 3.99. It consisted of $0.81 \pm 0.10\%$ (WB) of ash content, $2.57 \pm 0.10\%$ (WB) of crude protein, $2.57 \pm 0.41\%$ (WB) crude fat, and $8.43 \pm 0.18\%$ (WB) of total carbohydrate with a shelf life of 20 days. A positive impact on reducing blood sugar levels by Aloe Vera in the product was observed.

Keywords: Fermentation, lactobacillus, non-dairy, probiotic, vegetarian

Formulation of food supplements using locally available cereals and legumes to help to combat malnutrition in the Batticaloa District

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Mothers and children under five are the most nutritionally vulnerable groups having malnutrition. There are 5250 underweight children and 10862 pregnant women in the Batticaloa district. Vavunatheevu MOH division also has a high malnutrition prevalence in the district. There are 2884 under-five children of which 303 children are underweight and 704 pregnant women of which 148 Pregnant women are with low BMI in the Vavunatheevu MOH division. Hence, this study was conducted to develop food supplements using locally available low-cost cereals and legumes to help to combat malnutrition in the low-income Mothers and children in the Batticaloa district. Cereals and legumes are considered to be one of the best food combinations for providing essential macronutrients. The selection of raw materials was done based on the availability in the Batticaloa district, cost and richness of calories. Four supplementary foods as Nutri-Ball, Soup premix, Spicy chips and Cookies were developed. Sensory analysis was conducted with 30 un-trained panelists using 7 points hedonic scales to choose the best product according to the sensory appeal. Overall acceptability of the products showed nutria ball (6.6 ± 0.77), Spicy chips (5.5 ± 0.9), Soup premix (3.57 ± 1.16) and Cookies(3.97 ± 1.42) respectively. Nutri ball was selected. The formulated Nutri ball contained energy 456.19 kcal, moisture $7.93 \pm 1.15\%$, ash $3.0 \pm 0.0\%$, fat $10.67 \pm 7.38\%$, protein $16.39 \pm 0.14\%$, crude fiber $23.33 \pm 5.77\%$ and carbohydrate $40.33 \pm 9.89\%$ and shelf life study showed that the Nutri ball could be stored for one month period at ambient without any significant changes in sensory properties. The best supplements for mothers and children were formulated traditionally by using locally available cereals and legumes in the form of Nutri balls.

Keywords: Calories, energy, essential macronutrients, moisture content, fat

Formulation and evaluation of phytochemical and sensorial properties of new isotonic beverages prepared with gooseberry and mandarin

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An Isotonic drink is a type of beverage that help athletes, and those who work in intensive for recompensation of water and minerals lost during exercise while supporting performance during exercise by providing a quick source of energy and helping to prevent dehydration. It contains a set of easily digestible carbohydrates and an appropriately balanced composition of minerals. There is a renewed interest in the market to develop a drink with high antioxidants to protect the human body against excessive free radicals formed during intensive work. The aim of the study was to formulate a bioactive rich isotonic beverage using two types of gooseberries (*Phyllanthus acidus* /*Phyllanthus embilica*) fruits and mandarin (*Citrus reticulata*) fruit. Nine different treatments were designed with different concentrations by combined with gooseberries and mandarin fruits and evaluated the physicochemical properties, total phenolic content, flavonoids content, antioxidant capacity (DPPH• and total antioxidant capacity) and sensory property of the newly formulated drink during the storage time. The highest phenolic content was 134.36 ± 17.86 mg GAE/L, total antioxidant capacity 846.17 ± 47.14 mg AAE/L and total flavonoids 13.34 ± 0.56 mg/g RTE were measured in the beverage that formed from *Phyllanthus embilica*. Physicochemical properties such as pH, titratable acidity and color measurements (L*, a*, b* and chroma) were slightly altered during the storage time. In conclusion, the new isotonic drink can be useful to equilibrate redox balance in acute and intense exercise, and furthermore, research *in vivo* is necessary to verify their beneficial effects for sports, nutrition, and health.

Keywords: Antioxidants, bioactive drinks, electrolytes, gooseberry, sports drinks

Microbiological Quality of Fresh Fruit Juices Sold in Selected Town Areas in Sri Lanka

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Fresh juices are rich in nutritional value and considered as popular drink in Sri Lanka. They can be easily contaminated by microorganisms from unhygienic environment of food preparation area and serves as a potential source of food borne outbreaks. Improperly prepared fresh fruit juices are recognized as one of the major causes of food-borne illnesses. Therefore, this study was aimed at assessing the microbial safety of fruit juices prepared in selected areas in Sri Lanka and their hygienic conditions followed during preparations. Sixteen fresh fruit juice samples were collected from four different areas. Mango, Avocado, Passion fruit and Wood apple were collected from Kaduwela, Kadawatha, Gampaha and Negombo town areas from cafes and restaurants according to random stratified sampling method and tested for total viable count, total yeast and mold count, total coliform count and total staphylococcal count. Questionnaires were distributed among sixteen juice makers to obtain preliminary information on hygienic and safety practices of fruit juice makers. The results showed a pH range of juices between 2.84 to 6.25. The samples showed exceeding counts than the permitted level for total viable count (56.25%), total yeast and mold count (100%), total coliform count (62.5%) and total staphylococcal count (56.25%). The findings from observation and interviews indicated that there was a lack of training about safe and hygienic food preparing. 100% of the juice makers did not have a proper training on food hygiene and safety. 87.1% of them did not use any protective clothes or cover hair during working. Overall, these data revealed the poor microbial quality in most of the fruit juice sample tested suggesting, regular supervision and training about safe processing, and handling of fruit juices and hygiene of vendors can improve the quality of fresh fruit juices.

Keywords: Fruit juices, hygiene, microbial safety, Sri Lanka

Effect of cold storage temperature on postharvest shelf life of waxed Cassava (*Manihot esculenta*) roots

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Cassava (*Manihot esculenta*) plays a major role in the human diet as a source of dietary energy for people in developing countries. Cassava roots are more perishable within 1–7 days, because of post-harvest physiological deterioration. These changes are unacceptable because cassava is one of the main horticultural export commodities. The study aimed to enhance the post-harvest shelf life of cassava while minimizing quality changes. Current study investigated the effect of low temperatures and waxing on quality parameters. The "MU51" local cultivar was chosen and one of the prepared bio waxes was applied. Samples were stored in three different low temperatures (4 °C, 8 °C, and 12 °C) with 85% RH. Here quality parameters such as pH, color, firmness, starch content, moisture content, dry matter content, total soluble solids, titrable acidity, weight loss, and cyanide content were checked at four-day interval. Results revealed that the moisture content, dry matter content, starch content, color, texture, weight loss, and total soluble solids of waxed and non-waxed samples were significantly ($P < 0.05$) differed with stored temperature. The moisture content was reduced by 7.9% in non-waxed ambient and 3.2% in waxed samples stored at 8°C. The starch content was reduced by 25.07% in non-waxed ambient and 12.87% in waxed samples stored at 4°C. At the end of storage time, waxed samples at 4°C showed the lowest cyanide content (7.48 ± 0.12 mg/kg). At the end of three weeks, the highest weight loss was shown in non-waxed ambient samples as 3.05%. There was no significant ($P > 0.05$) difference in pH and titrable acidity of waxed and non-waxed samples. Relatively high pH (7.06 ± 0.037) and low titrable acidity (0.227 ± 0.05) were observed in ambient, non-waxed samples. This study concluded that waxed cassava roots could be kept for longer period at 4°C, and waxed cassava showed better quality characteristics than non-waxed cassava roots.

Keywords: Bio wax, cyanide, low temperature, physiological deterioration, post-harvest loss

Use of bio waxes for extending post-harvest shelf life of yams

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Yams (*Dioscorea* Spp.) are starchy large staple food crop produced by annual and perennial vines. During storage, a significant amount of yam deteriorates due to sprouting, weight loss, and rotting. Therefore, it was necessary to find convenient, cost-effective ways to prolong the shelf life of yam after harvest without negatively impacting consumer health. Therefore, this research was conducted to explore the effect of two bio waxes on postharvest shelf life of two different types of yams. Yams were treated with a wax formulation developed by incorporating cinnamon bark oil and hexanal in different viscosities. Bio wax A has low viscosity and Bio wax B has high viscosity. The study was determined to effect of the two waxes on weight loss, sprouting, VQR, decay incidence, texture, moisture content, pH and volume in yam. The sample was divided into three replicated lots each containing 26 yams. While the one lot was kept as controls, two lots were dipped in waxes for 45 seconds. Treated and control samples were stored in ambient conditions ($30^{\circ}\text{C} \pm 2^{\circ}\text{C}$; RH 70%) in plastic crates respectively. Physical and chemical characteristics were assessed on day 0 of the treatment and then every 7 days after that. The results obtained from postharvest waxing of yam varieties using two waxes revealed that were effective in reducing weight loss and sprouting in yam for a period of two months. The results from the study indicated that two waxes reduced rotting significantly ($P < 0.05$) for up to two months. In addition, waxing was also found to affect taste, texture, and flavor of yam. However, these treatments did not affect attractiveness and acceptability. In conclusion bio wax B are significantly reduced the rate of decay of yams extending the shelf life up to 2 months under ambient conditions rather than bio wax A.

Keywords: Horticultural, post- harvest, rotting, wax, yam

Impact of different extraction methods on the shelf life of Cinnamon (*Cinnamomum zeylanicum*) bark oil

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Cinnamomum zeylanicum is one of the major herbal and spice plants; originated in Sri Lanka. High-quality essential oils can be obtained from the bark and leaves of the Cinnamon tree. The composition, properties and shelf life of cinnamon oil can be altered with the method used for extraction. This study evaluated the quality and shelf life of *Cinnamomum zeylanicum* bark oil which is extracted by different extraction methods. The cinnamon bark oil was extracted by five methods *viz.*, steam distillation, hydro-distillation, hot water maceration, Soxhlet extraction with ethanol and acetone as solvents and ultrasonic extraction with ethanol as a solvent. The yield, density and water activity of oil were evaluated. Free fatty acid content, microbiological parameters, and antimicrobial properties of cinnamon oil were evaluated once every three weeks during storage time. Each sample was subjected to accelerated ageing to determine the changes during six months of storage time. Cinnamon bark oil was tested by sensory evaluation to identify the acceptance level of the sensory properties. The results showed that the essential oil, extracted by ultrasonic method gave the highest yield (6%), lowest water activity (0.523) and lowest oxidation rates (0.866 ± 0.067) after 6 months equivalent of accelerated ageing. Cinnamon oil extracted by steam distillation showed the lowest microbial count, yeast and mold count and highest antimicrobial properties. When comparing these five methods, Soxhlet and ultrasonic extraction methods are particularly hard to control. Organic solvents that are used for the extraction process can remain as residues in the final product. Moisture content is high in the samples extracted by distillation and maceration process which reduces the quality of oil during the shelf life. This study demonstrated, out of the five extraction methods, ultrasonic extraction is an effective method for cinnamon bark oil extraction, in addition to the traditional steam distillation process.

Keywords: Cinnamon bark oil, *Cinnamomum zeylanicum*, essential oil, extraction methods, shelf life

Development of jackfruit seed flour based veggie balls and assessment of their physicochemical and sensory properties

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Meat analogues or plant based products that mimic the properties of traditional meat products. This study was done to identify the methodology of jack fruit seed flour and to create a recipe for veggie balls. Seeds were washed and free from dirt then roasted. Seeds were ground into flour. Veggie balls were prepared by using different bulking agent. Flour properties were done for jackfruit seed flour. Particle size percentage was range from 0.5%- 38.68%, with 0.16 size being significantly different from other size. Dispensability of the flour 75.54%, oil absorption 153.00%, water absorption 611.667%, solubility 8.4233%, swelling power 6.8067% and colour 74.6533%. jackfruit seed flour prepared by boiling were used to compare the flour properties. jackfruit seed flour prepared Three formulation were developed with 40% of jackfruit seed flour and varying with 30% of cooked baby jackfruit(M₁), unripen jackfruit (M₂) and uncooked baby jack fruit(M₃). For veggie balls proximate colour and sensory parameters of the developed sample were studied in detail. M₁ was highly preferred by the sensory panel. Carbohydrate content range from 25.57 -29.25 with M₂ being significantly different from others. Moisture content range from 25.37 -31.03 with M₁ being significantly different from others. Protein ranges from 18.10-26.20 with M₃ significantly different from others. Fat range from 10.96-18.70 with M₃ being significantly different from others. Fiber range from 4.80-8.55 with M₂ being significantly different from others. Expressible moisture range from 18.48-27.42 with M₂ being significantly different from others. Jackfruit seed flour based veggie balls can be an alternative to meat ball for those who consume or prefer vegan.

Keywords: Jack fruit seed flour, meat analogue, plant based, protein food, sensory analysis

Development of an effective model for refined Carrageenan powder production with *Kappaphycus alvarezii* and its physico-chemical characteristics

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Carrageenan has highly demanded in Sri Lanka food industry due to its unique functional properties including gelling, thickening, stabilizing, emulsifying properties. Carrageenan production has not well prominent and the requirement is fulfilled through importation with spending thousands of dollars even country has production ability. Do not identifying effective feasibility extraction method and conditions can be identified as the major reasons behind that. The study focused on introducing the effective model for Carrageenan production using red seaweed *Kappaphycus alvarezii* with alkali extraction method. Different incubation KOH percentage, time and heating temperature were used to determine the optimum Carrageenan yield using box- Behnken design. Fifteen experimental runs with different combinations of incubation KOH percentage (5%, 6% and 7%), time (1, 2.5 and 4 hr) temperature (60, 70 and 80°C) were employed. Physico-chemical properties were assessed of obtained Carrageenan at optimized conditions and it was incorporated into vanilla ice cream according to the three treatments as without Carrageenan, commercially available and extracted Carrageenan to demonstrate stabilizing effect. Hardness, overrun, melting rate and viscosity and organoleptic characteristics including color, texture, appearance, taste and overall acceptability were evaluated of each treatment. Tasting panel of 30 untrained panelists with nine-point hedonic scale were used for sensory evaluation. Yield of extracted Carrageenan ranged from 27.93 to 45.31% and 7% KOH solution at 70 °C for 4 hours indicated the highest yield. There was a phase separation and high melting rate in ice cream made without carrageenan. There was not a phase separation and relatively low melting rate showed in ice cream made with carrageenan. There was no significant difference in consumer acceptance for ice cream made with commercially available and extracted Carrageenan at optimum condition ($P > 0.05$). Therefore, 7% KOH at 70°C for 4 hours was optimum conditions for Carrageenan extraction and it has potential of using as stabilizer.

Keywords: Ice cream, overrun, Sri Lanka, stabilizing, texture

Development of a convolutional neural network based tool for the real-time detection of personal protective equipment used in food industry

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Food can become contaminated with hazardous material due to direct handling by workers. Food handlers must wear clean personal protective equipment (PPE) to minimize those corresponding hazards and maintain employee health and safety by reducing the risk of injuries. In some cases, food handlers do not wear PPE correctly, and inspecting and advising them manually at every instance is inefficient and cumbersome. This study was aimed at developing a computer vision-based system for real-time detection of food handlers wearing commonly used PPE such as masks and head caps using live cameras. In this project, about 600 images of people wearing masks and head caps were used as the input dataset. These images were initially annotated and split randomly into training and validating data sets in an 80:20 ratio, which were used for the development of the convolutional neural network (CNN) model. The CNN model was built using the YOLOv7 object detection algorithm. While training the model, 200 epochs and a batch size of 16 were used. After the addition of audio files for the generation of warning messages, the output model was run on local machines for real-time detection of PPE. Finally, this model could detect a person, mask, and head cap with an average precision of 0.991, 0.962, and 0.989, respectively, and a mean average precision (mAP) of 0.981 for all object classes at a 0.5 threshold value. Thus, the performance of this model has a higher level of accuracy. This simple model can be further extended by training with appropriate images to detect all other PPE and food safety violations committed by food handlers in an industrial setting.

