



# PROCEEDINGS

of the  
Sixth Undergraduate Research Symposium  
UReS 2019

"Towards Sustainable Food Systems:  
Opportunities and Challenges"

December 10, 2019



Faculty of Livestock, Fisheries & Nutrition  
Wayamba University of Sri Lanka



**Proceedings of the  
Sixth Undergraduate Research Symposium  
UReS 2019**

*“Towards Sustainable Food Systems: Opportunities and Challenges”*

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

**December 10, 2019**

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Proceedings of the Sixth Undergraduate Research Symposium-UReS 2019

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## FOREWORD

It is with great pleasure, that I write this Foreword to the Proceedings of the Sixth Undergraduate Research Symposium (UReS 2019) of the Faculty of Livestock, Fisheries & Nutrition, Wayamba University of Sri Lanka. The UReS is one of the most important events of the academic calendar of the faculty. Over the last few years, it has created a better platform for the undergraduates of the faculty to present their final year research findings to a wider scientific community giving an ideal opportunity for networking with academia and industry partners.

This year, the proceedings consist of 80 abstracts alongside an invited keynote address titled *“Ecological Food Processing and Sustainable Consumption”* under the theme of *“Towards Sustainable Food Systems: Opportunities and Challenges”*. The main theme is further divided into two sub-themes: Food Science & Nutrition and Food Production & Technology Management. Each abstract was reviewed by the students’ internal and external supervisors which then thoroughly screened by members of the editorial board who appointed from each discipline.

I take this opportunity to convey my sincere gratitude to Prof. E.M.P Ekanayake, the Vice Chancellor of the Wayamba University of Sri Lanka and Prof. B.P.A. Jayaweera, the Dean of the Faculty of Livestock, Fisheries & Nutrition for the valuable guidance given in organizing the UReS 2019. I extend utmost gratitude to Dr. Janandani Nanayakkara, the Coordinator of UReS 2019 for the untiring effort made to make this event a success. The success of this proceedings is primarily built on undergraduate researchers who did an outstanding work amidst numerous practical difficulties and their internal & external supervisors who guided these youngsters to conduct scholarly work. At this moment, I congratulate all of them for their high caliber research work. I express my gratitude to members of the organizing committee/UReS 2019 and demonstrators of the faculty for their continuous support extended in compiling the proceedings. On behalf of the editorial board, I wish to thank all academic and nonacademic staff of the faculty who assisted in numerous ways for successfully compiling the Proceedings of the Sixth UReS 2019.

Dr. W. A. Harindra Champa

Editor-in-Chief/UReS 2019

Faculty of Livestock, Fisheries & Nutrition, Wayamba University of Sri Lanka

## Message from the Vice Chancellor

It gives me a great pleasure to write this message for the Sixth Undergraduate Research Symposium (URes 2019) of the Faculty of Livestock, Fisheries, & Nutrition, Wayamba University of Sri Lanka, which has been organized with a timely focused theme of *“Towards Sustainable Food Systems: Opportunities and Challenges”*.

It is well known that globally, food system-related problems such as climate change, loss of biodiversity and bioproductivity, alongside prevalence of diet-related diseases, are rising and under this scenario, it is imperative to explore ways of achieving sustainable food systems. I am really happy that the faculty is driving the young researchers towards this important research area.

I would like to commend the efforts of the Dean, Heads of Departments and other academic, academic support and nonacademic staff of the Faculty since it was their expertise and contributions which made the achievements of the undergraduates a great success.

Finally, I congratulate all the undergraduates who present their research findings at UReS 2019 and wish them the very best in their future endeavours.

Prof. E.M.P. Ekanayake  
Vice Chancellor  
Wayamba University of Sri Lanka

## Message from the Dean

I am very much pleased to write this message to the Sixth Undergraduate Research Symposium (UReS 2019) of the Faculty of Livestock, Fisheries & Nutrition. Our academics conduct world-class research and come up with innovations to enrich the research culture of the university. We always believe that true education is both an experience and a process, which lead to Just-In-time Learning and some of the most profound and lasting student learning experiences happen beyond the classroom. Therefore, the sole purpose of the final year students' research is to equip the undergraduates with the higher order skills such as creative thinking and analytical thinking which are vital attributes of graduates for employability and also which open up opportunities for their personal and professional development. Thus, UReS is a landmark of their academic career for the final year students to showcase their graduate attributes and innovations to the appropriate forum.

UReS in this year is themed as *“Towards Sustainable Food Systems: Opportunities and Challenges”* which is the core of our research base of the faculty and I am happy to note that 80 abstracts covering researches of Food and Nutrition and Food Production and Technology Management will be presented this time. The result of the findings will open opportunities of commercialization, impart new knowledge in the related subjects, create pathways for more innovation and further research which ultimately have greater impact on mankind.

I would like to extend my greetings and best wishes to all the presenters at the UReS 2019 and my thanks should go to all the supervisors too. I would like to offer my deepest gratitude to all the academic and nonacademic staff of the faculty and students those who contributed make this UReS 2019 a success.

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

## Message from the Coordinator

With great pleasure, I am writing this message to the Sixth Undergraduate Research Symposium (UReS 2019) of the Faculty of Livestock, Fisheries & Nutrition. Under the theme of “*Towards Sustainable Food Systems: Opportunities and Challenges*” eighty undergraduates from four departments of the faculty are presenting their final year research findings at UReS 2019. For the first time in the history of UReS, more than half of the young researchers of the faculty communicate their research findings to the symposium audience using the Three-Minute Research presentation style, which is a buzzing trend in the international research communication. Others interactively engage in the poster presentations employing their verbal and visual communication skills.

I would like to take this opportunity to acknowledge, Vice-chancellor of the university, Prof. EMP Ekanayake for facilitating the research culture of the university, Dean, Prof. Ajith Jayaweera for providing continuous encouragement and timely advice for organizing the event, our keynote speaker, Prof. Ajith De Alwis for accepting our invitation and inspiring us on the importance of sustainable food systems for the betterment of humankind and the planet.

The generous support of our sponsors let us organize the event as we planned. On behalf of the faculty, I convey my heartfelt thanks to them. I would like to thank the home crew - the members of the organizing committee - for their dedication and timely effort in organizing the symposium. Furthermore, I acknowledge the assistant registrar of the faculty, the staff of Deans’ office, the technical officers of the media unit, and 3<sup>rd</sup> year students of the faculty for supporting the organizing committee for making this event a success.

I wish to thank all the academics of the faculty and the external research supervisors for their support in creating the research interest among these budding researchers and guiding them for producing their research communications. Lastly, I highly appreciate the undergraduates for their effort in sharing their invaluable research findings at this symposium and making this event a success. I wish them very best in their future endeavours.