Keywords: Hazards, object detection, safety, warning message, YOLOv7

Determining the suitability of natural antifungal extract from guava (*Psidium guajava*) leaves for prevention of mold spoilage in bread

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Bread is commonly known as an essential dietary staple food worldwide and it is primarily spoiled by mold and fungi deteriorations. Guava (*Psidium guajava*) leaf extract has been proved to have strong antibacterial and antifungal properties; where it can incorporate to bread as a natural antifungal agent. Due to the dissatisfactions toward chemical preservatives; it is beneficial to prevent mold growth in bread using guava leaf extract while replacing chemical preservatives. The study aimed to determine the suitability of guava (*Psidium guajava*) leaf extract as a natural antifungal compound to prevent mold deterioration in bread. Guava leaves were dried at room temperature, and the dry-powdered material were extracted by maceration with ethanol. Using guava leaf extract antifungal sensitivity tests were (AFST) done for determine the inhibition action against *Aspergillus niger*, *Fusarium solani* and *Penicillium sp.* Five types of bread samples were prepared with 0.02%, 0.04%, 0.06% guava leaf extract concentrations, 300 ppm Sodium benzoate and with no preservatives. Mold growth rate were checked for above five types of bread samples under different storage and packaging conditions; where best concentration of guava leaf extract included bread was determined. Proximate analysis, physio-chemical properties and rheological properties were done for best concentration of guava leaf extract included bread. Sensory evaluation done to check the consumer acceptance. AFST showed that guava leaf extract has an antifungal effect on all the fungus types that has checked. For 0.02% guava leaf extract bread, showed less than 0.13 (1/day) mold growth rate under checked conditions, proximate compositions showed moisture $37.53 \pm 02.00\%$, fat $19.97 \pm 0.09\%$ and protein $12.02 \pm 0.23\%$ similar to controls. Farinogram showed weaker to medium flour properties, slight changes in physio-chemical properties compared to controls and absence of negative effects in the sensory quality. In conclusion, guava leaf extract can be developed as a natural preservative to prevent the fungal contamination in bread.

Keywords: Antifungal sensitivity test, natural preservative, physio-chemical properties, proximate analysis, rheological properties

Effect of coconut (*Cocos nucifera*) meat waste as a fiber source & natural antioxidant on the production of chicken meat patties as a functional meat product

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Virgin coconut oil cake and coconut milk residue are important byproducts left after coconut milk and oil processing which can be used in different food formulations to enhance their properties. The objective of this study was to find the effect of coconut waste as a fiber source and natural antioxidant on the production of functional chicken meat patties. For the development of meat patties, flour obtained from industrial virgin coconut oil cake, industrial coconut milk residue and homemade coconut milk residue were incorporated into meat at 10%, 15% and 20%. After a preliminary sensory analysis, the flour blends that give the best sensory properties were selected (industrial coconut milk residue and virgin coconut oil cake at 10 and 15%). Then its physicochemical, functional, and sensory properties were assessed. For 10 days of storage at 4°C, the antioxidant effects of each coconut waste for inhibiting lipid oxidation were periodically assessed. Homemade coconut milk residue contained higher amount of crude fiber (37.67 ± 0.29) than industrial coconut milk residue (20.83 ± 1.75) and virgin coconut oil cake (10.50 ± 0.50), whereas total dietary fiber was highest in industrial coconut milk residue (57.51 ± 7.97). The total antioxidant capacities ($\mu\text{g/ml}$) of the industrial virgin coconut oil residue, coconut milk residue and homemade coconut milk residue are 2.07 ± 0.06 , $0.85 \pm .005$, $0.89 \pm .006$ respectively. The moisture, ash, protein, carbohydrate, crude fiber, and total dietary fiber content of coconut waste incorporated patties were significantly higher. Addition of coconut waste significantly increased the emulsion stability and cooking yield. During refrigerated storage, formation of the lowest amount of lipid oxidation products showed by 10% industrial virgin coconut oil cake incorporated patties. It increased from 1.20 to 4.75 meq/kg for peroxide value and 0.3 to 0.99 $\mu\text{M/g}$ in TBARS test. It is concluded that industrial virgin coconut oil cake can be incorporated up to 10%, for preparation of fiber rich patties with more antioxidant potential.

Keywords: Functional properties, homemade coconut milk residue, industrial coconut milk residue, industrial virgin coconut oil cake, physicochemical properties

Department of Aquaculture and Fisheries

Extraction of fish oil from fish waste and evaluation of its potential applicability on soap production

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Saponification is the process that converts fats into soap by combining with acids. Currently, coconut oil is widely used for soap production and many alternatives are being tested with different perspectives. Therefore, the main objectives of this study were to produce a low-cost soap using fish oil extracted from fish waste, identify the fatty acid composition of the extracted fish oil, and compare the TFM (Total Fatty Matter) and pH values with the standards. First, fish waste was collected from the market and cleaned with distilled water, 01 kg of fish parts were weighed and cut into small pieces. Then using Soxhlet apparatus, fish fat was extracted, and filtered using filter paper. Then the filtrate was heated and separated from water and finally fish oil was mixed with caustic soda and the soap was prepared. Fish oil was tested for saturated, monounsaturated and polyunsaturated fatty acids using Gas Chromatography-mass spectrometry (GC-MS). The content of saturated fatty acids in the studied fish oil were recorded as: *Capric 0.06%, Lauric 0.13%, Myristic 5.84%, Palmitic 34.3%, Palmitoleic 28.6%, Stearate 6.49%*. The monounsaturated fatty acids in the studied fish oil: *Oleic 31.1%* and the polyunsaturated fatty acid in the fish oil: *Linoleic 10.89%, α -Linolenic 2.41%*. The TFM value of this developed soap is 58.97 and the pH is 8.34. Comparing with the standard values for laundry soap, (TFM: 60 and pH is 8-10) this developed soap can be categorized as grade 3 soap. According to the cost analysis, this soap is profitable since the fish waste was used as the main ingredient. Collectively, present study recommend that fish oil extracted from fish waste can be used to develop a low-cost soap to the market.

Keywords: Fatty acids, fish oil, fish waste, saponification, soap

Population dynamics of sea urchin *Salmacis virgulata* off northern Sri Lanka

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The population dynamic studies of the sea urchin *Salmacis virgulata* is not investigated before, despite its ecological importance. Thus, this research was conducted in the Jaffna peninsula, specifically in Point Pedro and Sankotti, using GPS coordinates N 09 45.662' and E079 52.549' taken by a GARMIN GPS 72H reader in determining the status of the population of *S. virgulata* which landed as entangling by-catch from a bottom set crab-nets. Hence urchin samples were collected from fishing boats operated at N 9 55.15' and E 80 19.16' repeated every month. The samples were then preserved using a combination of formalin and saline water. We collected samples only for three months, from the same location, as adverse weather conditions hampered two months of sampling. The length of the sea urchin was determined by measuring the horizontal test diameter twice at right angles, to the nearest 0.02 mm in all the specimens, using a Vernier calliper. The two measurements were then averaged to obtain the diameter. The data collected was analyzed using FISAT-II software to determine the length-frequency distribution, estimate the growth parameters and mortality rates, and reveal the impact of fishing activities on the sea urchin population. The results of the study indicate that the sea urchin population in the Jaffna peninsula is affected by fishing activities, with a fishing mortality rate of 0.292. This research provides valuable insights into the population dynamics of *Salmacis virgulata* in the region and highlights the importance of continued monitoring and conservation efforts to protect this important species. Overall, this research provides a comprehensive understanding of the population dynamics of *Salmacis virgulata* in the Jaffna peninsula and will be valuable for the management and conservation of sea urchin populations in the region.

Keywords: Conservation, fishing mortality rate, Jaffna peninsula, population dynamics

Oil-based fish canning of Rohu (*Labeo rohita*) and Silver carp (*Hypophthalmichthys molitrix*)

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Rohu and Silver carp have white meat and rich in nutrients including protein, EPA and DHA. There is a great potential of increasing the production of these fish in local reservoirs. Yet, no marketable product with long shelf-life in the market. Thus, the present study attempted to develop a value-added virgin coconut oil preserved can product from Rohu (*Labeo rohita*) and Silver carp (*Hypophthalmichthys molitrix*) and evaluate their quality standards and consumer preference. Fish products were developed according to the standard fish canning procedure. Then the quality of the raw and the canned products were tested for microbiological, biochemical and sensory attributes. Market-oriented and consumer-oriented sensory evaluations were conducted using 5 trained panelists and 34 semi-trained panelists respectively. Further, dressing percentage and cost-benefit analysis were done to determine the economic feasibility of the product. Total plate counts (CFU/ml) for both species for raw and canned products were within the acceptable ranges and it was 6×10^6 and 6.5×10^6 for raw Silver carp and Rohu respectively. *Escherichia coli*, *Vibrio spp.* and *Listeria monocytogenes* were absent in final product. Arsenic content of both canned products was not in detectable level while the total volatile nitrogen content was within the acceptable range. Silver carp showed a higher flesh yield (46%) compared to Rohu (40%), although it's lower in both products compared to the commercial mackerel-canned fish. Cost of production for Silver carp and Rohu were Rs.420 and Rs.500 respectively. Sensory evaluations revealed that the canned product of Silver carp has a higher mean rank for overall acceptability and the texture of the both products need to be improved. Thus, the expert panel recommended to use short-type thick cans, develop the product as a fish paste or small chunks and use thickening-agents to improve the texture. In conclusion, both canned products can be considered as suitable products for consumption and market with suggested modifications.

Keywords: Can product, chemical parameters, microbiological parameters, Rohu, Silver Carp

Current status of *Enterocytozoon hepatopenaei* (EHP) in selected shrimp farms in Chilaw

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Enterocytozoon hepatopenaei (EHP), a microsporidian parasite, has emerged as a pathogen in the shrimp culture industry. It is reported to be associated with retarded growth in cultured shrimp in many Asian countries. *E. hepatopenaei* was detected for the first time in Sri Lankan shrimp farms on January, 2022. This research was conducted to study the current status of *E. hepatopenaei* infection in the Sri Lanka town of Chilaw and around. A survey was first employed to gather information from 21 selected shrimp farms in the area. Live samples of *Litopenaeus vannamei* shrimp were also collected from each farm and then stocked in separate glass tanks in the laboratory until their evaluation for the presence of the disease. Wet mount microscopy and detailed histopathology were employed for disease identification and for determining the infection ratio of *E. hepatopenaei*. Based on the farmer's viewpoint, 9 out of the 21 farms examined were not *E. hepatopenaei* infected since these farms do not show symptoms related to this parasite. However, laboratory investigations confirmed that all 21 farms were infected by *E. hepatopenaei*. The appearance of symptoms was found to be related to the infection ratio. In general, an infection ratio <1 did not show symptoms while an infection ratio >1 showed symptoms. Investigations revealed that among the farms investigated, 57% employ some form of treatment and 42.8% are able to maintain an infection ratio <1 . In conclusion, all farms tested were infected by *E. hepatopenaei* and the symptom from this disease is correlated with the infection ratio. Current treatments appear to be effective in keeping the disease under control, although 100% prevention of the disease appears difficult at the moment.

Keywords: *Enterocytozoon hepatopenaei* (EHP), histopathology, infected ratio, *Litopenaeus vannamei*, wet mount

Effect of probiotic type and application rate on water quality and growth performances of Pacific white shrimp, *Litopenaeus vannamei* reared under the bio-floc system

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Cultivating *Litopenaeus vannamei*, in bio-floc systems under indoor circumstances is receiving a lot of interest. Though shrimp production in bio-floc systems getting popular over time, there is still a scarcity of research on the effect of probiotic application rate and the probiotic type on the performances of shrimp. The study was conducted to compare the effect of *Lactobacillus sp.*-based powdered probiotic (PP) and liquid probiotic (LP) while checking the impact of application rate on the water quality, survival, feed conversion ratio (FCR), total hemocyte count (THC) and growth performance of *L. vannamei*. A 42-day growth trial was conducted in a system consisting of 12, 120 L polyethylene indoor tanks using bio-floc technology while maintaining C: N ratio at 15:1. 25 shrimp PLs ($0.08 \pm 0.005\text{g}$) were stocked per tank (108 shrimp/m^2). Three treatments were assigned to test the effect of the LP application rate (every 2nd day/LPx2, every fourth day/LPx4, and every 7th day/LPx7). A PP was used as the fourth treatment, which was applied every 2nd day (PPx2) to compare with LPx2. The weekly dose of each treatment was kept constant based on the colony-forming units (CFU) of each product. Total suspended solids (TSS) and CFU, growth performances, survival, FCR, and THC of shrimp were determined. No significant differences were noted between treatments for weight gain, percentage weight gain, survival, and THC of shrimp. Significant improvement was noted for FCR in shrimp treated with LPx2 and LPx7 compared to the treatment of PPx2. No significant difference in CFU was detected in the rearing medium treated with LP and PP, while no significant differences were detected in TSS, TAN, and nitrite-N between treatments. It could conclude that there is no significant effect of probiotic application rate (once or thrice per week) on the growth performance, survival, or THC of shrimp.

Keywords: Bio-floc, growth performances, Pacific white shrimp, probiotics, water quality

Evaluation of the heavy metal contamination status and some selected water quality parameters in the Anawilundawa Mangrove Restoration site

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The *Anawilundawa* Mangrove Restoration (AMR) site which directly or indirectly exposed to several anthropogenic pressures from industrial, fisheries, agricultural and domestic sectors, may have the potential to contaminate with heavy metals. Therefore, present study was aimed to determine the physio-chemical parameters and heavy metal contamination status of water and sediment in AMR site and its peripheral. Water and sediment samples were collected from paddy field outlet, shrimp farm outlet, Dutch channel outlet and restoration site inlet during the period of mid-October to late-November, 2022. Basic physio-chemical parameters: temperature, salinity, pH and conductivity of water were measured by a multi-parameter in the field. The nitrate and phosphate were analyzed by spectrophotometer, following the standard APHA method. The presence of Cu, Cr, Cd and Ni were analyzed by Atomic Absorption Spectrophotometer (AAS). During the study period, highest average concentration of total nitrate ($0.125 \pm 0.017 \text{ mgdm}^{-3}$) was recorded in shrimp outlet, while the highest average phosphate concentration is recorded in restoration site ($26.964 \pm 1.344 \text{ mgdm}^{-3}$). Selected heavy metals were recorded at the detectable level in sediment than in water. The highest concentrations of Cr ($0.460 \pm 0.000 \text{ mgdm}^{-3}$) and Ni ($0.540 \pm 0.000 \text{ mgdm}^{-3}$) were detected for the sediment of paddy field. The highest concentration of Cu ($0.900 \pm 0.040 \text{ mgdm}^{-3}$) was recorded for the sediment of Dutch channel. For Cd, highest concentration was recorded in the sediment of paddy field ($0.360 \pm 0.020 \text{ mgdm}^{-3}$). Cadmium was not found in water during the study period. But Chromium was at the detectable level in water for each location. Possible heavy metal contamination pathways around the selected areas can be identified as shrimp farming and agricultural practices. Hence, present study emphasis the importance of regular monitoring, to avoid future environmental issues relates with the heavy metal contaminations in AMR and its peripheral.

Keywords: *Anawilundawa* Mangrove Restoration site, atomic absorption spectrophotometer, heavy metal, nitrate, phosphate

Effect of replacing fish meal with rubber seed meal on the growth performance of Tilapia (*Oreochromis niloticus*)

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Sustainability of aquaculture depends on many factors, including cost effective feed. Fish meal is generally considered as the golden standard protein source for many aquaculture species including Tilapia. Despite aquaculture industry is looking for alternative feed ingredients to replace fish meal due to the concerns on the sustainability of wild fish stocks, higher price and huge demand. As an alternative to fish meal, the locally produced underutilized feed ingredients like rubber seed meal may reduce the feed cost. Thus, the present study attempted to investigate the potential of rubber seed meal as an alternative protein source for aquaculture and its effect on fish growth performance. Five weeks feeding trial was conducted to evaluate the effects of replacing fish meal with rubber seed meal (RSM) on growth performance of Tilapia fry (*Oreochromis niloticus*). Four experimental diets were prepared with 0%, 10%, 30% and 50% RSM. 0% RSM and commercial Tilapia feed were used as controls. Performances of experimental fish were evaluated through survival rate, feed consumption, and growth performance. Results of the study revealed that the 30% RSM diet possessed significantly ($P < 0.05$) higher growth rate, feed consumption compared to other treatments. Moreover, the production cost of 1 MT of 30% RSM diet is approximately Rs. 50,000.00 and Rs. 120,000.00 lower compared to the 0% RSM diet and Tilapia commercial feed, respectively. In conclusion, 30% RSM resulted in better growth performance without any adverse effects and cost-effective production for Tilapia fry. However, further studies need to be carried out to evaluate the effect of RSM on digestibility, health status etc to determine the suitability of RSM at commercial scale.

Keywords: Fish meal, fish performance, rubber seed meal, sustainability, Tilapia

Effect of *Azolla pinnata* (R. Br.) and *Eichhornia crassipes* (Mart.) Solms as ingredients on physicochemical properties of feed and the feed consumption of Pacific white shrimp, *Penaeus vannamei*

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Due to the high cost of the primary components, one of the aquaculture industry's top concerns is to evaluate the efficacy of alternative ingredients in fish and shrimp feed. Aquatic plants are such alternatives that could reduce the cost of feed. Therefore, *Azolla pinnata* (R. Br.) and *Eichhornia crassipes* (Mart.) Solms (water hyacinth) with higher levels of protein were selected during the current study to test their efficacy in the feeds of *Penaeus vannamei* replacing soybean and maize. Both selected aquatic plants were collected and maintained at laboratory conditions, dried under 70 °C, and powdered to be used in feed formulation for shrimp. 20% each from *Azolla* (diet 1) and water hyacinth (diet 2) were included in diets replacing soybean meal and maize in the control feed (diet 3) as protein sources. The quality of feeds was tested by physicochemical tests and a feed consumption trial was conducted to test the palatability of each diet for shrimp. The feed consumption trial was conducted for five days (n=3). Shrimps (5.02g ± 0.17) were fed known quantities of feed three times daily, and the day's uneaten feeds were collected to determine the feed consumption. Compared to the control significant differences in the weight and sinking velocity ($P \leq 0.05$) of pellets were observed in diets 1 and 2, but not in the length and diameter ($P \geq 0.05$). In the aromatic amino acid leaching assay, diet 3 (control) showed higher leaching than the feeds replaced with aquatic plants. Feed consumption by *P. vannamei* did not show a significant difference between diets 1 and 2 compared to the control ($P \geq 0.05$), suggesting feeds with locally sourced *Azolla* and water hyacinth have a similar preference to the control diet with soybean and maize.

Keywords: Feed consumption, Pacific white shrimp, plant protein sources, shrimp feed

Evaluation of growth performances of *Gracilaria edulis* under the artificial conditions

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Due to seasonal variations and pollution, the agar production from natural environment has been limited, which leads scientists to look into the indoor production of Red seaweed species for the production of high quality agar to cater the growing demand. *Gracilaria edulis* is an agarophyte and contains one of the highest amount of agar (67.52% dry weight basis). The current study was conducted to evaluate the potential of *Gracilaria edulis* for indoor production under artificial light conditions. Three types of commercially available LED lights; purple, yellow and full spectrum as well as day light as control were used to test how the spectral composition of light affected the growth of *Gracilaria edulis* under laboratory conditions. The experiment was conducted for 56 days and the initial fresh weight of the sample was 30g. Stocking density was 8.57g/L and tank volume was 3.5L. There were 30 culture tanks for each treatment. Optimum water quality parameters were maintained throughout the experiment. Light intensity was maintained at $95 \pm 5 \mu\text{molm}^{-2}\text{sec}^{-1}$ in all four treatments. Growth performance of seaweed cultured under LED light was compared with the control experiment. Specifically, wet and dry weight, length, girth and divisions of the thallus were measured in triplicates weekly in all four treatments. The Daily Growth Rate (DGR) and Specific Growth Rate (SGR) were determined. Results revealed that *Gracilaria edulis* cultivated under yellow light had the highest DGR, SGR, length, wet weight and girth. Approximately 193% weight gain was observed at the end of the experiment. No significant difference in terms of divisions of the thalli was observed in all four treatments. There was also no significant difference between the tested full spectrum and day light wavelengths in terms of the tested growth parameters ($p > 0.05$). It can be concluded that, indoor production of *Gracilaria edulis* is possible under artificial conditions and the best wavelength for growth is yellow (570nm).

Keywords: Agar, *Gracilaria*, indoor production, led lights, specific growth rate, wavelength

Formulation of healthy protein rich crackers using dried sea cucumber powder

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Sea cucumber (*Stichopus chloronotus*) is an export commodity in Sri Lanka. These sea cucumbers are exported as a dried state to foreign countries. After the drying process, complete pieces of sea cucumber are exported to foreign countries and broken pieces are rejected. Therefore, this study was designed to develop healthy protein rich crackers using dried broken sea cucumber powder. For this study, crackers were developed with five different formulations by incorporating sea cucumber at different percentages namely, 0%, 1%, 5%, 10%, and 15%. Crackers with 0% incorporated sea cucumber powder were considered as control cracker. This investigation assesses the proximate composition of complete sea cucumber, and broken sea cucumber powder. The crackers were developed; proximate compositions were analyzed; physical properties were analyzed; sensory evaluation also was done using the semi trained panel. The results show that there is no significant difference between the nutritional composition of both complete sea cucumber and broken sea cucumber powder. Based on the sensory evaluation, it was concluded that sea cucumber can be substituted up to 10% for cracker preparation and vanilla flavour was most preferred. Further comparison of crackers substituted with 10% sea cucumber with control crackers, shows that 10% sea cucumber powder supplemented crackers have a significantly higher percentage of protein ($27.43 \pm 0.04\%$), fat ($8.36 \pm 0.05\%$), and ash ($5.15 \pm 0.02\%$), and significantly lower level of carbohydrate ($46.81 \pm 0.12\%$). 10% sea cucumber supplemented crackers and control crackers have similar physical properties. Accordingly developed 10% broken sea cucumber powder supplemented crackers were found to be the nutritional and most consumer preferred crackers that can be used for human consumption. Development of protein rich sea cucumber crackers can minimize the post-harvest losses in sea cucumber processing industry.

Keywords: Cracker, nutritional value, post-harvest, proximate composition, Sea cucumber

Mobile application development to identify diseases in Guppy fish (*Poecilia reticulata*)

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Sri Lanka's freshwater ornamental fish business has a huge demand in recent decades due to increasing export demand. In Sri Lanka's ornamental industry, disease spread is a major issue. Lack of proper knowledge and technical approaches for disease control are recognized as the most significant problems in the industry. In order to disease identification is mandatory for ornamental fish farmers from an economic perspective. The research's main targeted fish species is the guppy fish (*Poecilia reticulata*) because, according to the NAQDA registry, the bulk of exported fish species were determined to be guppy (87%). The research main objectives are, to recommend possible treatments and specific drugs for diseases in guppy fish, to minimize the spread of the disease and control it. As a result of this study, develop an Android application to identify diseases in guppy fish (*Poecilia reticulata*) and to recommend possible treatments for these infections. To develop this app, I used a suitable flat framework and programming language. Used software, Android Studio version Arctic Fox (2020.3.1) and Java, XML used as programming languages. Sri Lanka and International guppy fish diseases information were collected by using research papers. Information about diseases, their symptoms, and possible treatments contained in the mobile application. After developing the mobile application, a validation process was conducted to check the included information. The validation process has two forms that are based on live fish disease samples and based on references. Farmers and pet keepers may use the developed app to easily identify and diagnose diseases in guppy fish.

Keywords: Diagnose diseases, Guppy fish, mobile app, treatments

Developing a shrimp feed using tuna head and plant-based products for Pacific white shrimp *Penaeus vannamei*

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Shrimp farming offers a lot of potential to diversify rural income in Sri Lanka. However, most of the suppliers are unable to sustain their business because of the high cost of feed. Accordingly, this study is aimed to introduce a cost-effective shrimp feed with balanced nutrient content using tuna head and plant-based feeds for *P. vannamei*. As the fish meal, tuna head meal was prepared with fresh tuna head waste. Banana peel, Mango kernel, and Cabbage meal were used to prepare a vitamin-mineral mixture referred as BMC mixture. Four different formulas of shrimp feeds were developed using tuna head meal, soybean, maize, fish oil, and vitamin-mineral premix. Four diets were prepared by pelletizing methods and proximate analysis was carried out to analyze the nutritional content of feeds. In the present study, all four diets were comprised with high nutrients. Physical (pellet length, pellet diameter, pellet weight, and sinking velocity) and chemical (aromatic amino acids (AAA) leaching) characteristics of the diets were evaluated. There was no significant difference observed in their physical characteristics ($P \geq 0.05$). However, a significant reduction in AAA was observed in diets 1 and 2 ($P \leq 0.05$). To evaluate the effect of prepared feeds for *P. vannamei*, feed consumption trial was carried out. Shrimps were fed three times/day for five days. The feed consumption rate was analyzed and resulted with significantly ($P \leq 0.05$) highest consumption for diet 2 by shrimps. Subsequently, the effect of the BMC mixture was evaluated following the feed consumption trial and resulted with effective acceptance by *P. vannamei*. Moreover, prepared diets were cost-effective compared to a commercially available shrimp feed. Collectively, this study proves that tuna head and plant-based products can be used to develop a cost-effective shrimp feed with balanced nutritional values for *P. vannamei*.

Keywords: Feed consumption, *Penaeus vannamei*, proximate analysis, shrimp feed, Tuna head meal

Mangrove charcoal: A non-timber forest produce to manufacture artists' pencils

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Mangroves are highly adopted halophytic angiosperms found in equatorial, tropical, and subtropical regions of the world. This ecosystem provides numerous direct and indirect services including carbon sequestration. Nonetheless, mangrove flora is underutilized. In order to uplift coastal livelihoods without destructive removal of mangroves and to find alternatives for the charcoal pencil industry, charcoal pencils from the twigs of three mangrove species *Avicennia marina*, *Rhizophora mucronata*, *Excoecaria agallocha*, and associate *Hibiscus tiliaceus* was developed. The twigs, roots, and fruits of mangroves were pyrolyzed and twigs were wrapped in paper to form pencils. Pyrolyzed pencil roots of *Avicennia marina* and fruits of *Rhizophora mucronata* were grounded, mixed with clay, and compressed. Colour, hardness, weight loss during pyrolysis and carbon content using the loss of ignition (LoI) method were measured for paper-wrapped pencils. A panel of ten professional artists evaluated the pencils on a five-point hedonic scale. The mean lightness and blueness to yellowness values of pencils were approximately equal to the commercial medium-type pencils ($L=28.54$, $a=1.123$). During pyrolysis, the highest weight loss (78.9%) was for *Excoecaria agallocha*. The hardness of pencils from *Excoecaria agallocha* and commercial soft-type pencils were similar in value (22.66 N and 20.75N). The mean carbon content of the four species derived from LoI was 83.34% for *Excoecaria agallocha*, 75.99% for *Hibiscus tiliaceus*, 73.08% for *Avicennia marina*, and 65.15% for *Rhizophora mucronata*. Overall preference and preference to hardness, blackness, and uninterruptedness were high for pencils made of *Excoecaria agallocha*. The erasability of the pencils was specially mentioned as a plus point. Prepared charcoal powder and clay mixed well, and future studies will determine the best combinations and preferences. The study confirms the ability to convert fallen fresh twigs of studied species into charcoal pencils.

Keywords: Artists' pencil, mangrove charcoal, non-timber forest produce, pyrolysis

Estimation of plastic debris contamination and associated water quality in different sources of water feeding into the Assisted Natural Regeneration of Mangroves (ANRM) site in *Anawilundawa*

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Plastic debris contamination is a global issue. However, less attention has been paid to their presence in mangrove ecosystems. Since mangrove ecosystems receive both fresh and marine water, the potential for pollutants to enter mangroves is higher. In addition to natural mangroves, sites that are restored should also be accounted for, as pollutants can affect the success of restoration sites. Accelerated Natural Regeneration of Mangroves (ANRM) is a pilot project implemented in a 52ha of abandoned shrimp farms in *Anawilundawa* Ramsar Sanctuary in *Puttalam* District. The present study focused on identification of both macro and micro plastics and determination of some selected water quality parameters in ANRM site and its vicinity (Dutch canal, shrimp farm outlets and paddy field area). OSPAR marine debris protocol was adopted to assess macro debris and the accumulation frequency in four strata. Water and sediment samples each in triplicates were collected on three occasions in 2022 to assess microplastic contamination and the water quality. For microplastic debris assessment, microscopic analysis and FTIR were used. Parameters such as pH, salinity, conductivity, phosphate, nitrate, and chlorophyll-a content were measured for water. During the study period, significantly lower levels of salinity (0.96 ± 0.741 ‰) and conductivity (2.04 ± 1.514 ms/cm) were recorded in the paddy field. Plastic was the most prominent type of debris in all four sites both by weight and count. By strata, the highest debris count and weight were recorded for the Dutch canal and 221 pieces, 2050 g respectively. In microplastic analysis, fragments were the highest observed microplastic by shape. Blue was the highest observed color. FTIR analysis revealed that most of the plastics belonged to the poly (ethylene:propylene:diene) group. The results of the study form the baseline of pollutants which should be addressed via preventive management strategies.

Keywords: Mangrove, microplastic, OSPAR, plastic debris, water quality

Evaluation of the effect of four commercial feeds on the performance of Pacific white shrimp *Litopenaeus vannamei* juveniles reared in a biofloc-based, zero-exchange tank system

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Although the proper application of feed is one of the most crucial operations in shrimp culture, there has not been much research conducted to evaluate the effect of diet as a whole considering both physical and nutritional properties of commercially available feeds. The current study was conducted to analyze the performance of *Litopenaeus vannamei* fed four different shrimp feeds (Nt, Nn, Bl, and Hg) available in the market and to identify the variability of physicochemical parameters of feed and their effect on shrimp. As physical properties, pellet length, diameter, weight, hardness, water absorption, bulk density, sinking velocity, and as chemical properties crude protein, fat, and aromatic amino acid leaching (phenylalanine, tyrosine, and tryptophan) were analyzed. The growth trial was conducted using sixteen polyethylene tanks (130 L) recirculating with a sump (400L) as a common biofloc system. The growth performance of the cultured shrimp was calculated in terms of the mean final weight, weight gain, Percentage weight gain, feed conversion ratio (FCR), and survival rate. Significant improvements were noted for final weight, weight gain, and FCR in shrimp fed "Bl" compared to the shrimp fed "Nt", while both showed no significant differences in the performances of shrimp fed "Nn" and "Hg". Feed consumption was measured as the amount of food eaten by the shrimp (N = 8) in each tank over a 30-min period. Shrimp fed "Bl" showed significantly high feed consumption compared to the consumption of the rest of the diets. Significant differences were noted between feeds for all above mentioned physical properties. However, this study confirms the need of evaluating both the physical and chemical parameters of feeds, which could vary between products. In addition, the decision for feed evaluation parameter selection should also be further evaluated in terms of economic viability and the variability of feed quality between different batches.

Keywords: Growth performances, nutrient leaching, pacific white shrimp, physical properties of feed

Organoleptic assessment, microbiological quality and proximate analysis of Giant freshwater prawns (*Macrobrachium rosenbergii*) produced in culture-based fisheries

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Giant freshwater prawn (GFWP) produced in culture-based fisheries in four perennial reservoirs were subjected to this study. Samples were evaluated for organoleptic assessment at landing sites. A newly developed evaluation sheet in 0-10 point Likert scale was used for this purpose. GFWP samples were tested for proximate analysis using AOAC METHOD 942.05. Total plate count, presence of E-coli, *Vibrio* spp. and *Listeria monocytogenes* were tested according to APHA (2015). A total of 60 individuals were subjected for organoleptic analysis based on following five main criteria; odour, carapace texture, color of eye, shell color and carapace color. Each criterion consisted with seven sub criteria. Physical damages were considered as constraints and each were weighted with minus marks (-30). According to the scores, prawns were grouped in to five categories. Samples comprised with males (63%), females (22%) and small males (15%). Carapace color was the least scored criterion (8.21) of large males and in females it was both carapace texture and color (7.92). Small males obtained the least score for carapace color (5.44). Main physical damages in males were broken peapods (10.5%) and chelate legs (5.3%). Females had minimum physical damages. Large males were distributed among excellent (2.6%), very good (68.4%), good (5.3%), fairly good (2.6%) and poor (21%) categories according to the scale. Moisture, ash, fat and protein content of male and female were 55.25 ± 3.77 , $61.76 \pm 5.12\%$; 0.87 ± 0.73 , $0.65 \pm 0.68\%$; 4.90 ± 1.11 , $6.50 \pm 1.45\%$ and 27.08 ± 0.39 , $26.54 \pm 0.57\%$ respectively and no significant difference between two sex or among reservoirs. Total bacterial count in males and females were, $4.91 \pm 5.08 \times 10^3$ and $7.93 \pm 11.52 \times 10^3$ CFU/mg respectively and in the acceptable range. All samples were positive for E-coli sp. *Vibrio* sp. and *Listeria monocytogenes* and further studies are needed to confirm the microbial status.