Dr Janandani Nanayakkara

Coordinator/UReS 2019

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

## **Keynote Address**

### **Ecological Food Processing and Sustainable Consumption**

By

**Prof. Ajith de Alwis**

Senior Professor, Chemical and Process Engineering, University of Moratuwa, Sri Lanka;  
Project Director, Coordinating Secretariat for Science, Technology and Innovation  
(COSTI), Ministry of Science, Technology and Research, Sri Lanka

Over the next three decades a fact that has to be considered is that the global population is likely to be around 10 billion – 3 billion more than today! Feeding 10 billion with anticipated 50% more energy and 30% more water is going to be a certainly challenging. The fact that one has to operate within significant constraints due to climate change has to be factored into all our actions. We just do not have the luxury of doing things as in sixties and seventies when the current list of developed economies launched themselves with speed. Today, all are critically appraising the whole food supply chain with a change mindset. The source, make and deliver the basics would not change but the way we do these three activities are going to be radically restructured if the societies are to emerge unscathed from these crop of challenges. Understand the direct impact of climate change on agriculture; factor in the health impact that would bring in a double whammy. There is the need to accelerate ensuring national resilience by way of innovation in all fronts perhaps.

Food processing has to be seriously addressed by ensuring optimal resource consumption and ensuring circular behavior. One should not be just producing to an unsustainably consuming individual in an equally unsustainable society. Turn the menus to ensure better with nutritious and low with carbon and water footprints. Minimal processing techniques, ensuring circular economic principles to run the food industry would bring ecological food processing. Sustainable consumption however is a key. The 10 billion to have a more equitable food opportunities definite restructuring of supply chains are imperative. Shorter supply chains would be of more value and indigenous ingredients should find their rightful place in main menus. The diet of the future has to be different. Food processing is intimately tied to packaging as processing prosper with packaging. The latter has given rise to the global phenomena of solid waste and plastic wastes in particular. Packaging has to be developed in line with sustainability and this is a serious

challenge that had to be won quite early in the battle. While minimizing is the first line of attack innovating with biodegradable packaging is the final solution. It is important that perhaps the food that is likely to be wasted ended up being the packaging to the food and fuel to power the supply chain. When you understand this scenario it is evident that the overall burden on the stressed planet is much reduced. As an individual country these developments while having obvious environmental returns most certainly would deliver economic returns as well. Ecological food processing and sustainable consumption would definitely ensure the sustainability for a foreseeable future.

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# **Food Science and Nutrition**



## **Formulation and evaluation of nutri-bar using pumpkin (*Cucurbita maxima*) seeds**

**K.H.T. Amaya\* and B.M.K.S. Thilakarathne**

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The demand for convenience foods is increasing due to the busy lifestyles and consumers look for variety of snacks which are nutrient dense and healthy. This study was undertaken to formulate a nutri-bar incorporating pumpkin seeds with puffed rice, green gram, finger millet, dates & peanuts and to evaluate the proximate composition, anti-nutrient content, antioxidant activity, and storage quality. Nutri-bars were prepared with various percentages of pumpkin seeds (0 – control, 5, 10, 15, and 20%) and subjected to sensory analysis. Most acceptable nutri-bar (20% of pumpkin seeds) and control bar were selected to carry out the proximate, antioxidant, anti-nutrients and microbiological analysis. Antioxidant values showed a significant difference ( $p \leq 0.05$ ) between two samples. The total phenolic content (mg GAE/g dw) were 0.819 and 0.985 in the control and formulated bar respectively. The DPPH radical scavenging activity (mg AAE/g dw) showed significant difference between control and formulated product with the values of 13.21 and 14.79 respectively. The oxalate, tannin and phytate contents (mg/g) in the control and formulated products were within the acceptable range. The formulated sample contained moisture  $8.186 \pm 0.335\%$ , ash  $2.400 \pm 0.491\%$ , fat  $7.077 \pm 0.147\%$ , protein  $9.263 \pm 0.177\%$ , crude fiber  $22.935 \pm 0.774\%$  and carbohydrate  $50.137 \pm 1.034\%$ . No microbial count was found during the six weeks of storage and water activity was  $\pm 0.525$  under the ambient condition in PVC package. The ingredient cost of 100 g of nutri-bar was Rs.115.00. In conclusion, nutritional, healthy and ready to eat nutri-bar could successfully be prepared from pumpkin seeds.

**Keywords:** anti-nutrients, antioxidant, pumpkin seeds, nutri-bar.

## **Development of low glycemic index bread using chickpea (*Cicer arietinum*) flour**

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A study was conducted to develop low glycemic index bread using chickpea flour as an alternative to wheat flour. Since chickpea flour has more dietary fiber, it has a very low glycemic index when compared to wheat flour. The proximate composition of chickpea flour was determined using AOAC procedures. As chickpea flour does not contain gluten, the gluten was isolated from wheat flour. Different forms of isolated gluten (wet, dried and powdered gluten) were evaluated for their functionality in bread making. Four levels of gluten (8, 10, 12, and 14%), yeast (1, 1.25, 1.5 and 2%), baking temperatures (220, 200, 180 and 150 °C) and two levels of baking time (25 and 35 min) were evaluated for bread formulation. The results revealed that chickpea flour contained  $8.75 \pm 0.25\%$  of moisture,  $2.89 \pm 0.10\%$  of ash,  $25.62 \pm 0.95\%$  of crude protein,  $4.58 \pm 0.65\%$  of crude fat,  $1.65 \pm 0.095\%$  of crude fiber and  $56.51 \pm 1.12\%$  of carbohydrate. Wet gluten has the ability to reform the gluten matrix and dry powdered gluten lost the ability to reform matrix. Optimum expansion of dough was obtained at the combination of 12% of gluten and 1.5% of yeast. Baking at 180, 200 and 220 °C created roasted and very hard crust even with low baking time. Baking at 150 °C for 25 min caused row flavor inside the bread. Baking at 150 °C for 35 min gave a relatively similar product to wheat bread. In conclusion, low glycemic bread could be prepared using chickpea flour.

**Keywords:** bread, chickpea flour, gluten, low glycemic index.

## **Conventional low-calorie diet on body composition and metabolic parameters on obese and overweight adults**

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Obesity is a leading cause of non-communicable diseases. Conventional low-calorie diets have been proven beneficial effects in losing body weight from the baseline in the short term. Hence, a study was conducted to determine the effect of a conventional low-calorie diet on obese indicators: weight loss, fasting blood glucose level, blood pressure, and lipid profile. The study was a quasi-experimental design. Participants of overweight and obese adults ( $n = 10$ ) aged  $56 \pm 9$ y were recruited from Hettipola, Sandalankawa and Munamaldeniya non-communicable disease (NCD) clinics. The selected participants were provided with individualized conventional low-calorie diet plans. Diet plans were consisted of 30 kcal/day/weight and calorie deficit according to the obese category of each participant. All the anthropometric, clinical, dietary and biochemical measurements were taken on first and 12<sup>th</sup> weeks. Dietary analysis was done using Food base 2000 software. There was a significant ( $p < 0.05$ ) decrease in plasma LDL and significantly increased plasma glucose level after 12 weeks of the intervention period. Energy and carbohydrate intakes were significantly decreased. The body fat percentage was significantly decreased, and lean mass percentage was significantly increased. The study showed effectiveness in reducing body fat and increasing the lean mass. However, no enough evidence to support the conventional low-calorie diets are effective in losing weight and improving lipid profile except for LDL and decreasing the plasma glucose level. Further studies are suggested with modified study approaches on behavioral and dietary changes.