Keywords: Bacterial count, *E. coli*, *Vibrio* sp., *Listeria monocytogenes*, organoleptic characteristics

The antibacterial efficiency of plant extracts and commercial probiotic supernatants against Virulent bacteria in Aquaculture

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A possibility of antibiotic resistance exists nowadays due to the overuse of antibiotics against many pathogenic bacteria. This study focuses on finding alternative strategies to control bacterial infections instead of antibiotics. The antibacterial efficiency of selected plant extracts and probiotics, were tested against pure cultures of *Aeromonas hydrophila*, *Edwardsiella tarda*, and *Vibrio sp.* The initial bacteria count of *Aeromonas hydrophila*, *Edwardsiella tarda*, and *Vibrio sp.* were 8.34×10^3 CFU/mL, 5.96×10^3 CFU/mL and 6.64×10^3 CFU/mL respectively. 100 mg/mL concentrated *Phyllanthus acidus* leaves, *Chaetomorpha antennina* extracts and overnight incubated probiotic supernatants (Amaz Pro©, Live Gro©, and EM.1 Eco Pro©) were used. Distilled water and Ciprofloxacin Aqueous solution were used as negative and positive controls respectively. The micro dilution technique was used and incubated for 4 hours at 37°C. Then, 50 µl of solutions in each well were mixed with 950 µl of distilled water and spread on tryptic soy agar culture plates, and incubated overnight at 37°C. Colony Forming Units per milliliter of pathogenic bacteria in each plate were counted. According to final results *P. acidus* C. *antennina* extracts, Amaz Pro©, Live Gro© and Eco Pro© supernatants show, 96.11±0.3%, 95.37±0.39%, 88.77±0.36%, 31.18±0.32%, -35.36±0.13% inhibition percentage against *A. hydrophila*. 29.11±0.19%, 18.56±0.04%, 36.6±0.10%, 85.22±0.24%, 28.10±0.10% inhibition percentage against *Vibrio sp.* and 85.96±0.11%, 93.3±0.27%, 30.2±0.04%, 46.8±0.07%, 25.77±0.06% inhibition percentage against *E. tarda* respectively. It could conclude that *P. acidus* leaf and *C. antennina* extracts, show good percentage of inhibition against *A. hydrophila* and *E. tarda* infections. Amaz Pro© supernatant shows good percentage of inhibition against *A. hydrophila* and Live Gro© supernatant shows considerable percentage of inhibition against *Vibrio sp.* infection. Therefore, those plant extracts and probiotic supernatants can be used as alternatives to reduce the use of antibiotics to some extent.

Keywords: *Aeromonas hydrophila*, antibiotic efficacy, *Edwardsiella tarda*, probiotics, *Vibrio sp.*

Development of a protocol to recover protein and fat from fish collagen processing wastewater

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Collagen extraction from fish skin involves the removal of non-collagenous protein and fat at the pretreatment step which accounts for about 2% and 6% respectively of the total wet skin. This is generally achieved by washing with water followed by washing with sodium hydroxide to remove protein and fat in wastewater. Many studies have focused on optimising the sodium hydroxide wash to obtain the final collagen product with high purity, however, the focus given to “water- wash” is scanty in published literature. Also, no attempts had been made to recover these proteins and fat from the wastewater, which could be an important aspect at the industrial level. Therefore, this study was conducted to optimise the water-washing step and develop a method to recover protein and fat. Yellowfin tuna (*Thunnus albacares*) skin obtained from a fish processing factory was used as the raw material. The water-washing step was modified as four washes at 1:10 weight to volume ratio. Protein and fat content in the skin of fish was determined after each washing with water and sodium hydroxide. Bligh & Dyer method was modified to quantify the fat content. The first water-washing step showed the highest fat removal, and the first sodium hydroxide wash showed the highest non-collagenous protein removal. A method was developed to recover these proteins using the salting-out method with a 90% recovery percentage. Fat was recovered in three types; as a fat-in-water emulsion (100% recovery), by heating (85% recovery), and by solvent evaporation (90% recovery). The fatty acid profile was analysed by Gas Chromatography. Recovered protein with salt can be used as a fertilizer and purified protein can be used for the food industry. All protocols that have been developed in this study are economically feasible and could be adapted for any related industries in recovering fat and oil from wastewater.

Keywords: Fat, method development, non-collagenous protein, omega-3, recovery

Diversity of seaweeds and associated faunal species on artificial coastal breakwaters in Sri Lanka

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Constructed breakwaters can create suitable substrates for seaweeds and associated fauna; few studies have revealed their biodiversity. Two coastal breakwaters each in Marawila and Wennappuwa, in the north western province, were studied to identify macroalgal and faunal diversity. Quadrat sampling was performed from October to December 2022 on the exposed (seaward) and sheltered (landward) aspects of the breakwaters in supralittoral, intertidal and the subtidal zones. Samples were identified to genus and species level. Five Rhodophyta: *Gracilaria corticata*, *Jania cultrata*, *Jania adhaerens*, *Laurencia sp.* and *Pterocladia caerulescens*, three Chlorophyta: *Caulerpa sertularioides*, *Ulva compressa* and *Chaetomorpha antennina* and one Phaeophyta: *Chnoospora minima* were recorded. *Sargassum sp.* and *Rhizoclonium africanum* were recorded from Marawila, but not on the breakwaters. Zonation of floral distribution on the breakwaters was observed. *Ulva compressa* was the main species found on the supralittoral and the sheltered side of the structures. On the exposed side of all sites *J. cultrata*, *C. minima* and *C. antennina* were dominant. *P. caerulescens* dominated and ranged from 45-75% of the total cover of subtidal region with nine species. Among fauna, six gastropod species; *Trochus radiatus*, *Nodilittorina pyramidalis*, *Echinolittorina biangulata*, *Purpura persica*, *Cellana rota* and *Clypidina notata* were identified. Two oyster species: *Magallana bilineata* and *Saccostrea cucullata*, two barnacle species; *Chthamalus sp.* and *Amphibalanus sp.* were recorded. One sea urchin species: *Stomopneustes variolaris*, one mussel species: *Brachidontes sp.* and one chiton species were among the fauna. There were no differences among the faunal and floral diversity and the water quality among sampling sites at each sampling occasion but the diversity at all sites was reduced from first to the last sampling occasion. This study was limited to the northeast monsoon period and year round sampling will provide the actual diversity and the successions of macro algae and associated fauna.

Keywords: Coastal environment, marine macro algae, molluscs, zonation

Effects of calcium concentration in low salinity water on growth, feed conversion ratio, and survival of Pacific white shrimp, *Litopenaeus vannamei*

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Calcium (Ca^{2+}) is a crucial component of the crustacean exoskeleton and directly affects the molting process by hardening the cuticle through calcification. Commercial shrimp farmers supplement commercially available Ca^{2+} and magnesium (Mg^{2+}) salts to raise their levels in the rearing medium. Due to constant addition, or due to the variations in groundwater as a mineral source, Ca^{2+} concentrations in low salinity water could be significantly high. Therefore, a growth trial was conducted in an experimental system consisting of twelve, 70L glass tanks as a static biofloc system to ascertain the impact of higher Ca^{2+} concentrations in low salinity water (5 g/L) on growth, survival, feed conversion ratio (FCR), whole-body Ca^{2+} and Mg^{2+} levels of *L. vannamei*. Ca^{2+} levels of 120, 200, and 340 mg/L were achieved by adding increasing levels of Calcium chloride (CaCl_2) to the diluted seawater. Diluted seawater with no addition of CaCl_2 was used as the control treatment with a Ca^{2+} level of 67 mg/L, which is closely comparable to that of seawater at particular salinity (Mg^{2+} : Ca^{2+} = 2.98). After the 5-week growth trial, shrimp were counted and group-weighted by the replicate tank ($n=3$) to determine the growth, survival, and FCR, and collected shrimp were dried and powdered to determine Ca^{2+} , and Mg^{2+} levels in the whole body. The findings of the current study confirmed that the excessive levels of Ca^{2+} in 5 g/L salinity compared to the level of Ca^{2+} in diluted seawater has no significant effect on growth, FCR, survival, whole-body Ca^{2+} , and Mg^{2+} levels of shrimp. Therefore, it could conclude that there are no pros and cons of having a higher Ca^{2+} level up to 5 times than that in 5 g/L seawater in the rearing medium for the production of *L. vannamei*.

Keywords: Calcium, growth, low salinity, Pacific white shrimp, survival

Development of brine solution based Rohu (*Labeo rohita*) and Silver carp (*Hypophthalmichthys molitrix*) canned fish Product

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Although inland fish production has been increasing in the country, no processed freshwater fish products in the market except from dried fish and smoked fish. Present study intended to check the potential of developing brine solution based canned fish products using Silver carp and Rohu fish. Dressing percentage, microbial and chemical qualities, customer preference and cost benefit analysis was performed in this research. Row fish were subjected to total plate count (TPC), total Coliform, E. coli. Final product was tested for total volatile nitrogen (TVN), availability of Arsenic and commercial sterility based on SLS 516:1983. A sensory evaluation was performed using trained (05) and semi-trained (34) panelists. Results revealed that the dressing percentages were 46% and 40% for Silver carp and Rohu respectively but low compared to the commercially used mackerels for canning. TPC in raw fish for Rohu and Silver carp were 6.5×10^6 and 6×10^6 CFU/ml respectively and within acceptable levels. E. coli. was positive in raw flesh of Rohu only. Microbial growth was not detected in canned products. Results revealed that TVN was 4.2 and 4.5mg/100g in canned Rohu and Silver carp respectively and in the acceptable range. Arsenic was not in detectable levels in the final product. Costs of production for a 425g can were Rs. 501 and 351 for Rohu and Silver carp respectively. Overall acceptability of the product by the semi-trained panel had no significant difference with the commercial product ($P > 0.05$), but the opinion of the trained panel favors the commercial product. However, the new products received significantly ($P < 0.05$) low scores for the texture from both panels. Expert panel recommended to use short cans for packing and to use of thickening agent for further improvement in fish caning. Expert panel suggested to use these fish to develop fish paste due to the soft delicate texture.

Keywords: Culture based fisheries, product development, reservoir fisheries, sensory evaluation

***Ulva lactuca* incorporated instant Kola Kanda porridge mixture: Nutritional convenience and as a functional food**

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Sri Lanka has a varied range of green seaweed species along its coastline. *Ulva lactuca* seaweed is a rich source of health promoting macro and micronutrients, and bioactive components compared to terrestrial plants. The objective of this study was to develop an instant porridge mixture combining seaweed, *Gotu kola* leaves, and brown rice as a functional food. Sea lettuces (*Ulva lactuca*), Asiatic pennywort leaves (*Centella asiatica*), brown rice (*Oryza sativa*), ginger roots (*Zingiber officinale*), garlic cloves (*Allium sativum*), and coconut powder (*Cocos nucifera*) were used as ingredients. Collected ingredients were cleaned, oven-dried at 50 °C for 16 h and made into coarse powder. Three mixtures with 4, 6, and 8% of seaweed added porridge mixtures were developed and each was subjected to sensory evaluation. According to the overall preference, 4% and 6% *U. lactuca* added mixtures were selected as best preferred samples. The proximate analysis was conducted for 100 g of each mixture and the highest values for crude fiber (13.67 ± 3.8g), ash content (5.13 ± 0.28g), crude protein (10.75 ± 0.521g), carbohydrate (67.96 ± 3.79g) and crude fat (6.22 ± 0.96g) were obtained for 8% *U. lactuca* added mixture, followed by 6% and 4% *U. lactuca* added mixtures. According to the sensory and proximate analysis, 6% *U. lactuca* added porridge mixture showed best preference than the other two mixtures. Therefore, antioxidant test was conducted to 6% *U. lactuca* added mixture, and significantly highest ($P < 0.05$) antioxidant value, (IC₅₀ 12.64 mg/mL) was obtained suggesting its possible antioxidant capacity. Thus, this developed seaweed based instant porridge is can be recommended as a nutritional convenience functional food.

Keywords: *Centella asiatica*, functional food, instant porridge, seaweed, *Ulva lactuca*

Vertical profiles of selected soil physico-chemical parameters in natural, restored and degraded mangrove ecosystems of Sri Lanka

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Mangrove growth and biomass are influenced by physico-chemical characteristics of the pedosphere. For successful management of mangrove ecosystems and restoration, information on these characteristics is important. A study was conducted to establish vertical profiles of soil pH, salinity, electrical conductivity (EC), color and bulk density up to 50-cm depth in five mangrove restoration sites and adjacent natural mangrove ecosystems in Anawilundawa, Pubudugama, Achchankulum, Trincomalee and Batticaloa. Patterns among depths, sites, status (natural, restored, degraded), composition (*Avicennia marina* dominant, *Rhizophora mucronata* dominant, mixed species) and time since restoration (10 and 18 months) were compared. Stratified random sampling was used and three replicates were taken from each stratum in each site and a total of 1650 samples were analysed. Mean pH in natural mangrove areas was 7.4 ± 1.00 with no significant difference with depth, whilst EC decreased and bulk density increased with depth. Soil pH at Pubudugama and Trincomalee were significantly higher (8.4 ± 0.41) than the other three sites ($7.4 \pm \text{SD } 0.96$), whilst the lowest EC ($2.1685 \pm 1.6002 \text{ mScm}^{-1}$) and the highest bulk density ($1.4732 \pm 0.4743 \text{ gcm}^{-3}$) were recorded for Batticaloa. The lowest pH (7.4 ± 1.0052) was recorded in the natural mangroves, the lowest EC ($4.9739 \pm 2.9931 \text{ mScm}^{-1}$) in restored areas and the highest bulk density ($1.3894 \pm 0.2770 \text{ gcm}^{-3}$) in degraded areas. *A. marina* dominant mangroves had the highest pH (7.8 ± 0.91) and EC ($6.21 \pm 4.678 \text{ mScm}^{-1}$). Bulk density was higher in mixed mangroves and bare lands with some salt marsh vegetation ($1.3819 \pm 0.2770 \text{ gcm}^{-3}$). Both pH and bulk density decreased with age of mangroves. The brownness of the soil increased with depth. The results now form the baselines that are important in restoring degraded areas.

Keywords: Mangrove soil, physico-chemical parameters, spatial variation, vertical profile

Development of pickle from two edible seaweed species (*Kappaphycus alvarezii* and *Sargassum crassifolium*) and comparison of nutritional composition and sensory attributes

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Seaweed is one of the healthiest food sources with high nutritional values. Many edible seaweed species found in Sri Lanka are underutilized due to lack of knowledge on their nutritional values and poor availability in the market as readymade food items. This study aimed to develop healthy and tasty pickles from two selected edible seaweed species *Sargassum crassifolium* and *Kappaphycus alvarezii*. For this study, different types of pickles were prepared with three different formulations by incorporating sugar at 5%, 10%, and 15% and three different spice levels 3%, 4% and 5%. The preferred pickle was chosen by sensory evaluations. The proximate compositions of both pickles were also compared. Further, second sensory profiles of pickles were also analyzed for the final products and compared. The sensory evaluation revealed that the highest consumer's preference is for pickle made up from *K. alvarezii* with 5% of sugar and 3% of spices. When comparing the pickle from *K. alvarezii* with 5% of sugar and 3% of spices with the pickle from *S. crassifolium* with 5% of sugar and 3% of spices, the pickle from *K. alvarezii* had significantly higher percentage of protein ($0.45 \pm 0.26\%$), moisture ($73.26 \pm 1.21\%$), and crude fibres ($6.50 \pm 0.00\%$) content. *S. crassifolium* pickle had significantly higher percentage of fat ($12.00 \pm 0.05\%$), ash ($3.00 \pm 0.03\%$) and carbohydrate ($10.17 \pm 0.67\%$) content. The pH values in the liquid part of the pickles ranged from 5.4 to 5.6. The total plate counts (CFU/g) were enumerated for both pickles and they were in the range of recommended food safety standards. Therefore, this study concluded that newly developed pickles from seaweed species are rich with nutrients, preferred by consumers and safe for human consumption hence will be a healthy readymade food item for Sri Lankan consumers.