**Keywords:** non-communicable disease, low-calorie, obesity, overweight.

## **Effect of dietary counseling and physical activity on body weight, waist circumference, waist to hip ratio and plasma lipids of obese adults**

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Obesity, excess accumulation of body fat, is a major public health problem in the world. Poor dietary habits and physical inactivity are major causes of obesity which act as risk factors for several chronic diseases namely cardiovascular disease, hypertension, and type 2 diabetes. The present study was conducted to see the effect of lifestyle modification on obesity management, with the objective of assessing the effect of dietary counseling and physical activity on body weight, waist circumference, waist to hip ratio and plasma lipids of obese adults. This randomized controlled intervention study was carried out for 14 weeks. Apparently healthy obese individuals (n=30; male=8, female=22) were recruited as subjects, were randomly assigned to intervention (n=15) and control groups (n=15). Intervention group received the educational package on diet and physical activity and followed up in biweekly group counseling sessions. Control group were only provided the general lifestyle guideline at the baseline through a group education session. Anthropometry, blood pressure and fasting plasma lipids, were measured at the baseline (t=0), midpoint (t=8) and end (t=14) weeks of the study phase. Dietary intake and physical activity level were measured using a 3-day diet diary and long version of International Physical Activity Questionnaire at baseline, midpoint, and endpoint of the study. Results showed that significant ( $p < 0.05$ ) reductions in waist circumference and plasma triglyceride levels of the intervention group. However, there was no significant improvement in body weight of the intervention group. There were significant reductions in energy from saturated fat and added sugar in the intervention group. Physical activity level has been significantly increased ( $p < 0.05$ ) in the intervention group. Therefore, it can be concluded that the education package consisted of dietary counseling and physical activity were effective to improve the waist circumference and plasma triglyceride level of obese adults.

**Keywords:** body composition, dietary counseling, physical activity.

## Effect of low-calorie diet on management of type 2 diabetes mellitus

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Type 2 diabetes mellitus (T2DM) is a major burden to the health-care system and the prevalence of diabetes is rapidly increasing, therefore, a novel approach in management is needed. Lifestyle management has a greater effect on T2DM, among that diet and physical activity play a major role. This quasi-experimental study aimed to evaluate the effect of a low-calorie diet (LCD) on the anthropometric and biochemical parameters of T2DM patients and to investigate the compliance of the two diets. A total of 35 T2DM patients completed a 12-week LCD (n = 11) and a low-carbohydrate diet (n = 24-control group). Anthropometry, fasting blood tests, blood pressure and 24-hour recalls were taken at baseline and after 12 weeks. A paired t-test was done to test the within groups and an independent sample t-test was done for between group mean differences. There was no significant difference in anthropometric and biochemical parameters within the LCD group at baseline and 12-week. High-density lipoprotein and total cholesterol levels were significantly increased ( $p < 0.05$ ) after LCD. The 24-hour energy consumption remains unchanged before and after the intervention which showed noncompliance of participants during the intervention. Dietary analysis indicated that there were no significant changes in the macronutrient intakes before and after the intervention. The low-carbohydrate diet showed benefit of controlling total cholesterol and diastolic blood pressure compared to LCD. Increased HDL levels indicated a significant benefit of LCD compared with the low-carbohydrate diet. The compliance to the study of the participants for the diets was low. In conclusion, the study did not provide sufficient evidence to prove the effectiveness of the dietary intervention by comparison of two dietary programs used in the study. Further extended studies using alternative dietary intervention trials are suggested.

**Keywords:** dietary intervention, quasi-experimental, lifestyle management.

## **Knowledge, attitudes and practices of grandmothers in child feeding and caring in estate sector communities**

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Grandmothers involved in child feeding and caring influence on children nutritional status in the estate sector. Nevertheless, no studies have been conducted to assess the involvement of grandmothers in child feeding and caring. This study was conducted to assess the Knowledge, Attitudes, and Practices (KAP) of grandmothers in child feeding and caring. The subjects were 119 grandmothers from the Ambagamuwa area in the Nuwara-Eliya district. An interviewer-administered questionnaire which includes questions on socio-demographic characteristics and KAP on child feeding and child-caring was used to collect data at the household level. The questions on child feeding consisted of knowledge-15, attitudes -13 and practices -16 and knowledge -7, attitudes -10 and practices -12 on child-caring. Each correct answer was given a score of "1" and the wrong answer was given a score of "0". Total scores out of 100 for each aspect of child feeding and child-caring were calculated. Based on the obtained scores, each aspect of child feeding and child-caring of grandmothers was categorized as "high" ( $\geq 70\%$ ), "moderate" (41-69%) and "low" ( $\leq 40\%$ ) with respect to KAP. Out of grandmothers, 63, 76.5, and 76.4% had a moderate level of KAP on child feeding while 96.6, 81.5 and 99.2 had a high level of KAP on child-caring, respectively. Although most of the grandmothers knew about the initiation (71.4%) and continuation (87.4%) of breastfeeding, very few (2.5%) grandmothers knew about the introduction of egg white on the appropriate time and feeding during illness (4.2%). More than half (63.9%) of the grandmothers knew about the frequency of brushing teeth every day. This study suggested that there is a necessity of awareness programs to correct child feeding and caring practices for grandmothers to overcome the health and nutritional problems among children in the study area.

**Keywords:** attitude, knowledge, practice, questionnaire.

## High prevalence of sarcopenia and associated factors in the elderly

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Sarcopenia refers to an aging-related loss of muscle mass and function which is common in older people, especially in the elders who live in long-term care facilities. Aging is associated with changes in body composition including loss of muscle mass. The protein intake is positively associated with the preservation of muscle mass in the elderly and increasing total protein intake is identified as a potential strategy to reduce sarcopenia related loss of physical function. A comparative cross-sectional study was conducted to examine the prevalence of sarcopenia and associated factors among the elderly subjects and to compare the dietary protein intake, hand-grip muscle strength and body composition in free-living and institutionalized elderly. A sample of institutionalized (n=100) and free-living (n=100) elderly men and women over 60 years in Matara district were selected by convenient sampling method. Height, weight, waist circumference, hip circumference, mid-upper arm circumference, calf circumference, triceps, biceps, hand-grip muscle strength of the prominent hand and body composition measurements were taken. Two 24-hour dietary recalls were used for dietary assessment and mini nutritional assessment tool was used to identify their nutritional status. The overall prevalence of sarcopenia in the study population was 36% with 89% in institutionalized elders and 39% in free-living elders. There was no significant difference in protein intake ( $p=0.319$ ) between the two groups. Mean hand-grip muscle strength and percentage of lean mass were significantly higher in free-living elders compared to institutionalized elders ( $p < 0.05$ ). There was a significant ( $p < 0.001$ ) positive correlation ( $r=0.385$ ) between protein intake and hand-grip muscle strength. In conclusion, a higher prevalence of sarcopenia was found among institutionalized elderly compared to free-living elderly, but there was no significant difference in the protein intake among the two groups.

**Keywords:** elderly, hand-grip muscle strength, lean mass, protein intake.

## **Barriers for consumption of right quantity of fruits and vegetables in Sri Lanka: a case in Kurunegala district**

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Sri Lankan population does not consume the recommended amount of fruits and vegetables. Low fruits and vegetables consumption is an important risk factor for non-communicable diseases and micronutrient deficiencies. The objective of the study was to determine the degree of consumer-level problems in consuming the right quantity of fruits and vegetables and to identify the barriers at production, distribution, storage in the sector. Interviewer based questionnaire was used to identify the degree of consumer-level barriers. Secondary information was used to identify barriers at production, distribution, and storage of fruits and vegetables. Hundred adult consumers completed a survey in Kurunegala district. Information on demographics, socioeconomics, barriers to fruits and vegetable consumption and frequency of fruits and vegetables consumption were collected. Secondary information was used to analyze the changes occur in growing land areas, annual production fluctuations, postharvest losses during the transportation and changing climatic conditions and to calculate the logistic expenses namely labor, irrigation, fertilizer and transport costs for fruits and vegetables. The consumer-level barriers to fruits and vegetables consumption were the high cost (40%), lack of market place (21%), family/ peer/ society influences (16%) and poor availability (15%) in Kurunegala district. Lack of improvement in the growing land areas, high postharvest losses during transportation, decreasing trend in the number of rainy days and the widened price gap between the growers and consumers were the main barriers at production, distribution, storage and marketing of fruits and vegetables. In conclusion, barriers at consumer level as well as production, distribution, storage and marketing levels limit the consumption of the right quantity among the adults. Further studies representing the Sri Lankan population are warranted to get more insights.

**Keywords:** consumers, climate change, postharvest losses.

## **Acute and long-term effects of caffeine consumption on blood pressure and heart rate of normotensive individuals**

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Caffeine consumption has shown to elevate blood pressure. This randomized controlled clinical trial was designed to investigate the acute and long-term effects of caffeine consumption on blood pressure and heart rate among normotensive subjects. Coffee was used as a caffeine source in acute and long-term studies. Sixty apparently healthy normotensive adults aged between 20-25 years were recruited as subjects. Subjects were randomly assigned to three groups as treatment (caffeinated coffee) (n=20), decaffeinated (decaffeinated coffee) (n=20) and control (water) (n=20). The same subject groups were recruited for both acute and long-term studies. The acute study investigated the responses for 2 hours and after 8 weeks of washout period, the long-term study was conducted for 3 consecutive weeks. The blood pressure and heart rate were measured in every 30 minutes up to 2 hours in the acute study after ingestion of coffee samples or control. Blood pressure and the heart rate were measured weekly for up to 3 weeks in the long-term study. The results showed a significantly elevated ( $p < 0.05$ ) systolic blood pressure in the acute study. Diastolic blood pressure and the heart rate did not change significantly in the acute study. In the long-term study, there were no any significant changes in systolic and diastolic blood pressure and heart rate. Therefore, it can be concluded that acute caffeine consumption increases the systolic blood pressure significantly, whereas 3 weeks of continuous caffeine consumption does not increase the blood pressure or the heart rate significantly.

**Keywords:** blood pressure, caffeine, coffee, heart rate.

## **Development and quality evaluation of instant green smoothie as more convenient and healthy product**

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Fruits and vegetables are healthy food sources that contain nutrients and phytochemicals with health-promoting properties. Production of a healthy and more convenient product can be contributed to increasing the consumption of fruits and vegetables. The aim of this study was to develop an instant green smoothie powder as a more convenient product using locally available fruits and green leafy vegetables and to evaluate the quality parameters of the powder. The most suitable fruits, green leafy vegetables, and liquid were selected for preparation of the green smoothie and the fresh green smoothie was developed. The developed green smoothie was freeze-dried to obtain instant green smoothie powder. The instant green smoothie powder was analyzed for proximate composition; crude protein ( $2.67 \pm 0.00$ ), crude fat ( $1.96 \pm 0.001$ ), moisture ( $4.82 \pm 0.003$ ), crude ash ( $1.22 \pm 0.000$ ) and crude fiber ( $28.57 \pm 0.008$ ). The results of the physicochemical properties of the product revealed that the pH ( $4.21 \pm 0.0385$ ), titrable acidity ( $0.2134 \pm 0.0369$  g/100 mL), total soluble solid ( $12.33 \pm 0.0028\%$ ) and water activity ( $0.172 \pm 0.01$ ) were different from the fresh green smoothie. The powder properties were revealed that the powder has very good flow ability ( $6.665 \pm 2.354$ ) according to the Carr Index and it has a low cohesiveness ( $1.0713 \pm 0.0264$ ) according to the Hausner ratio. The solubility ( $94.71 \pm 2.4253$ ) of the powder complied with the SLS 668: 1984. The vitamin C content of the fresh green smoothie was 148 ppm and  $107.25 \pm 5.32$  AAE mg/g of total antioxidant capacity. This instant powder can be introduced as a more convenient and healthy choice for the consumers with higher crude fiber content, microbiological stability with excellent powder properties.

**Keywords:** fruits and vegetables, green smoothie, instant powder.

## **Glycemic response and quality evaluation of coconut flour incorporated crackers**

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Coconut (*Cocos nucifera*) flour is the residue remaining after virgin coconut oil extraction. It is considered a good source of protein and dietary fiber. This study was conducted to develop a sugar-free cracker using coconut flour as a substitute for wheat flour and to determine the physicochemical, sensory, microbial properties and glycemic response of the cracker. Crackers were prepared by incorporating coconut flour in different proportions (0, 10, 20, 30, and 40%) and evaluated by a 30-member semi-trained panel using a 7-point hedonic scale to determine the critical limit of coconut flour substitution. Crackers were evaluated for the physicochemical properties such as moisture, fat, protein, ash, crude fiber contents, color, texture, thickness, diameter and spread ratio. In addition, microbial load and water activity were tested to determine the shelf-life of the product. Glycemic response of best-accepted crackers was investigated in 10 normal healthy subjects by giving 25g of glucose and cracker with 25g of available carbohydrates. Fasting and postprandial blood glucose levels were measured at 15, 30, 45, 60, 90 and 120 minutes post consumption of the control and the cracker. Results showed that wheat flour substitution with coconut flour up to a level of 20% could be achieved without affecting the overall quality. According to the proximate composition cracker substituted with 20% coconut flour contained 2.95% moisture, 3.18% ash, 13.95% crude protein, 18.68% crude fat, 13.23% crude fiber and 47.94% carbohydrate. When substitution level increased, protein and fiber contents of the crackers were increased. During 6 weeks of the storage period, total plate count and yeast and mold counts were not detected and water activity was ranged between 0.23-0.26. Glycemic index and glycemic load of 20% coconut flour incorporated crackers were 56 and 4, respectively. Hence, these crackers could be considered as intermediate glycemic index food.