Keywords: Nutritional composition, pickle, seaweed, sensory profile

Development of a novel marshmallow and a spread using underutilized *Dioscorea alata* (Purple yam), *Sonneratia caseolaris* (Mangrove apple) and *Limonia acidissima* (Wood apple)

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Enhancing the nutritional value of confectionary foods using underutilized crops is a sustainable solution to the current global food shortage and a creative approach to ensure adequate nutrition intake. This abstract presents outcomes of nutritionally enhanced marshmallows and a spread using underutilized *Dioscorea alata*, *Sonneratia caseolaris* and *Limonia acidissima*. Using 80% boiled *D.alata* and 20% each from *S.caseolaris* and *L.acidissima*, two distinct flavours of marshmallows were developed. For spread, 50% boiled *D. alata*, 20% sesame and 15% each from *S.caseolaris* and *L. acidissima* were used. A semi trained panelist of 13 members ranked the products based on a seven hedonic scale. The most preferred products were analyzed for physical and chemical parameters, proximate composition, shelf life, antioxidant activity, flavonoids, HPLC sugar and vitamin profile. Results indicated significant customer preference over commercially available marshmallows. Marshmallow contained less sugar ($31.69 \pm 0.92\%$), less carbohydrate ($47.4 \pm 0.51\%$), high crude protein ($8.30 \pm 0.51\%$), and crude fiber ($1.10 \pm 0.03\%$) than the commercial marshmallow. A 10 g of marshmallow contained fructose (0.41 ± 0.00 mg), sucrose (2.88 ± 0.10 mg), and glucose (0.54 ± 0.08 mg). Cohesiveness, springiness, and adhesiveness textural parameters were similar to commercial marshmallows. The wood apple spread contained no sugar and was rich in crude fiber ($5.24 \pm 0.13\%$), protein ($10.41 \pm 0.04\%$), and vitamins B and C. Underutilized crops increased the final product's antioxidant properties and mineral composition. Results showed no significant differences in taste, aroma, colour, and acceptability between the commercial and developed products. Both products were suitable for short-term storage (up to 5 days) with no significant colour variance. Commercial production is feasible due to readily available ingredients as well as introduction as a cottage industry.

Keywords: Mangrove, proximate analysis, underutilized foods, yam

Diversity and abundance of hard coral species in near-shore sites off Jaffna peninsula in Sri Lanka

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Due to limited studies on the status of hard corals in northern Sri Lanka, we conducted baseline surveys at 4 sites (Kareinagar, Mandathiev, Point Pedro and Sakkottei) at Jaffna Peninsula. Video transects, conducted over the coral reefs at each study site, were converted to 100 picture frames along the specified distance using a GPS recording camera. Randomly allocated 2500 data points on these picture frames were analyzed using the Coral Point Counter (CPCe). Mandathiv, a major landing site, reported the highest coral cover (49.12%), but most of it was dead corals (45.28%). Point Pedro had the highest live coral cover (5.12%). Kareinagar and Sakkottei had more live coral diversity (>90%) due to low human impacts. Point Pedro and Kareinagar had 7 genera of hard corals followed by Mandathiv and Sankottei of 5 and 3 genera respectively. The highest significant difference in the Shannon Weiner index was present between *Favites* and *Poillopora*. (0.046) while that of Simpson's index was present between *Favia* and *Poillopora*. (0.030). But there was no significant difference in diversity indices at different sites (SW=0.621, S= 0.680). Point Pedro and Sakkotei had different hard coral compositions. The hard coral composition of Mandathiv is negatively correlated with the sandy nature of the bottom substrate while that of Sakkotei is positively correlated with the rocky nature. Kareinagar is positively correlated with coralline algal cover. Though no linear relationship exists between hard coral cover and the bottom substrate and macroalgal cover (P-Values; 0.096, 0.003, 0.665). The hard coral cover tends to decrease with the macroalgal cover or the sandy nature of the bottom substrate increases (Spearman rho value; -0.167, -0.296, -0.044). Reported information would be important as the baseline in future.

Keywords: Conservation, diversity, video transect, vulnerable ecosystems

Seasonality and dynamics of the fishing grounds and catches of yellowfin and skipjack tuna in the Indian Ocean based on landings in Sri Lanka

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Being the 36th largest fish-producing country in the world Sri Lanka targets Yellowfin tuna (YFT) (*Thunnus albacares*) and skipjack tuna (SJT) (*Katsuwonus pelamis*) as the main tropical tuna fishes in the Indian Ocean due to its high commercial value and demand from the international market. In commercial marine fisheries, catch forecasting with remote sensing and satellite data are costly. Thus, this study aims to evaluate the seasonal abundance of SJT and YFT with respect to their fishing position and depth to contrast the fishery trend in the Indian Ocean by using the fisheries logbook data of Sri Lanka landings from 2016 to 2021, obtained from the Ministry of Fisheries. The depths of the catches were contrasted based on the gear type. The study is based on Geographic Information System (GIS) and descriptive statistical analysis. Fish abundance differences of the regions in Sri Lankan waters can be identified, SJT's most abundant regions have been migrated to the southern and south-eastern regions but very close to Sri Lanka and the most abundant regions of YFT have been migrated to different directions a little away from Sri Lanka. Although Sri Lanka has shown a drastically high catch in 2017, the tuna fishery has progressed gradually since 2019. This study shows, that the available data can be used to determine the fishing locations, depths of catches and the size of the catch. It has shown that catching locations and abundance of fish varies regionally while the catching depth varies with season. Thus, the trends shown by this study could be used to develop a forecasting tool for determining the potential catches in the Indian Ocean.

Keywords: Longline, Skipjack tuna, Yellowfin tuna

Effect of dietary supplementation of Butterfly-pea (*Clitoria ternatea* L) on the colour enhancement of Fighter fish (*Betta splendens*)

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The market value of ornamental fish is greatly influenced by their attractive colours. Since fish may have limited ability in generating exotic colours on their own, supplementing the feeds with pigmenting agents may result to vivid coloration. The current research was conducted to determine the colour enhancement of Fighter fish (*Betta splendens*) by supplementing their feed with Butterfly-pea flower powder (*Clitoria ternatea* L). Four treatments in three replicates under completely randomized design were performed. Equal number of fish were stocked in twelve glass tanks and fed twice a day with commercial fish feed brand, Growfin, containing 0% (Control), 1% (T1), 2.5% (T2) and 5% (T3) of dried Butterfly-pea flower powder for 45 days. Growth and colour measurements were performed fortnightly. The head, dorsal, and tail colours of each fish were assessed through a colour reader, CR-10 Plus. The colour was measured in terms of L*, a*, and b* that is based on the International Commission on Illumination (CIE). The Hue (H \square) and Chroma (C*) were calculated from a* and b*. Furthermore, the colour was assessed visually among panelists at the end of the experiment. Colour reader Results showed that a significant increase ($p < 0.05$) in blue colour (-b*) in T3 relative to Control during the first two weeks. Visual analysis revealed that T3 exhibited the highest blue colour intensity of 88% ($p < 0.05$) and this was followed by T2 and T1. The growth of fish did not significantly differ among the four dietary treatments ($p > 0.05$). In conclusion, colour enhancement of Fighter fish can be achieved by supplementing fish feeds with *Clitoria ternatea* flower powder. Additionally, CR-10 Plus can be utilized to quantify color intensity using the (CIE) color system, which is more reliable, ethical, and simple than spectrometry and color charts.

Keywords: *B. splendens*, *C. ternata* L, Konica minolta colour reader, ternatin anthocyanins

An approach to developing a cottage-level cheese by incorporating soft-shelled giant freshwater prawns, which have no export value

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The giant freshwater prawn (GFP) (*Macrobrachium rosenbergii*) has been emerging as a promising alternative to uplift the livelihood of rural culture-based fishers in Sri Lanka. The GFP marketing system in most reservoirs is controlled by the monopoly of collectors. In maintaining the monopoly of the market some dominant buyers purchase all the GFP catch including the soft-shelled individuals, for a low price, but subsequently throw those away due to less market value. Hence, this study was conducted to add value to these discarded low-valued soft-shelled GFPs by incorporating them into cottage-level cheese. First, a method was developed to make cheese at the household level using acid-heat coagulation. A mild organic acid was used as the coagulant and 125 mL was selected to optimize the yield. Then, this method was modified to incorporate soft-shelled GFPs in three different forms; cube, ground, and freeze-dried. In this method, pasteurized milk was heated up to 70-72°C with soft-shelled GFPs blanched at 95°C for 30s and the acid was subsequently added. The resultant curd was then pressed. Proximate analysis indicated 56.34 ± 0.67%, 60.11 ± 0.90%, 55.95 ± 0.46%, 57.26 ± 1.10%, moisture; 15.45 ± 0.32%, 10.14 ± 0.83%, 10.45 ± 0.17, 12.03 ± 0.38%, fat; 7.08 ± 0.31%, 6.99 ± 0.35%, 17.91 ± 0.63%, 19.71 ± 0.03%, protein; 0.98 ± 0%, 1.02 ± 0.04%, 0.91 ± 0.09%, 0.77 ± 0.04%, ash respectively for cheeses prepared only with milk and with cubes, freeze-dried, and ground GFP incorporated cheeses. Texture profile analysis displayed no significant difference in chewiness and cohesiveness for all four cheese types ($P > 0.05$). Ground form demonstrated the highest gumminess (0.73 ± 0.2 N) and hardness (2.03 ± 0.2 N) values. There was no significant difference in colour among the three samples compared to the milk-only cheese as the standard ($P > 0.05$). Sensory evaluation and shelf-life evaluation will be conducted on the target audience.

Keywords: Cheese, coagulation, cottage-level, soft-shelled giant freshwater prawn

First records of two edible jellyfishes from Sri Lankan waters and proposing a taxonomic revision for *Lobonemoides* sp.

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“Ball type” and “white type” are two species of edible jellyfish which are commercially harvested from the northwest and southeast coastal areas in Sri Lanka. The identity of the two species was unknown due to the lack of extensive taxonomic studies conducted in Sri Lanka on Scyphomedusae. Morphological characteristics were observed from the collected specimens entangled into local fishing gear (trammel nets, gillnets and beach seines) operated near coastal and lagoon areas along the west coast from Jaffna in the north to Kirinda in the southeast for over a year. The collected samples and museum-deposited specimens were compared with the available literature. According to the study, “ball type” and “white type” were identified as *Crambionella Orsini* (Vanhöffen, 1888) and *Lobonemoides gracilis* Light, 1914 respectively as the first records from Sri Lanka. Further, from a Principal Coordinate Analysis conducted on the morphometric data obtained from Sri Lankan specimens and original descriptions, the other two species in Genus *Lobonemoides*; *Lobonemoides robustus* Stiasny, 1920 and *Lobonemoides sewelli* Rao, 1931 were identified as the synonyms of *L. gracilis*. Thus, we propose a taxonomic revision in the nomenclature of *L. robustus* and *L. sewelli*.

Keywords: Edible jellyfish, morphology, Scyphomedusae, synonyms, taxonomy

Quality assessment of Frigate Tuna (*Auxis thazard*) stored under three different storage conditions

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Fish are among the most perishable food commodities which needs efficient storage conditions to avoid quality deterioration. In Sri Lanka chilling and freezing are the commonly practiced storage conditions for seafood in households and even in multiday boats. In order to develop efficient storage conditions, shelf life of fish under different temperature conditions needs to be determined. Thus, the main objective of this study was to determine the shelf life of frigate tuna (*Auxis thazard*) which is a popular food fish species in Sri Lanka, stored under different storage conditions as refrigerated and freezing conditions. Sampled fish were placed in three different temperature conditions; (-18^oC), 0^oC and 4^oC and quality of the fish were determined through sensory analysis, microbiological analysis and bio-chemical analysis in weekly intervals for 5-weeks. Sensory evaluation was done according to the Quality Index Method using six trained panelists. For the microbiological analysis, Aerobic Plate Count (APC) was obtained according to the SLSI standards. Histamine, TVB-N and formaldehyde analysis were conducted using reverse-phase HPLC method, steam distillation method and UV spectrophotometry respectively to determine the bio-chemical quality of the fish. Significance of parametric data was analyzed using Analysis of Variance in SPSS software. Sensory analysis revealed that the fish stored at 4^oC showed the fastest deterioration in all sensory attributes within analysis period. Fish stored at 4^oC exceeded permissible levels of APC (8.62 log CFU/g), TVB-N (142.257 mgN/100g), Histamine (125.25 ppm) in 5th week. None of the fish stored at any temperature condition exceeded the permissible level of formalin content (5 ppm) in fish samples. According to the overall results fish stored at 4^oC storage condition is at the optimum human consumable range only for less than 2 weeks and fish stored at 0^oC and (-18) ^oC storage conditions is at the optimum human consumable range for more than 5 weeks.

Keywords: Formaldehyde, freezing, histamine, quality, TVB-N

Evaluation of salinity tolerance, root system architecture and nutrient uptake in three rice varieties of Sri Lanka

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Rice (*Oryza sativa*) is an edible starchy grain that is used by roughly one-half of the world's population as a staple food. Several abiotic factors such as soil nutrient content, salinity, acidity, element toxicity, etc found to cause negative impacts on rice production and yield, which could vary depending on the variety of rice. The current study was conducted to compare the salinity tolerance and the root architecture of Bg304, At307 & Bw312 and to compare performances in nutrient absorption in At307 & Bw312. For the evaluation of salinity tolerance, a hydroponic system with Albert solution was used with varying levels of electrical conductivities; 1, 6, 10, and 14 $\mu\text{S}/\text{cm}$ while plant height, the number of leaves and tillers, leaf colour, saline toxicity, and final root volume were measured at the end of 15 days. During experiment 02, root architecture was measured after a 65-days trial following the root basket method. The third experiment was conducted to compare the individual effects of N, P, and K in the recommended dose, half dose and no supplementation from the recommended level, while keeping the other two nutrients constant at recommended optimum level. Plant height, the number of leaves and tillers, leaf length, leaf width, and stem diameter were measured weekly during the experimental period of 65 days. Based on the results, significant negative effects were noted in all tested variables in each tested rice variety when increasing the salinity of the medium. A significantly higher number of roots were detected in Bg304 for each tested angle compared to Bw312 and At307, confirming its efficacy to use in the low country wet zone. At the conclusion of the nutrient absorption trial, significant differences were detected in leaf width, stem diameter, and number of tillers, except for plant height, number of leaves, and leaf length.

Keywords: Hydroponic system, root architecture, root basket method

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Effect of selective natural preservatives on the microbiological, chemical, and physicochemical characters of chicken sausage during storage

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Meat products are excellent source of nutrients for humans. However, they also provide a better environment for microbial growth. Therefore, preservatives are used to prevent the growth of microorganisms. Nitrites and nitrates are widely used synthetic preservatives in sausage production. But, the use of synthetic preservatives has negative health concerns. Therefore, there is an increasing interest in discovering natural preservatives (i.e., plant extracts and essential oils) as alternatives to synthetic preservatives. The main objective of the present study was to evaluate the effectiveness of the use of natural preservatives in the production of chicken sausages. Six sausage samples were produced by changing the type of the preservative used as follows: without any preservative, with sodium nitrite, cinnamon extract oil, beetroot powder, beetroot powder with lyophilized starter culture (*Staphylococcus carnosus*, *Pediococcus acidilactic*, and *Lactobacillus sakei*), and bay leaf (*Laurus nobilis* L.) powder. All the sausage samples were analyzed for physicochemical and chemical properties, microbial quality, and sensorial characteristics at 10-day intervals until 30 days of storage. Crude fat, crude protein, water activity, and energy values of all the sausage types were within the acceptable range for the chicken sausages. Sausages added with cinnamon extract oil, and beetroot powder with culture showed the lower ($P < 0.05$) counts of total bacteria, *Listeria monocytogens* and *Staphylococcus aureus* compared to the other types of sausages during 30 days of storage. *Escherichia coli* and yeast and molds were not detected in all the samples at all the time points. However, sausage with cinnamon extract oil had lowest acceptability for the taste and overall acceptability compared to other types of sausages. In conclusion, natural preservatives could be effectively used to produce chicken sausage though, their effects on the sensory properties of the sausage need to be further improved.

Keywords: Beetroot powder, cinnamon extract oil, natural preservatives, sausage

Evaluating nutrient composition of the protein supplements used in the feed mills around Kuliypitiya area

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Quality of the feed stuffs and the availability of the precise information on the nutrient content are important for the formulation of a balanced compounded feed. Soybean meal (SBM), meat and bone meal (MBM), fish meal (FM) and coconut poonac (CP) are the four major protein supplements used in animal feed processing and which accounts 56.96 %, 36.19 %, 2.27 % and 1.41 %, respectively from the total usage of protein supplements in Sri Lanka. Therefore, the objectives of the present study were to compare the nutrient composition of the SBM, MBM, FM and CP used in the feed mills around Kuliypitiya area and to evaluate the uniformity of the nutrient content of each supplement among the feed mills. Samples of the SBM, MBM, FM and CP were collected from seven feed mills around Kuliypitiya area. All the sample were analyzed for the crude protein content using the Kjeldahl method. The crude protein content of the SBM, MBM, FM and CP collected from seven feed mills varied from 51.1 to 54.6 %, 49.2 to 58.2 %, 22.2 to 69.6 % and 21.6 to 23.6 %, respectively. Except for the FM, other three supplements collected from all the feed mills were within the standard level of crude protein for the respective protein supplement. Three out of seven feed mills had lower crude protein values than the standard value for the FM. Additionally, the crude protein values of a particular supplement collected from seven feed mills were differed ($P < 0.05$) among each other for all the protein supplements. Because of the lack of uniformity in the crude protein content of the protein supplements among the feed mills in Kuliypitiya area it is important to precisely knowing the nutrient content of the protein supplements before using them for the feed formulation at the farm level.

Keywords: Compounded feed, feed ingredients, gross energy, nutrient composition, protein supplements

Development and evaluation of a semi-hard cheese incorporated with buffalo milk and cow milk

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Cheese ranks top among all the milk products in terms of consumer preference, calories, and nutrition. Among the milk from different animal species cow milk is widely used for the cheese preparation. However, the sensory quality and the meltability of the cheese made by the combination of the milk from different animal species are superior to cheese prepared from the milk from a single species. Compared to cow milk, buffalo milk has more casein, fat, and minerals and these factors could positively influence the yield and the quality of cheese. Therefore, this study was aimed to develop a semi-hard cheese by combining buffalo and cow milk. Buffalo milk and cow milk were mixed at five different ratios (v/v) as follows: 100:0, 75:25, 50:50, 25:75, and 0:100. The cheese yield was calculated during the cheese processing. All the cheese samples were analyzed for proximate composition and the sensory attributes. Inclusion of buffalo milk was found to increase ($P < 0.05$) the cheese yield, fat, and protein contents compared to the cheese made from sole cow milk. Cheese made from 25:75 ratio of buffalo and cow milk presented the highest sensory attributes in terms of flavor, texture, color, aroma, taste, after taste, physical appearance, and overall acceptability. In conclusion, incorporation of buffalo milk into cow milk enhances the yield and the chemical properties of the semi-hard cheese. The sensory properties could be downgraded if the inclusion level of the buffalo milk exceeds 25 %.

Keywords: Buffalo milk, cheese yield, cow milk, semi-hard cheese

The effect of probiotic and prebiotic on the syneresis of curd (*Meekiri*)

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Syneresis is one of the common textural quality defects found in the traditional fermented buffalo milk curd (*meekiri*). Probiotics and prebiotics have been reported to control the syneresis in fermented dairy products (i.e., yoghurt). Therefore, the objective of the present study was to evaluate the effects of probiotics and prebiotics on the syneresis in buffalo milk curd. Exopolysaccharide-producing *Lactobacillus* strain [*Lacticaseibacillus rhamnosus* GG (LGG)] and arrowroot (*Maranta arundinacea*) powder (AR) were selected as the probiotic and the prebiotic, respectively to determine the effects on syneresis of curd. Four different buffalo milk curds were prepared with or without the addition of probiotics and prebiotics as follows: control curd (C) without probiotic and prebiotic, probiotic curd (Pro) only with 2 % LGG, prebiotic curd (Pre) only with 3 % AR, and synbiotic curd (Syn) with both 2% LGG and 3% AR. The curds were evaluated for the percentage of syneresis, textural properties, post acidification and proximate composition for the 10 days of refrigerated storage period. Addition of LGG and AR reduced ($P < 0.05$) the syneresis in all the curds (Pro, Pre, and Syn) compared to the C from the beginning of the storage period. Cohesiveness of the Pro, Pre, and Syn curds was different ($P < 0.05$) from C throughout the storage. However, inclusion of LGG, AR or both did not affect ($P > 0.05$) the post acidification and the crude protein content of the curds, but the total solid content was increased ($P < 0.05$) with the addition of AR. Therefore, these findings can be concluded as probiotics (LGG), prebiotics (AR), or both (synbiotics) could be effectively used to control the syneresis in buffalo milk curd without any adverse effects on the composition and quality throughout the 10 days of storage.

Keywords: Curd, prebiotic, probiotic, synbiotic, syneresis

Development of a blended spread incorporating cow milk cream into coconut milk cream [*Cocos nucifera* (L.)]

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The consumption of high fat spreads is limited due to the health concerns. Coconut spread is one of the low- fat spread types with health benefits. However, the texture and taste of the coconut spread is inferior compared with high- fat spreads (i.e., butter). Therefore, the main objectives of the present study were to develop a blended spread incorporating cow milk cream into coconut milk cream and evaluate its quality compared to the coconut spread. A coconut spread, three different blended spreads incorporating 25 %, 50 % and 75 % cow milk cream into coconut milk cream and a butter (using cow milk cream) were prepared. The proximate composition of all the spreads was analyzed. Changes in the chemical (acid value, iodine value, pH value and peroxide value) and physical (color and texture) quality parameters were monitored weekly for one month of storage. The sensory attributes of the fat spreads were compared using 30 untrained panelists. Incorporation of cow milk cream into the coconut milk cream increased ($P < 0.05$) the fat content and decreased ($P < 0.05$) the crude protein and ash content of the blended spread. Incorporation of cow milk cream controlled ($P < 0.05$) the acidity and reduced ($P < 0.05$) the peroxide value of the blended spreads starting from the second week of storage compared to the coconut spread. Hardness and the 'b' value (yellowness) of the blended spreads improved ($P < 0.05$) with the addition of the cow milk cream throughout the storage period. The blended spread produced incorporating 75 % cow milk cream was highly ($P < 0.05$) preferred by the sensory panelists. In conclusion, the quality (physical, chemical and keeping) and the consumer preference of the coconut spread could be improved by the incorporation of cow milk cream to produce a blended spread.

Keywords: Blended spread, coconut cream, cow milk cream

***Alocasia macrorrhizos* as an alternative source of ingredient in pet animal feed**

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This study was conducted to find an alternative low-cost feed source for energy by integrating the flour of *Alocasia macrorrhizos* for pet foods. The demand for meeting the nutritional requirements of animals in Sri Lanka is being seriously hampered by the rising cost of feed ingredients in the animal feed sector. This is a very important necessity in Sri Lanka due to import restrictions. The reason behind the selection of *Alocasia macrorrhizos* was high availability, lack of human consumption, and low cost for cultivation. Flour of *Alocasia* was mixed with chicken, fish, and vegetables. Extruding technic was used to make kibbles. According to the proximate analysis, starch, protein, fat, ash and fiber composition were 89.6 %, 11.4%, 0.5 %, 3.2 % and 2.1 %, respectively. Finally, a preference test was done by using two categories such as stray dogs, and home dogs. Each group consisted of 12 dogs. Three samples were used for the preference test including the product prepared from *Alocasia macrorrhizos* and two other commercially available pet food samples. Results revealed 33% of stray dogs and 42 % of home dogs accepted *alocasia* feed as their first choice. The hardness of commercial pet food and *Alocasia macrorrhizos* food were 14.01 ± 1.42 N, 21.33 ± 2.75 N, and 17.82 ± 1.19 N, respectively. Population mean values of L (darkness to lightness), a (greenness to redness), b (blueness to yellowness) values of color between commercial food and *Alocasia macrorrhizos* food were significantly different ($P < 0.05$). According to the observations food consisting of *Alocasia macrorrhizos* is a very effective alternative food source for adult dogs.

Keywords: *Alocasia macrorrhizos*, dry pet food, extrude, Kjeldahl method, meat meals

***Colocasia esculenta* (L.) as an Alternative Source of Ingredient in Pet Animal Feed**

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Pet food industry has well established markets in developed countries like United States but it plays a minor role in developing countries like Sri Lanka. Increasing cost of feed ingredients in animal feed industry has been identified as a serious barrier to meet the demand of nutritional requirement of animals in developing countries. Animal feed ingredients face intense competition as human food leading to more demand than supply. It is vital to investigate the use of alternatives that are less expensive, locally available and least preferred by humans to overcome this scarcity. Therefore, this study was carried out with the objective of determining the effect of using *Colocasia esculenta* (L.) as an alternative source of economical ingredient in pet animal food by integrating it with a locally available dry dog food. Finely ground flour was prepared by washing, slicing, drying and pulverizing harvested wild cocoyam. *C. esculenta* cocoyam flour, chicken, fish and vegetables were the ingredients used in extruded dog food formulation. Proximate composition of cocoyam flour was determined by NIRS method. Palatability was checked by using six dogs per each four different dog categories; stray puppies, stray adults, home puppies and home adults. Results indicated that first choice of homestay dogs and stray dogs were 25 % and 42 %, respectively. Furthermore, the results indicated that there were significant differences ($p < 0.05$) in population mean values of L, a, b values of colour between the formulated food and the commercial food. The hardness of commercial food showed 14.01 ± 1.42 N while *C. esculenta* based food with 18.01 ± 0.82 N. In conclusion, *C. esculenta* can be considered as a better economical alternative feed ingredient in pet food especially during this economic crisis.

Keywords: Alternative feed ingredient, Calcium Oxalate, *Colocasia esculenta*, dog food, extrude

Utilization of locally available feed ingredients in the formulation of a novel horse feed

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Horse industry is well established in developed countries, but it is yet a modest industry in developing countries like Sri Lanka. The growth of horse industry in Sri Lanka has a huge potential for enhancing the country's economic standing. Less availability and high cost of horse feed are among the major constraints faced by Sri Lankan horse industry. Therefore, this study was carried out with the objective of formulating a palatable horse feed using locally available feed ingredients in Sri Lanka which conforms the main nutritional requirements of moderate working horses. Guinea grass, broken rice, rice polish, coconut oil, coconut poonac and Vitamin-mineral supplement were used as the ingredients in feed formulation. The ration was formulated according to the recommended daily nutritional requirements of moderate working horses. Accordingly, a total mixed ration was formulated in the form of pellets. The proximate composition and the gross energy of the formulated feed were determined using standard protocols. The physical characteristics between formulated feed and a commercial feed were analyzed through independent sample t-test. The results of the proximate analysis revealed that the crude protein content and the gross energy of the formulated feed were 7.5 g/100g and 246.2 kcal/100g, respectively. Furthermore, the results indicated that there were significant differences ($p < 0.05$) in the hardness, colour and bulk density between the formulated feed and the commercial feed. The commercial feed showed a significantly higher bulk density of 660.50g/L (SD \pm 14.1) than the locally prepared feed; 481.71g/L (SD \pm 10.91). Hardness of the formulated feed (40.43 \pm 1.34 N) was significantly higher than the commercial feed (13.02 \pm 2.03 N). However, the nutrient content of the locally manufactured horse feed was compatible with the basic nutritional requirements of moderate working horse.

Keywords: Formulation, horse feed, locally available, pellets, total mixed ration

Determination of nutritional factors and performance of a novel horse feed prepared by locally available feed ingredients

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Horse feed production is not in a satisfactory condition currently in Sri Lanka. Hence the formulation of a total mixed ration using locally available ingredients will become a trending industry in Sri Lanka. Not only formulation but also analysis of the feed is essential for the determination of the nutritional factors and performance of the feed. Proximate analysis was performed to find out the nutritional factors and palatability test, faeces evaluation, weight gain, and colic signs were tested for determination of performance of novel horse feed. The palatability test was performed by measuring and analyzing the time duration animal spent for approaching the feed, total time duration animal took to finish the feed and two-pan free choice tests to measure first approach and first choice. The moisture content of faeces, after feeding with and without novel feed was measured and weight gain was measured using a weigh band. The results of the proximate analysis revealed 7.5 g/100g protein, 6.2 g/100g total fat, 40.1 g/100g carbohydrate, 36.2 g/100g total dietary fibre, 1.6 g/100g moisture, 8.4 g/100g total ash and 246.2 kcal/100g in novel feed. The time duration animal spent for approaching the feed, total time duration animal took to finish the feed, moisture contents of faeces were significantly different ($P < 0.05$) between sun-dried novel feed, air-dried novel feed and commercial feed. According to the two-pan free choice test, the commercial feed showed 80 % of first choice and approach. Weight gain test revealed there was neither a weight gain nor a weight loss during two week feeding trial period and no colic signs during the feeding trial periods. In conclusion, locally available feed ingredients could be profitably converted into horse total mixed ration and protein content, gross energy of novel horse feed meets the basic nutritional requirement of the horse.

Keywords: Feeding trial, horse feed, nutritional factors, palatability, total mixed ration

Manufacture of Functional Halloumi Cheese Fortified with Garlic (*Allium sativum* L.) and Pepper (*Piper nigrum* L.)

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Halloumi, the traditional cheese of Cyprus, is produced using typically two processes: milk coagulation and pressed curd cooking. More recently, the product has gained international merit due to its characteristic aroma, elastic texture, and easy slicing ability. The scope of this study was to develop a functional bovine Halloumi cheese fortifying with Garlic and Pepper and evaluate its physicochemical properties during 35-day storage period at 7 days of intervals under refrigerated conditions ($10 \pm 1^\circ\text{C}$). The Halloumi cheese was developed using pasteurized cow milk by adding CaCl_2 and rennet. After coagulation, the curd was placed in a mold and pressed until the whey was removed. Then curds were heated and salting was done. Finally, a mixture of garlic and pepper powder [5 % (w/w)] was added to the cheese sample. According to the proximate composition analysis, mean values of total solids (from 45.79 to 49.62 %), fat (from 13.64 to 15.85 %), protein (from 17.97 to 19.84 %) and ash (from 2.14 to 3.53 %) were increased during the storage period. In comparison, moisture (from 63.86 to 61.49 %) and pH value (from 6.09 to 5.22) were decreased significantly ($p < 0.05$) in developed Halloumi cheese. A significant total color difference (ΔE^*) of the Halloumi cheese was observed on the 21st day of storage. The storage results revealed that hardness (4.20 N to 6.11 N), gumminess (1.99 N to 3.57 N), and chewiness (2.31 N to 3.34 N) increased and cohesiveness decreased (0.85 to 0.74) in Halloumi cheese significantly. This study concluded that the physicochemical properties were changed in Halloumi cheese during storage.

Keywords: Bovine milk, functional, garlic, halloumi cheese, pepper

Consumer perception of functional Halloumi cheese fortified with Garlic (*Allium sativum* L.) and Pepper (*Piper nigrum* L.)

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Sensory evaluation is a critical in understanding consumer attitudes and perceptions related to food innovations. Sensory evaluation is important for determining the eating quality of cheese, its consumer acceptability, and establishing lawful and specific relationships between food characteristics and human perception. This study evaluated the sensory attributes and consumers' perceptions of developed Halloumi cheese fortified with garlic and pepper with a non-fortified Halloumi cheese as a control. The sensory evaluation consisted of a nine-point hedonic test and sensory mapping, factor Analysis (FA), principal component analysis (PCA), Just Above Right (JAR) and Check-All-That-Apply (CATA) using XLSTAT and SPSS software with 30 untrained panelists. According to Cochran's Q test, panelists perceived and identified texture, overall flavor, before and after taste, appearance and aroma attributes; aroma, texture, before taste, after taste and overall flavor were significant for spice powder mixture fortified Halloumi cheese. Pearson Correlation was conducted to compare the consumer preference scores with instrumental data. The analyzed results revealed that the participants significantly preferred aroma, texture, and before and after taste of fortified Halloumi cheese ($P < 0.05$) than the non-fortified Halloumi cheese. PCA showed aroma, texture, overall flavor, and before and after taste highly correlated. According to Pearson correlation, sensory color score correlated with instrumental color values (l, a and b values). JAR analysis showed that 53 % accepted the color of the developed product. Overall, the analysis of all sensory attributes demonstrated that the fortification of Halloumi with spice powder mixture had higher consumer acceptance than the traditional Halloumi cheese in this study.

Keywords: Cheese, consumer perception, garlic, halloumi, pepper

Microbiological shelf life of functional Halloumi cheese fortified with garlic (*Allium sativum* L.) and pepper (*Piper nigrum* L.)