**Keywords:** coconut flour, crackers, glycemic index, physicochemical properties.

## **An instant healthy vegetable soup mix incorporated with ivy gourd (*Coccinia grandis*) leaves**

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An instant soup mix rich in nutrients and health benefits has high demand in any part of the world. The aim of this study was to formulate an instant healthy vegetable soup mix incorporated with ivy gourd (*Coccinia grandis*) leaves powder, which provides an antidiabetic effect. According to the preliminary studies, it was revealed that 25% of ivy gourd leaves can be incorporated into the standardized soup mix (vegetable powders 17%, corn flour 5%, rice flour 15%, salt 3% and 5% spices without changing its palatability characteristics. Sensory evaluation was carried out to select the best protein source using cowpea, green gram, and chickpea flour. Soup mix consists of 30% cowpea flour was selected as the best treatment. In this study it was revealed that moisture, ash, protein, fat, fiber and carbohydrate contents (percent wet basis) of selected and control samples were 9.16 and 10.21; 10.16 and 7.13; 19.58 and 19.55; 2.52 and 2.50; 6.2 and 5.8; 52.34 and 54.82 respectively. Significant differences observed in total antioxidant capacity, total phenolic assay, and total carotene content in the selected and control samples were 123.08 and 85.56 mg AAE/g dw; 1.22 and 1.12 mg GAE/g dw; 4.17 and 0.57  $\mu\text{g/g}$  respectively. In conclusion, the developed product could be specially targeted to diabetic patients and the ingredient cost was LKR. 110.00 per 100 g of soup mix.

**Keywords:** chick pea, instant soup, proximate composition, legumes.

## Physico-chemical and antioxidant properties of fruits and vegetable seeds belongs to the family Cucurbitaceae

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Seeds of the Cucurbitaceae plant family are discarded as by-products during food processing. Due to the presence of biologically active compounds, Cucurbitaceae seeds show functional properties such as anti-diabetic and anti-inflammatory. This study was conducted to determine the physicochemical and antioxidant properties of ten selected seeds belongs to the family Cucurbitaceae available in Sri Lanka and to discover the value of consumption. *Cucurbita maxima*, *Momordica charantia*, *Cucumis sativus*, *Citrullus lanatus*, *Luffa acutangula*, *Benincasa hispida*, *Momordica dioica*, *Cucumis melo*, *Trichosanthes cucumerina*, and *Cucurbita moschata* seeds were collected, cleaned and air dried at  $45 \pm 2^\circ\text{C}$ . Physical properties (weight, density, volume, and specific gravity) and proximate composition of seeds were determined by using AOAC methods (2005). Total polyphenol content, total antioxidant capacity, and % DPPH free radical scavenging activity were analyzed in methanol extraction of seed powder. Weight, density and volume varied as  $0.01 \pm 0.02$  to  $0.26 \pm 0.02$  g,  $449.35 \pm 0.02$  to  $948.33 \pm 0.02$  kgm<sup>-3</sup> and  $0.016 \pm 0.02$  to  $0.328 \pm 0.02$  cm<sup>3</sup> respectively. Moisture, crude protein, crude fat, crude fiber, ash and carbohydrate ranged respectively as  $5.1 \pm 0.02\%$  to  $9.5 \pm 0.02\%$ ,  $14.8 \pm 0.02\%$  to  $34.40 \pm 0.01\%$ ,  $15.53 \pm 0.03\%$  to  $35.72 \pm 0.02\%$ ,  $18.90 \pm 0.04\%$  to  $45.24 \pm 0.03\%$ ,  $2.6 \pm 0.02\%$  to  $8.0 \pm 0.02\%$  and  $15.23 \pm 0.02\%$  to  $22.92 \pm 0.02\%$ . Total antioxidant capacity, free radical scavenging capacity, and total phenolic content ranged within  $16.38 \pm 0.01\%$  to  $34.31 \pm 0.02\%$ ,  $3.51 \pm 0.02$  to  $510.83 \pm 0.01$  (mg AAE/g dry weight),  $3.491 \pm 0.02$  to  $11.078 \pm 0.01$  (mg GAE/g dry weight), respectively. It can be concluded that the Cucurbitaceae seeds have considerable levels of nutrients and antioxidant properties, thus, they could be used as ingredients for new product development.

**Keywords:** antioxidant properties, fruits, physicochemical, vegetables.

## Enrichment of biscuit with alpha linolenic acids and enhancement of antioxidant activity using Mexican chia (*Salvia hispanica* L.) seed powder

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Chia seeds have become one of the most popular superfoods among the health-conscious people. Chia seeds provide several nutrients that have great potential as nutraceutical compounds, which benefit human health. The most important compounds of the seeds include soluble and insoluble fiber, oil with high amounts of  $\omega$ -3 and -6 fatty acids, proteins with a high level of essential amino acids, minerals, vitamins, and phytochemicals with high antioxidant activities including phenolic and isoflavones. The chemical composition, fatty acid (FA) profile of 0.3 g/100 g alpha linolenic acid (ALA), and DPPH free radical scavenging activities have been determined using three kind of biscuits, which are control, 0.3 g /100 g ALA added biscuit(S), and 0.6 g /100 g ALA added biscuit (HS). The protein content increased significantly among chia-supplemented biscuits 9.54 g /100 g, 10.26 g /100 g, 12.39 g /100 g for control, S, and HS respectively. The fat content of control, S, and HS biscuits was 14.78 g /100 g, 14.83g /100g, and 14.89 g /100 g. Carbohydrate content decreased as chia was incorporated into the biscuit formulation, because chia seeds, contain less carbohydrate, can replaced part of the wheat flour in the biscuit formulation. IC<sub>50</sub> values of the control, S, and HS biscuits were 58.32 mg / mL, 35.81 mg / mL, and 18.04 mg / mL respectively. Based on the comparison of the IC<sub>50</sub> values, the order of the hydroxyl radical-scavenging activity was found to be as follows; HS > S > Control. The hardness of control, S, and HS biscuits are 33.96 N, 17.95 N, and 45.51 N respectively. Source of chia flour added biscuit was equal to control and hardness was favorable for the regular biscuit. Fatty acid profile of S biscuit has shown 69% of ALA. ALA content in chia seed powder was more than 66%. High baking temperature has not affected to the ALA content of the product.