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Fresh cheese products are characterized by reduced shelf life because they are an excellent growth medium for many microorganisms. For this reason, it is essential to monitor the microbiological quality of fresh cheese products. Therefore, the purpose of this research was to monitor the microbiological quality of Halloumi cheese during the storage period. Halloumi cheese blocks fortified with garlic and pepper were produced from pure bovine milk, without any starter cultures, packaged in vacuum polyethylene laminate bags and stored at $10 \pm 1^\circ\text{C}$. The growth changes in total bacteria, *Escherichia coli*, yeasts and molds, *Staphylococcus aureus* and lactic acid bacteria of prepared Halloumi cheese samples were monitored within 40 days of storage at 10 days of intervals by spread plate technique. The shelf life of stored Halloumi cheese fortified with garlic and pepper was determined using microbiological analysis. The results obtained in this study indicated a significant increase ($p < 0.05$) of total bacteria, *E. coli*, yeasts and molds and lactic acid bacteria counts of Halloumi cheese during the storage time and there was a significant decrease ($p < 0.05$) of *S. aureus* count of Halloumi cheese during the storage time. The days to exceed the maximum permissible limit for total bacteria, *E. coli*, yeasts and molds, *S. aureus* and lactic acid bacteria were 32, 33, 21, more than 40 and 25 days, respectively; yeasts and molds exceeded the 1.5 log CFU/g maximum permissible limit after 21 days of storage. Therefore, the microbiological shelf life of functional Halloumi cheese fortified with garlic and pepper was detected as 21 days at $10 \pm 1^\circ\text{C}$ of storage.

Keywords: Halloumi cheese, microbiological analysis, permissible limit, shelf life

Influence of salting method on the physicochemical and sensory properties of functional Halloumi Cheese fortified with Garlic (*Allium sativum* L.) & Pepper (*Piper nigrum* L.)

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Salt is indispensable in cheese manufacturing as a preservative and flavour enhancer. The main objective of the current study was to evaluate the effect of dry salting and brine salting methods on the physicochemical and sensory properties of a functional halloumi cheese fortified with garlic and pepper. The dry salting treatment was done surface only, and both surface and inside; 13 % and 10 % brine solutions were used in the wet salting method. The changes in the physicochemical properties of the samples were investigated during the 30 days of storage at seven days' intervals at 7 °C. Sensory evaluation was performed using 30 untrained panelists. According to the results, the samples of the 13 % brine salted groups had significantly higher moisture (43.38 ± 1.67 %), salt (4.22 ± 0.46 %), and ash (4.05 ± 0.65 %) contents. In contrast, the surface & inside dry salted group had higher fat content (15.28 ± 0.11 %) and pH value (5.89 ± 0.06). The results revealed that salt, moisture, fat, ash, and pH contents significantly differed during storage ($p < 0.05$). According to the sensory evaluation, surface-only dry salted cheese was the most preferred (46.66 %). There was a significantly different effect on salt treatments for saltiness, sweetness, and shininess ($p < 0.05$). There was no different effect on salt treatments for creamy flavour, moist texture, and firmness ($p > 0.05$). In conclusion, the salting method affected halloumi cheese's physicochemical and sensory properties.

Keywords: Brine salting, dry salting, halloumi cheese, salting

Status and risk factors associated with Bovine Mastitis in Homagama Veterinary Region, Sri Lanka

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Bovine Mastitis is the most common inflammatory infectious disease of the mammary gland of dairy cows and that lowers the milk yield and reduced the quality of milk in affected cows. It is the most important cause that leads to an economic loss in the dairy industry of Sri Lanka. Homagama Veterinary Region was chosen for this study because the milk production as well as the number of productive cows are highest in that region compared to other veterinary regions in Colombo District. Objective of this study was to evaluate the risk factors associated with Bovine Mastitis in Homagama Veterinary Region dairy cattle to inform risk reduction activities to improve the quality and quantity of milk production and dairy farmer income. And also, to evaluate the most common Bovine Mastitis causative organisms including *Staphylococcus spp.* and *Escherichia coli*. A pre-tested questionnaire was used to collect information on cows and their management practices in randomly selected 40 farms. Samples from mastitis infected animals were collected and subjected to bacteriological analysis. Expected cow-related factors, unhygienic environments and inadequate knowledge or practice of mastitis control were remained significant (Exp(B) >1) according to the Binary logistic regression analysis. The contribution of *Staphylococcus spp.* with *Escherichia coli* to Bovine Mastitis was high in Homagama Veterinary Region. The results revealed that cow factors and milk hygiene play a significant role in the prevalence of bovine mastitis and mix infections are prominent in Homagama Veterinary Region.

Keywords: Bovine mastitis, dairy cow, *Escherichia coli*, risk factors, *Staphylococcus*

A risk-based scoring to quantify biosecurity in dairy cattle farms in Pannala veterinary region, Sri Lanka

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Biosecurity which comprises all measures preventing pathogens from entering and spreading within a herd is preferred in animal husbandry over treatments. This study describes the development of a risk-based scoring system and evaluates the level of biosecurity in 50 dairy cattle farms in Pannala Veterinary Division. A pilot trail was conducted and the questionnaire was revised based on comments. Biosecurity was quantified by converting the answers to 50 questions into a score from 0 to 100. The minimum score, '0', represents total absence of any biosecurity measure on the cattle farm. Whereas the maximum score, '100', means full application of all investigated biosecurity measures. Other than the level of biosecurity, level of milking hygiene was also quantified separately for each farm using 9 questions. The obtained data were analyzed by using descriptive statistics and spearman's rank correlation coefficient. The total biosecurity was on average 54 ± 8 %. Within the category of external biosecurity, the subcategory related to 'removal of dead animals' was the least considered biosecurity measure (mean score=18), while 'visitors and farmworkers'(mean=69) was the highest considered biosecurity measure. Within the category of internal biosecurity, the subcategories 'manure removal' and 'cleaning and disinfection' were the highest considered biosecurity measures (mean=95). There was a very weak non-significant positive correlation between farm-level internal and external biosecurity scores ($r=0.121$, $P=0.402$). The level of milking hygiene was on average 57 %. These findings indicate that there is a lot of variations in internal, external and milking practices among participating farms, suggesting that improvements are possible. Since the subcategory 'health management' scored the lowest, better education of farmers may help to improve overall biosecurity in dairy cattle farms.

Keywords: Biosecurity, dairy cattle farms, Pannala veterinary region, risk-based scoring system

Assess high-grade Eppawala rock phosphate (HERP) solubilization by phosphate solubilizing Fungi

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High-grade Eppawala Rock Phosphate (HERP) is a locally available phosphate source that is applied to plants as fertilizer. But its low solubility reduces its efficiency as a fertilizer. Phosphate-solubilizing fungi have the potential to enhance phosphate solubilization. This research aimed to quantify the HERP solubilization by three phosphate solubilizing *Penicillium* species and to evaluate their incubation periods' effect on HERP solubilization and media acidification. HERP samples were subjected to 3 treatments; inoculation with *Penicillium* spp. 1, *Penicillium* spp. 2, and *Penicillium* spp. 3 and uninoculated control, for 15 days. HERP solubilization was spectrophotometrically quantified and the absorbance and pH were measured from day zero to day eight, on day ten, and fifteen. Results showed that HERP solubilization by all three *Penicillium* species gradually increase with the incubation period and reached a constant level. *Penicillium* spp. 1 and *Penicillium* spp. 2 acquired the constant level after seven days while *Penicillium* spp. 3 acquired after four days. The pH also declined with the HERP solubilization and became constant. There was a significant difference in HERP solubilization and media acidification among all three *Penicillium* species and control, as well as among different incubation periods ($P < 0.05$). *Penicillium* spp. 1 showed the highest potential to solubilize HERP. HERP solubilization was significantly different among 3 subsets of incubation periods as; day 0, day 1-3, and day 4-15, although there was no significant difference within those subsets ($P < 0.05$). This study concludes that a sustainable and eco-friendly increment of HERP solubilization by phosphate solubilizing *Penicillium* species leads to a reduction in repeated HERP application as fertilizer, and it can reduce fertilizer cost and also over-exploitation of HERP source. HERP solubilization needs to be further studied under optimized conditions together with field trials to develop a bio-fertilizer.

Keywords: Fungi, high-grade Eppawala rock phosphate, *Penicillium* spp., solubilization

Acknowledgment: This study was funded by AHEAD/RA3/DOR/WUSL/LAS STEM 57 project, granted by World Bank

Synthesis of Di-Calcium Phosphate (DCP) from Eppawala rock phosphate (ERP) and eggshells

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Di-Calcium Phosphate (DCP) is a common inorganic phosphorus supplement used in animal feed. Eppawala Rock Phosphate (ERP) is one of the locally available rock phosphate resources in Sri Lanka, which can be utilized as a good P source while eggshell is a good source of CaCO₃ for DCP synthesis. This study is a preliminary approach to investigate the possibility of utilizing the ERP and eggshell to synthesize DCP. ERP solution was prepared by dissolving ERP powder in concentrated HNO₃ acid and CaCO₃ was added until it reaches 2.5 pH at 50 ± 5 °C. The mixture was filtered through a filter paper and the supernatant was collected. Then CaCO₃ or eggshell was added to the supernatant as the Ca source at 50 ± 5 °C with continuous stirring until it reaches 4.5 pH. The reaction mixture was maintained at 4.5 pH for 15, 30, 60 minutes and the precipitate was collected and washed with deionized water. Dried samples were characterized using X-ray Powder Diffraction (XRD) and Energy Dispersive X-ray Analysis (EDXA). XRD and EDXA analysis confirmed the synthesis of DCP with 16.45-17 % P and 35- 41 % Ca at a reaction time of 15 minutes with eggshells and 30 minutes with CaCO₃. Results indicated that there was some amount of unreacted CaCO₃ in the final product. This study concludes that there is a possibility to synthesize DCP by using ERP and eggshell powder as P and Ca sources. However, further studies are needed to improve the quality and cost associated with the production of these products as animal feed supplements.

Keywords: Di-Calcium Phosphate (DCP), eggshell powder, Eppawala rock phosphate

Acknowledgement: This study was funded by AHEAD/RA3/DOR/WUSL/LAS STEM 57 project, granted by World Bank

Prevalence of *Listeria monocytogenes* and *Staphylococcus aureus* isolated from raw milk in Pannala Veterinary Division

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Several pathogenic bacteria including *Listeria* and *Staphylococcus* cause foodborne diseases. Listeriosis is a severe foodborne disease which primarily affects newborn babies, elderly people, pregnant women and immunocompromised people and *Staphylococcus* causes food poisoning due to the consumption of contaminated food. This study was conducted to determine the prevalence of *Listeria monocytogenes* and *Staphylococcus aureus* isolated from raw milk in Pannala veterinary division. 50 samples of cow milk and 10 samples of goat milk were collected to determine the presence of *L. monocytogenes*. And also, 20 samples of cow milk and 5 samples of goat milk were collected to determine the presence of *S. aureus*. All milk samples were obtained from randomly selected small-scale farmers. Samples were isolated by using selective specific culture media for each microbe and these isolates were further characterized by different biochemical methods such as gram staining and catalase test. The prevalence of *L. monocytogenes* in cow milk was (14 %) and in goat milk (20 %) and also the prevalence of *S. aureus* in cow milk was (45 %) and in goat milk (40 %). Both gram-positive and catalase positive samples were selected for DNA extraction to further confirm the particular bacteria by polymerase chain reaction. *Listeria* and *Staphylococcus* were found in cow milk in comparatively high concentrations than in goat milk. The present study indicates the prevalence of the *L. monocytogenes* and *S. aureus* in raw milk due to the poor hygienic practices and therefore, emphasizes the need for adopting these hygienic practices.

Keywords: Gram staining, *Listeria monocytogenes*, listeriosis, raw milk, *Staphylococcus aureus*

Does forage production fulfill the feed requirement? A pilot study, to estimate the biomass composition and dry matter yield using Remote Sensing Techniques

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The greatest challenge facing the local cattle industry is the inability to get high-quality feed at a reasonable price. However, the coconut triangle has the inherent capacity to increase the production of high-quality forage. This study aims to estimate species biomass composition and dry matter yield of dominant forage species and to assess variation of forage production in the Siringapatha National Livestock Development Board (NLDB) farm land and Mahayaya estate, Sri Lanka. The present study used 30 pasture samples and 1 m x 1 m forage collected randomly from the cultured and non-cultured areas of Siringapatha and from Mahayaya which was dominant in the non-cultured area. Remote sensing approaches were used to estimate the total forage area and monthly variation of the greenness of forage using the NDVI (Normalized Difference Vegetation Index). *Panicum maximum* (Guinea grass), *Cenchrus ciliaris* (Buffel grass), *Pennisetum clandestinum* (Kikiyu grass), *Brachiaria milliformis* (Cori grass), and *Brachiaria ruziziensis* (Ruzi grass) were identified as predominant grass species in both study areas. Siringapatha cultured area mostly covered with *B. ruziziensis* in 82 %. But the Siringapatha non-cultured area was highly covered with Guinea (35.3 %), Kikiyu (54.2 %), and Buffel (9.4 %) grasses. The land area of Mahayaya was completely covered with Guinea (72.7 %) and Kikiyu (27.2 %) grasses. There is no significant difference in the dry and wet weight of the samples obtained from cultured and non-cultured areas in Siringapatha and Siringapatha Non- cultured area, and Mahayaya respectively. Monthly variation of the greenness/NDVI showed a significant reduction in May and June months within 2015-2020 time period during the prolonged dry season. Total biomass estimates were 2844.44 kg DM/ha in the Siringapatha and 4961.27 kg DM/ha in the Mahayaya area. In Siringapatha, 1 hectare of dry matter was sufficient to supply food for 270 milking cows per day. Implementation of pasture inventory method is recommended in this study to get an idea about species composition, yield of grazing sites and establishing land-use regulatory policies to allocate separate land for feed production on each farm.

Keywords: Biomass, Mahayaya, pasture inventory, remote Sensing, Siringapatha

Goat management systems in selected veterinary regions of Jaffna district, Sri Lanka

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Goats are popular among rural smallholders as they efficiently convert feed into edible and high-quality milk and meat. The Jaffna district is one of the main regions in the country, where goats are successfully reared and can be developed further. This study aimed to study the goat management systems in selected veterinary regions of the Jaffna district. A total of 120 goat farmers from five out of fifteen veterinary divisions of the Jaffna district (Tellipalai, Chankanaï, Uduvil, Nallur, and Jaffna) were interviewed with a pre-tested questionnaire and the information on their goat management practices was collected. The collected data were analyzed by SPSS (Version 25.0) and Minitab (Version 15). The results revealed that goat farming was important livelihood activity in the Jaffna district where 48 % of surveyed farmers were involved in goat production as their primary source of income. Meanwhile, 58 % of surveyed goat farmers were medium-scale producers (owned 16-25 animals) and the remaining 42 % were small-scale producers (owned < 15 animals). Most of the goat farmers (75 %) adopted to semi-intensive management system whereas 13 % and 12 % of farmers adopted extensive and intensive management systems, respectively. Goat breeds found in the study area were Jamunapari (45 %), Saanen (25 %), Indigenous (17 %), and Crossbreed (13 %). From the sample population, 81.5 % of males and 18.5 % of females practiced goat farming. Further, 50 % of farmers had above five years of experience in goat rearing. Most of the farmers (94 %) provided housing for animals, mainly elevated sheds (45 %). The majority of them raised goats for both milk and meat. The average milk yield was 0.85 L/ewe/day and the average market weight was 17.2 kg/animal. High cost of production, lack of feed and land area were identified as the main constraints to developing the goat industry in the study area. It could be brought to the optimum level by implementing appropriate management practices.

Keywords: Constraints, goat management system, Jaffna, questionnaire

Association between somatic cell count and physicochemical and compositional characteristics of raw milk of primiparous Jersey-Friesian crossed dairy cows

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This study aimed to investigate the association between Somatic Cell Count (SCC) and some selected physicochemical and compositional parameters of raw cow milk and to determine whether these parameters can be used to predict mastitis. Milk samples were collected from each of the randomly selected 80 primiparous Jersey-Friesian crossed dairy cows kept at a National Livestock Development Board (NLDB) farm during evening milking. SCC and selected physicochemical [pH, freezing point (FP) and density] and compositional parameters (protein %, SNF %, lactose %, salt %) of milk samples were determined. The results were analysed using correlation regression analysis and ANOVA of SPSS software. The cows were classified into three classes based on SCC: Class 1 - SCC < 1 X 10⁵ per mL, Class 2 - SCC 1 X 10⁵ – 4 X 10⁵ per mL, and Class 3 - SCC > 4 X 10⁵ per mL. According to the results of regression analysis, the pH and SCC had a moderate positive correlation. There was a weak positive correlation between FP and SCC and all the other parameters had weak negative correlations with SCC. From the total examined cows, 70 %, 24 % and 6 % were classified into Classes 1, 2, and 3, respectively. All evaluated parameters showed significant differences among the three SCC classes. Class 3 cows had the highest pH (7.04 ± 0.19) and freezing point (-0.39 ± 0.58), whereas SNF % (7.07 ± 0.83), salt % (0.51 ± 0.06), Protein % (2.87 ± 0.33), and lactose % (3.53 ± 0.43) were the lowest. This study indicates, higher SCC has a detrimental impact on milk composition and physicochemical quality. Further, it implies the possibility of using pH as an accurate, simple, and rapid indicators for diagnosis of mastitis. However, the reported results must be confirmed with a larger sample size.

Keywords: Dairy cows, electrical conductivity, mastitis, pH, somatic cell count

Acknowledgement: Grant No. 199, Multidisciplinary Research Grants 2022, University of Peradeniya

Prevalence and risk factors associated with repeat breeding syndrome in dairy cattle in Northwestern Province

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Repeat breeding syndrome (RBS) is a significant problem in dairy cattle management as it delays conception which results in prolonged calving intervals. Further, it leads to economic losses due to additional inseminations, higher culling rates and higher maintenance cost of non-productive animals. This study was conducted to determine the prevalence and risk factors associated with RBS in dairy cows in the Northwestern Province. The individual animal records of 827 dairy cows reared in seven National Livestock Development Board (NLDB) farms (Farm A- 63, Farm B-233, Farm C - 53, Farm D -111, Farm E -81, Farm F -172, and Farm G -114) in Northwestern Province were examined. General farm management-related information was collected using a pre-tested questionnaire. Risk factors associated with RBS were analyzed using binary logistic regression of SPSS software. Cows failed to conceive after at least three or more successive inseminations were considered as repeat breeding cows. The overall prevalence of repeat breeding in examined population was 16 % meanwhile the prevalence of RBS was 6.35, 18.03, 43.40, 9.91, 25.93, 4.07 and 21.05 % in farms A, B, C, D, E, F and G, respectively. According to the results of logistic regression analysis the parity, farm, age, and average milk yield significantly contributed to the risk of repeat breeding among the studied populations. There was no significant effect of breed and calving to first service interval on the prevalence of RBS. In primiparous cows, the risk of having RBS was greater than that of multiparous cows. The risk of becoming a repeat breeder was increased with age and it was positively associated with average milk yield. The RBS is a multifactorial problem which is not only affected by the inherent characteristics of individual animals but also by external factors associated with cattle management.

Keywords: Cattle, parity, prevalence, repeat breeding syndrome, risk factors

Effect of *Lactocaseibacillus rhamnosus* GG on physicochemical and sensory properties of goat milk yoghurt

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Goat milk is considered a healthy alternative to cow milk due to its less allergenic nature, and higher digestibility and nutrient content. Goat yogurt is a popular product originating from goat milk but often has low consumer acceptability due to its strong flavour and aroma. Probiotics have been suggested as a strategy to improve the product characteristics of goat milk products. This study aimed to evaluate the effect of exopolysaccharide-producing probiotic *Lactocaseibacillus rhamnosus* GG (LGG) on physicochemical and sensory properties, and consumer acceptability of various goat yoghurt preparations: (i) goat milk yoghurt (GM), (ii) goat milk yoghurt containing LGG (PGM), and (iii) symbiotic goat milk yoghurt containing LGG and barley flour (SGM). Plain cow milk yoghurt was used as the control. Physicochemical properties were measured at weekly intervals on the 1st, 7th, 14th, and 21st days after preparation and stored in refrigerated storage ($4 \pm 1^\circ\text{C}$). Sensory analysis and consumer acceptability tests were conducted using products after 7 days of storage. pH in all formulations was significantly decreased over the storage. Syneresis in goat yoghurts were significantly higher than that of cow milk. The addition of LGG significantly reduced syneresis in goat yoghurt but not in symbiotic yoghurt. LGG improved the whiteness (L^* values) of goat milk yoghurt ($p < 0.05$) after 21 days of storage but did not affect a^* and b^* values. The addition of LGG significantly increased the firmness and gumminess of goat yoghurts up to the levels comparable to that of cow milk. The same was observed in symbiotic preparation. However, LGG did not affect cohesiveness. In sensory analysis, compared to other preparations, probiotic goat yoghurt received the highest scores for all tested properties (appearance, aroma, texture, taste, sweetness, and overall acceptability). Consumer acceptance was also higher for probiotic yoghurt. Results conclude that LGG improves the physicochemical and sensory properties of GM yoghurt.

Keywords: Caprine milk, consumer acceptance, exopolysaccharides, probiotics, syneresis

Composition of milk from major buffalo breeds in Sri Lanka: Indigenous type and crosses of Murrah and Nili-Ravi

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Buffaloes play a pivotal role in the rural farming systems in Sri Lanka and heavily contribute to the economy of those farming communities. Buffalo milk production accounts for approximately 13 % of the total milk production in Sri Lanka and is mainly utilized for curd manufacturing. Milk composition greatly affects the composition and yield of dairy products in addition to their sensory and keeping qualities. To the best of our knowledge, there was no comprehensive information available on the milk compositions of major exotic buffalo breeds in Sri Lanka. Thus, this study aimed to determine the milk compositions of the major buffalo breeds in Sri Lanka: local/indigenous type and crosses of Murrah and Nili-Ravi. Fresh milk samples of the indigenous type and crosses of Murrah and Nili-Ravi were collected from a farm located in Wadigawewa, Polonnaruwa District. Milk samples from 5 different lactating buffaloes from each breed were obtained for analysis. All the animals were in the same phase of lactation (mid-lactation). The protein, fat, and solid non-fat (SNF) contents of milk were analyzed by a milk analyzer. Lactose content was determined by the titration method. The water content, solid content, and mineral content were estimated based on the protein, fat, SNF, and lactose contents. Results showed that milk proteins, milk fat, lactose, SNF, and total solid contents varied from 4.2-4.9 %, 5.3-7.5 %, 4.9-5.1 %, 10.1-10.7 %, and 15.4-18.2 %, respectively among the breeds. Milk from the local buffalo breed had significantly higher levels of protein, fat, SNF, and total solids than that of the Murrah and Nili-Ravi milk. Lactose and mineral contents are comparable among the breeds. Results concluded that milk from local buffalo is highly nutritious and may result in higher curd yield than milk from Murrah and Nili-Ravi crosses.

Keywords: Buffalo, Lanka buffalo, milk composition, milk fat, milk protein

Nutritional evaluation of *Gliricidia sepium* incorporated basal ration for lactating dairy cattle

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Dairy cattle nutrition is important to maximize the milk yields of lactating cows. Guinea grass (*Megathyrsus maximus*) is a freely available feed resource in Sri Lanka and is well-known for its aggressive growth, higher regeneration ability, and adaptability to a wide range of agro-climatic conditions. However, low protein content limits its use as a promising forage for dairy cows. *Gliricidia* (*Gliricidia sepium*) supplementation has been suggested as an effective way to improve the digestible protein content of guinea grass-based diets. Our previous studies suggested that milk yields of dairy cows proportionately increase with increasing levels of *gliricidia* supplementation (up to 30 % inclusion levels). The current research aimed to evaluate the nutritional composition of four Guinea grass-based diets with varying levels of *gliricidia* (0 %, 10 %, 15 %, and 30 %) supplementation. Proximate compositions of the formulated diets were determined using AOAC protocols. Proximate compositions of Guinea grass and *gliricidia* were also evaluated. The gross energy contents of the diets were evaluated by the bomb calorimetric method. Results showed that crude protein and crude fat contents in *gliricidia* were higher than those in Guinea grass ($P < 0.05$). The gross energy content of *gliricidia* (~18 MJ/kg) was also significantly higher than that in Guinea grass (~15 MJ/kg). Dry matter contents in the diets were increased proportionately with increasing levels of *gliricidia*. Crude protein contents were 6.05 ± 0.19 , 9.94 ± 0.29 , 13.05 ± 0.40 , and 14.92 ± 0.14 , respectively for 0%, 10%, 15%, and 30% *gliricidia* inclusion levels. Crude fat content in the diets was also increased significantly with higher inclusion rates of *gliricidia*. Ash contents in the diets showed the same pattern. The gross energy contents of the diets were increased with increasing levels of *gliricidia*. Results concluded that *gliricidia* supplementation to guinea grass-based diets may significantly improve crude protein, crude fat, and energy contents of the feed which are positively associated with higher milk yield.

Keywords: Dairy nutrition, Feed formulation, Feed energy, Forage, Sri Lanka

Sensory Profile of a Probiotic Ice Cream made of Buffalo milk

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Compared to cow milk, buffalo milk is highly nutritious and adds a rich creaminess to its products due to its high-fat content which makes it a promising probiotic carrier. The current study aimed to (1) characterize and quantify the sensory profile of buffalo milk ice cream using qualitative descriptive analysis (2) compare the sensory properties of probiotic buffalo-milk ice cream and buffalo-milk ice cream against cow milk ice cream (3) evaluate consumers' acceptability for the probiotic buffalo milk ice cream, and (4) investigate the effect on probiotics on sensory and physicochemical properties of buffalo milk ice cream. Three formulations of ice creams: (1) a control cow-milk ice cream (CMIC), (2) a plain buffalo milk ice cream with conventional yoghurt culture (3) a probiotic buffalo milk ice cream with *Lactocaseibacillus rhamnosus* GG (LGG) and conventional yoghurt culture were prepared. A qualitative descriptive analysis was performed using 12 trained panelists who quantify intensities for 10 pre-determined sensory attributes. Descriptive data showed that all the sensory attributes of plain buffalo ice cream were similar to that of CMIC. The addition of probiotics significantly reduced the sweetness of the probiotic ice cream while maintaining all other attributes at levels comparable to CMIC. Identified principal components explained ~73% of the total variance of sensory data. Creaminess, sweetness, slipperiness, and bitterness were the most influential sensory attributes. CMIC had the highest consumer preference followed by plain buffalo milk and probiotic buffalo milk ice creams. Measurements taken for physicochemical properties after 14 d showed that buffalo milk ice cream has higher acidity and lower melting rate compared to cow-milk-ice cream. Results conclude that the sensory profile of buffalo milk ice cream is comparable to that of the cow-milk ice cream and the addition of probiotics into buffalo-milk ice cream does not alter sensory attributes, except sweetness.

Keywords: Consumer preference, *Lactobacillus rhamnosus*, principle component analysis, quantitative descriptive analysis

Effect of the fat level on the yield and sensory properties of Halloumi cheese

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The fat content in milk is vital in cheeses, contributing to cheese's yield, composition, microstructure, and sensory properties. The present study was undertaken to prepare a cow milk-based Halloumi cheese with varying fat content and evaluate its effect on yield and sensory properties. Halloumi cheese samples were prepared with three different standardized fat levels (5 %, 1.5 %, and 0.7 %). The initial yield, yield after cooking in whey, and yield after brine treatment of Halloumi cheese prepared from three different fat levels were estimated. The sensory evaluation consisted of a nine-point hedonic test and Check-All-That-Apply (CATA) analysis using XLSTAT software with 30 untrained panelists. The results revealed a significant difference in initial yield, yield after cooking in whey, and yield after brine treatment in Halloumi cheese produced from three different fat levels ($P < 0.05$). The highest cheese yield was obtained (18.01 ± 0.03 %) from the Halloumi cheese with a 5 % fat level. According to CATA analysis, there is no significant difference ($P > 0.05$) among sensory terms and attributes tested in above mentioned three cheese samples. The consumer acceptability test results revealed that the Halloumi cheese with a 5 % fat level showed the highest overall acceptability, compared to the Halloumi cheese with a 0.7 % fat level with the lowest overall acceptability.

Keywords: Acceptability, fat content, Halloumi cheese, sensory evaluation

Effect of pH on the yield and physicochemical properties of Ricotta cheese

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Ricotta cheese is mainly produced by means of the utilization of whey, a by-product of the dairy industry. The objectives of this study were to detect the optimum pH of Ricotta cheese based on the yield, physicochemical and textural properties. Ricotta cheese was developed by mixing cow milk with whey at 60 °C and heating it to 85 °C. Different volumes of acetic acid were used to change the pH value of produced Ricotta cheese. The yield of Ricotta cheese was significantly different ($P < 0.05$) with different pH values, and the highest yield was ($117.28 \text{ g} \pm 1.47$) obtained at pH 4.8. Ricotta cheese developed at optimum pH (4.8) had 70.61 ± 0.75 % of moisture, 14.53 ± 0.45 % of protein, 2.66 ± 0.13 % of fat and 0.98 ± 0.02 % of ash. During the storage period of Ricotta, the colour values, L^* , a^* , and b^* , were not significantly different ($P > 0.05$); however, colour change (ΔE) was significantly different ($P < 0.05$). Textural properties of Ricotta cheese (cohesiveness, gumminess, chewiness, hardness) at optimum pH were significantly different ($P < 0.05$) during the storage time. This study concluded that the highest yield and desirable physicochemical parameters were obtained for Ricotta cheese developed at a pH of 4.8.

Keywords: Cheese, pH, physicochemical, Ricotta, yield

Determination of microbiological shelf life of developed Ricotta cheese

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Ricotta cheese is a typical Italian fresh dairy product obtained by heat-coagulation of the proteins in whey. Microbial contamination is a challenging problem in the fresh cheese industry. Therefore, the objectives of this study were to investigate the microbiological changes throughout the storage and determine the microbiological shelf-life of the developed ricotta cheese. In this study, ricotta cheese samples were stored in refrigerated conditions (10 ± 1 °C), and microorganisms in the cheese samples were enumerated for thirty-one days at ten days of time intervals by using the total plate count method. The microorganism which demands the shortest time to reach its maximum allowable limit in the cheese was identified as the spoilage indicator organism, and the required time was considered as the microbiological shelf life of the ricotta cheese. According to the study results, the growth of microorganisms was significantly different ($P < 0.05$) during the storage time except for *Escherichia coli* ($P = 0.799$). Results revealed the presence of 4.03 ± 0.07 log cfu/g total bacteria, 2.67 ± 0.1 log cfu/g yeasts and molds, 3.41 ± 0.19 log cfu/g Lactic acid bacteria, 2.63 ± 0.3 log cfu/g *Staphylococcus aureus*, and 0.67 ± 1.15 log cfu/g *E. coli* at the end of the storage period. Lactic acid bacteria were the spoilage indicator organism, and it demanded 21 days to reach its maximum allowable limit of 2.6 log cfu/g in Ricotta cheese. In conclusion, this study shows that developed Ricotta cheese using cow milk whey has 21 days of shelf-life at 10 ± 1 °C storage condition.

Keywords: Cow milk, maximum allowable limit, microbiology, Ricotta cheese, shelf-life

Physicochemical characteristics of Ricotta cheese that made using different acid types

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Ricotta cheese is prepared by heating whey and acidifying the resultant hot liquid to coagulate whey proteins. The recovery of milk constituents from cheese whey is affected by various processing conditions such as pH, temperature, and CaCl_2 followed during the production of Ricotta cheese. Therefore, this study aimed to investigate the physicochemical properties of Ricotta cheese made using different acid types; citric acid, acetic acid, apple cider vinegar, and lime juice. The addition of each acid for Ricotta cheese production was done at a predetermined optimum pH of 4.8. The cheese samples from different acids were stored in refrigerated conditions ($10 \pm 2^\circ\text{C}$). pH value, texture (hardness, gumminess, chewiness, and cohesiveness) and colour were measured for twelve days within four days of time intervals. At the end of the experiments, the final pH values recorded for Ricotta cheese made with citric acid (5.55 ± 0.40), acetic acid (5.63 ± 0.41), lime juice (5.36 ± 0.41) had no significant difference ($P > 0.05$) and the Ricotta cheese made with apple cider vinegar had a significant difference ($P < 0.05$). The colour values of the Ricotta samples were not significantly different ($P > 0.05$) with the acid types. Ricotta cheese made with citric acid showed reduced values for hardness, gumminess, and chewiness compared to Ricotta made with other acid types. Cohesiveness has significantly increased in the Ricotta cheese sample made using citric acid. In conclusion, the use of different acid types was attributed to the final pH value and other physicochemical properties of the Ricotta cheese.

Keywords: Acid types, colour, pH, physicochemical characteristics, texture

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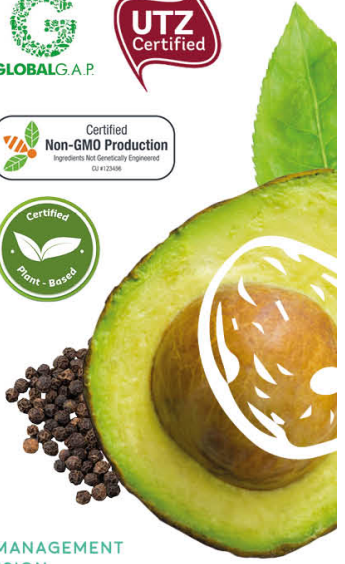


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ISSN 2465-5821