**Keywords:** alpha-linolenic acid, chia, *Salvia hispanica*.

## Measurement of the food literacy level of adolescents

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Having healthy dietary habits during adolescence is important to establish lifelong healthy dietary patterns and prevent non-communicable diseases. Food literacy measurements can be used to measure existing knowledge, skills, and behaviors related to food in adolescents. The objectives of the study were to explore the food literacy level of adolescents and to determine the differences in their food literacy level based on demographic factors. A cross-sectional study was conducted among 367 adolescents including 175 females and 192 males in grades 8, 9, 10 in Kuliypitiya and Giriulla education zones in Kurunegala district. A self-administered questionnaire consisted of a validated food literacy scale, food frequency questionnaire, open-ended questions on the importance of food literacy, and demographic questions were used as the data collection tool. Students with parental consent were included in the study. The mean food literacy score of the adolescents was  $166 \pm 20$  out of 217. Fifty-two percent of adolescents had high food literacy and 48% had low food literacy. The mean total food literacy score and food literacy sub-domains scores (skills, knowledge, functional, food choice, and interactive) were significantly higher in females than males. Males had significantly lower odds to have high total food literacy score (OR=0.52, CI=0.34-0.80) and high skill sub-domain score (OR=0.58, CI=0.38-0.88) than the females. Grade 10 students had lower odds of having high total food literacy score than the grade 8 and 9 students (OR=0.38, CI=0.22-0.67). A significantly higher percentage of students with higher food literacy compared to lower food literacy consumed higher frequency of vegetables (69% vs 31%, Chi square=9.82, P=0.002) and lower frequency of sugar-sweetened beverages (64% vs 36%, Chi square=37.07, P<0.001). In conclusion, food literacy level of female adolescents was higher than male adolescents. Higher intake of vegetables and lower intake of sugar-sweetened beverages are associated with high food literacy.

**Keywords:** adolescents, demographic factors, food literacy, questionnaire.

## Development of an organic ripening agent using *bilin* (*Averrhoa bilimbi*) and *kappetiya* (*Croton laccifer*) leaf powder mixture

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Use of chemicals on ripening of fruits has become a debated issue and therefore, organic alternatives should be investigated. Previous studies have reported that leaf powder of *bilin* (*Averrhoa bilimbi*) and *kappetiya* (*Croton laccifer*) 1:1 ratio induce ripening of banana. Based on the results of the previous studies, this study was designed to develop an organic ripening agent using *bilin* and *kappetiya* leaf powder mixture (LPM) at 1:1 ratio. A pellet was prepared using LPM (net weight 3 g) and the effectiveness of the developed organic ripening agent was evaluated on *Embul* bananas. Commercially mature *Embul* bananas (color index -1, TSS%  $8.7 \pm 0.21$ ) were treated with pellets. One kg of banana samples was exposed to 10 pellets (T1), 20 pellets (T2) and 30 pellets (T3). Further, one kg of bananas was exposed to smoke generated from burning of one pellet (T4) and bananas without treatment were used as the control (T5). Physicochemical properties (peel color, pH, firmness, TSS, titratable acidity (TA), TSS/TA ratio, visual quality rating) and sensory properties (peel color, odor, taste, texture, overall acceptability) were determined. Emanations of LPM and smoke were analyzed by gas chromatography (GC). Ethylene was detected only in smoke sample. Further, bananas exposed to 30 pellets and smoke had significantly ( $p < 0.05$ ) different pH ( $4.55 \pm 0.24$  and  $4.46 \pm 0.06$ ), firmness ( $\text{kg cm}^{-2}$ ) ( $2.46 \pm 0.20$  and  $1.6 \pm 0.28$ ), TSS % ( $22.96 \pm 0.28$  and  $23.34 \pm 0.44$ ), TA % ( $0.93 \pm 0.03$  and  $0.94 \pm 0.03$ ) and TSS /TA ( $24.80 \pm 1.03$  and  $24.74 \pm 1.19$ ) than the control but VQR of treated samples were similar to the control ( $p > 0.05$ ). The highest mean score for peel color (13.50) was recorded in bananas exposed to smoke generated from pellets. Excellent sensory attributes were obtained by bananas exposed to 30 pellets. In conclusion, exposure of one kg of *Embul* bananas to 30 pellets of LPM hastened ripening effectively.

**Keywords:** banana, ethylene, ripening, smoking.

## **Effect of dietary counselling and physical activity on body weight, body composition and fasting plasma glucose level of obese young adults**

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Obesity is an emerging public health problem, arising at alarming rates in Sri Lanka. Physical activity and dietary counseling are the key strategies for obesity management. In the absence of studies on lifestyle management of obese young adults in Sri Lanka, present study was conducted with the objective of investigating the effect of physical activity and dietary counseling on body weight, body composition and fasting plasma glucose level of obese young adults. This randomized controlled intervention study was conducted for fourteen weeks (t=14) with 30 obese undergraduates (males= 8; females= 22). They were in the age range of 20-25 years with Body Mass Index (BMI)  $\geq 25$  kg/m<sup>2</sup>. Subjects were randomly allocated to intervention (n=15) and control groups (n=15). Intervention group received the educational package on diet and physical activity and followed up in biweekly group counseling sessions. Control group were only provided the general lifestyle guideline at the baseline through a group education session. Anthropometry, blood pressure and fasting plasma glucose level were measured at the baseline (t=0), midpoint (t=8) and endpoint (t=14) weeks of the study phase. Dietary intake and physical activity level were measured using a 3-day diet diary and long version of International Physical Activity Questionnaire at baseline, midpoint and endpoint of the study. Results showed that there were significant ( $p < 0.05$ ) reductions in the body fat percentage, basal metabolic rate, impedance and systolic blood pressure of the intervention group compared with the baseline. However, there were no significant improvements in body weight, lean mass and fasting plasma glucose of the intervention group. Dietary intake of the intervention group was improved in terms of total energy, energy from saturated fat and added sugar. Physical activity level of the intervention groups was significantly ( $p < 0.05$ ) improved compared to the control group. Therefore, it can be concluded that combination of dietary counseling and physical activity is beneficial in improving the body composition of obese adults without a significant weight loss.

**Keywords:** body composition, dietary counselling, obesity, physical activity.

## **Cardiovascular risk factor prevalence is higher among post-menopausal women compared to premenopausal women**

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Cardiovascular disease (CVD) is the leading cause of death in worldwide. Both modifiable and non-modifiable risk factors contribute to the cardiovascular disease risk. Hormonal changes during menopause lead to physiological changes that increase the risk of cardiovascular disease. This cross-sectional study was carried out in Pannala Divisional Secretariat in Sri Lanka to investigate the association between cardiovascular risk factors and menopausal status. A total of 236 subjects from pre-menopausal (n=118) and post-menopausal (n=118) Sri Lankan women aged 30-60 years were recruited by a convenient sampling method. Body composition, nutrient intake, blood pressure, and physical activity level were assessed. An independent t-test was used to compare pre and post-menopausal groups. Odds ratios were calculated to predict the risk of elevated blood pressure and central obesity. One sample t-test was used to compare the current dietary intake of post-menopausal women with their Recommended Dietary Allowances (RDA). Mean Systolic and Diastolic blood pressure, waist circumference, waist to hip ratio, and fat mass were significantly higher in post-menopausal women compared to pre-menopausal women ( $p < 0.05$ ). Odds Ratio (OR) for elevated systolic blood pressure and diastolic blood pressure was 4.3 (95% CI 2.4-7.4;  $p < 0.05$ ) and 2.7 (95% CI 1.5-4.9;  $p < 0.05$ ), respectively in post-menopausal women compared to pre-menopausal women. OR for increased waist circumference was 2.6 (95% CI 1.4-4.9;  $p < 0.05$ ) in post-menopausal women. Both pre and post-menopausal women had a significantly higher mean intake of saturated fat than RDA ( $p < 0.05$ ). The prevalence of cardiovascular risk factors was higher among post-menopausal women compared to pre-menopausal women. Post-menopausal women had significantly higher odds of having elevated blood pressure and central obesity which are strong risk factors for CVD.

**Keywords:** cardiovascular risk, menopausal status, post-menopause, risk factors.

## **Challenges, barriers and potentials in implementing food-based dietary guidelines through school curriculum and school environment**

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Food-based dietary guidelines (FBDGs) are a tool of nutrition education developed to provide knowledge on balanced meal and healthy lifestyle. School based nutrition education affect healthy dietary pattern and physically active lifestyle of a person in long term. Therefore, it is important to evaluate the school curriculum and environment for their influence on implementation of FBDGs. The objectives of the study were to investigate the teachers' opinion about the presence of FBDGs in the school curriculum, challenges and potentials in implementing FBDGs in the school environment. A descriptive cross-sectional study was conducted with a purposive sample of 167 teachers who taught food and nutrition related subjects with at least 2 years of teaching experience, selected from 90 secondary schools of 4 education zones in Gampaha, Kurunegala and Kalutara districts. Data were collected using self-administered questionnaires. The content of each subject was mapped against 17 FBDG. Major topics identified by the teachers in curricula were balanced diet, healthy eating patterns, and nutrients in foods, nutrient requirements in different stages of the life cycle and food groups and their importance to body functions. According to the teachers' opinion students' fruits, dairy products and water consumption were not adequate and there was no significant difference in the opinion between national and provincial schools. Major challenges found in implementation of FBDGs in the schools were; insufficient practical guidance, insufficient time, lack of healthy food service program and fast foods outlets around the school. Adequate sanitary facilities available for girls and boys is the major potential factor in implementing FBDGs. Health and Physical Education subject was the major subject providing knowledge on FBDGs. All FBDGs are addressed in the secondary school curriculum when several subjects are considered together implementation of FBDGs. Overall, school environment is conducive into implementing FBDGs although there were some barriers and challenges.

**Keywords:** health and physical education, nutrition, school curriculum.

## Development of horse gram (*Macrotyloma uniflorum*) based ready to serve nutritious drink

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The horse gram (*Macrotyloma uniflorum*) is an underutilized legume containing protein ( $24.2 \pm 0.25\%$ ), fiber ( $6.7 \pm 0.20\%$ ) and minerals ( $3.6 \pm 0.09\%$ ). However, its consumption is limited due to the unavailability of value added products. The present study was conducted to develop a ready to serve (RTS) horse gram based nutritious drink. A commercially available variety of ANK brown was used. Raw materials: horse gram, red rice; *Kalu Heenati* and sesame were pre-processed into blends. Proportionally adding those blends with *Kithul* treacle/bee honey and the stabilizing agent followed by homogenizing, three formulations were prepared (F1 - 10% *Kithul* treacle with 0.5% carrageenan, F2-10% bee honey with 1% carrageenan and F3 -10% bee honey with 0.5% carrageenan). Samples were bottled and thermally sterilized at 121°C. The best formula was selected by sensory evaluation using a trained sensory panel (nine - point hedonic scale). The highest mean ranks for the overall acceptability, taste, mouth feel and texture were obtained for F1 (7.02, 7.10, 6.90, and 7.50). Further analysis was done for the selected F1 formulation. The proximate composition and mineral contents of the product and control made out of rice were carried out according to the AOAC (2012) methods. Proximate composition of the product showed energy (73.25 kcal), protein ( $1.69 \pm 0.14\%$ ), fat ( $0.30 \pm 0.01\%$ ), fiber ( $0.84 \pm 0.05\%$ ), total minerals ( $0.20 \pm 0.01\%$ ) and carbohydrate (15.99%). Product contained minerals; iron (1.80 mg/kg), zinc (2.20 mg/kg), calcium (105.0 mg/kg), potassium (785.0 mg/kg) and phosphorus (0.03%). Total soluble solids content of the product was 13.0% and acidity was 0.01%. Total plate count, yeast and mold count and total coliform count were not detected during two months of storage period. The developed product complies with the SLS 729:2010 which requires introducing as a RTS drink.

**Keywords:** ANK brown, bee honey, nutritious healthy drink, treacle.

## **Adherence of the school canteen guidelines by the schools in Southern Province**

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The school canteen guidelines were issued to optimize educational performance and promote healthy food choices among school children in Sri Lanka. Hence, this study was conducted to determine the adherence of school canteen guidelines by the schools in Southern Province. A sample of government schools in Southern Province was selected using simple random and stratified sampling methods. An interviewer administered questionnaire including school canteen guidelines, direct observations of the canteen and in-depth interviews with the selected members of the canteen committee were used as the data collection techniques. To determine the adherence to the ten guidelines, a scoring system (scale ranged 0-100) was developed. Each guideline was given maximum ten scores. According to the obtaining scores, adherence was categorized into five; 0-20 not adhered; 20.1-40 poorly adhered; 40.1-60 slightly adhered; 60.1-80 moderately adhered and 80.1-100 strongly adhered. A total of 56 schools were visited. Only 33 schools had a canteen and out of them, 29 schools had a school canteen committee to monitor the canteen. Results showed that only 1 (3%) school strongly adhered and 14 (42%) schools did not adhere to the school canteen guidelines. The least adhering guideline by the studied schools was 'ascertain the cleanness of utensils' and 'ascertain food safety and appropriate nutritional value'. The availability of 'unhealthy' foods in the canteen and availability of food stalls around the school were major identified barriers for not adhering to the school canteen guidelines. The findings of the study suggested that the requirement of proper mechanism to monitor the adherence of the school canteen guidelines by the schools.

**Keywords:** children, healthy food choices, Sri Lanka.

## Evaluation of differently processed coconut milk

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Coconut milk is a prominent taste enhancer in culinary products throughout the South Asian countries. The domestic consumption of coconut kernel involves an extraction method that removes considerable amount of dietary fiber and nutrients as coconut residue. Hence, this study was conducted to determine the physicochemical properties and consumer acceptance of differently processed coconut milk to minimize the domestic consumption of coconut kernel. Conventional coconut milk (treatment 1) and blended coconut milk (treatment 2) were prepared by hand squeezing and blending of coconut scrapings with water (1:1w/w). Fresh coconut paste (treatment 3) was prepared by grinding steamed scraped coconut kernel while dry coconut paste (treatment 4) was prepared by grinding desiccated coconut into a fine paste. Five samples from each treatment were analyzed for proximate composition. Sensory evaluation was done with thirty semi trained panelists by preparing four types of dhal curries. The consumer survey was done with fifty housewives, instructing them to prepare four types of dhal curries using provided coconut paste sachets. According to the proximate analysis, there was no significant difference in fat and fiber contents of treatment 1 and treatment 2. Fresh and dry paste content significant amount of fiber (4.67 and 10.33% respectively) and fat (24.27 and 71.13% respectively) compared to the conventional practices. However, results of overall acceptability clearly showed that, treatment 3 and 4 have lower sum of ranks because of ground coarse particles of the pastes (48.5 and 68.0 consecutively). Nevertheless, the consumer survey revealed easiness of usage of treatment 3 and 4 obtained higher sum of ranks (120.5 and 138.0). Hence, further, improvement is needed to improve sensory quality of both pastes especially dry paste, which has higher sensory potential compared to the fresh paste.

**Keywords:** coconut, milk, paste, physicochemical, sensory.

## **Effect of low carbohydrate diet on clinical parameters of diabetes patients**

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Prevalence of type 2 diabetes and related complications is increasing rapidly worldwide. Since type 2 diabetes mellitus is a behavioral disease, lifestyle changes are pivotal in management. Diet plays an important role in glycemic control. A previous study showed that 30%-carbohydrate diet over 6 months led to a remarkable reduction in HbA1c levels in patients with type 2 diabetes, however, not enough studies have been conducted related to this area. The aim of this study was to determine the effect of low carbohydrate diet (25% carbohydrate) on biochemical and anthropometric parameters in patients with type 2 diabetes. In 12 weeks Quasi-experimental study, 35 diabetes patients were selected from Kurunegala and Mawanella areas. Treatment group (n=24) followed low carbohydrate diet and control group (n=11) followed low caloric diet. Clinical and biochemical parameters were measured and recorded in baseline and after 12 weeks of intervention. Endpoint data in the treatment group were compared with both its baseline and endpoint data of the control. According to the treatment group baseline data, there was a positive trend between carbohydrate intake and their fasting blood glucose level. Compared to the baseline the systolic and diastolic blood pressure decreased by 7.9 mmHg ( $p=0.016$ ) and 7.5 mmHg ( $p<0.0001$ ), respectively and LDL decreased by 16 mg/dl ( $p=0.203$ ) in treatment group after 12 weeks. There was a significant increase in intake of percent energy from fat by 3.2% ( $p=0.033$ ) and significant reduction of carbohydrate intake by 53.5 g ( $p=0.042$ ) in treatment group after 12 weeks. Diastolic blood pressure, total cholesterol and HDL levels were improved significantly. However, there were no significant differences in systolic blood pressure, fasting blood sugar, total cholesterol, and LDL levels within the 12 weeks of study period. In conclusion, this study did not provide sufficient evidence to justify the dietary intervention of low carbohydrate diet on managing the anthropometric and biochemical parameters in patients with type 2 diabetes mellitus. Further studies on this topic are recommended.

**Keywords:** dietary intervention, low caloric diet, type 2 diabetes.

## **Content mapping of the junior secondary school curricula for critical food literacy components**

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Food literacy is an individuals' ability to plan, manage, select, prepare and eat food supporting the achievement of personal health and sustainable food system. School is an ideal setting for promoting health and wellbeing of an individual. Therefore, food literacy education at secondary school provides long term health benefits to adolescents. The objectives of this study were to investigate food and nutrition experts' and school teachers' opinions about food literacy components (FLC) that should include in the secondary school curricula and to evaluate present secondary school curricula for the adequate coverage of content related to the food literacy. A list of FLC was identified through a comprehensive literature survey. The opinion on the appropriateness of the FLC of 25 food and nutrition-related professionals, 23 teachers and teachers' instructors who teach related subjects were obtained through interviews. Content of textbooks and teachers' guides of junior secondary school curricula (5 subjects in grade 6-11) were mapped against FLC. Thirty-seven components were identified by the experts and teachers as important FLCs. FLCs were categorized under four major themes: History of food, food systems, the science of food and nutrition and influencers, issues and challenges. The majority of the experts and school teachers/instructors agreed to include all identified components to the school curricula. Thirty five out of 37 components were found in the present curricula and 'World food problems' and 'Nutritional quackery in the media and Marketing' were the components which were not included in the curricula. Most of the components seem to be delivered as knowledge and only few were addressed to develop skills. In conclusion, proposed FLC are included in the existing secondary school curricula. Practical and Technical Skill, Home Science and Agriculture and Food Technology are the major subjects containing food literacy components.

**Keywords:** curriculum mapping, food literacy components, secondary school.

## **A guide of sodium content in foods for hypertensive patients**

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Hypertension is a public health issue affecting 8.2% of the population in Sri Lanka. Dietary sodium intake is one of the risk factors for hypertension. Since the absence of any guide on sodium content in foods available in Sri Lanka, this study was conducted to develop a guide of sodium content in commonly consumed food items. A preliminary survey was conducted to identify the dietary pattern, sodium intake in commonly consumed food items of 30 hypertensive patients age ranged between 30-60 years through a pre-tested interviewer-administered questionnaire, two 24 hour recalls, food frequency questionnaire and direct observations of food available at the local market and home gardens. In the next step, sodium content of commonly available foods was determined using Indian and ASEAN food composition tables and food labels. Foods were categorized into low (<120 mg/100g), medium (120-600 mg/100 g) and high (>600 mg/100 g) sodium-containing foods according to the sodium content in 100g of food. A booklet was developed by including preface, function of sodium, sodium-rich food items, tables of categorized sodium containing foods and way of referring the booklet. The results of the preliminary survey showed that the mean daily intake of sodium ( $2298 \pm 751$  mg) was higher than the recommended daily intake (1500 mg/day) of hypertensive adults. The developed booklet consists of one portion of commonly consumed foods containing sodium amount in “mg” with photographs. High, medium and low sodium-containing foods were indicated with the colors of red, yellow and green, respectively. This developed booklet on sodium content of foods may be a useful guide for hypertensive patients to manage their condition and healthy adults for preventing the hypertensive conditions.

**Keywords:** dietary pattern, foods, guide, hypertension.

## **Formulation and evaluation of *dawul kurundu* (*Neolitsea cassia*) leaf extract coating on postharvest life of lime (*Citrus aurantifolia*)**

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Lime (*Citrus aurantifolia*), a non-climacteric, seasonal fruit becomes unmarketable after 3-4 days from harvesting. Hence, a study was conducted to evaluate the effect of coating made out of leaf extraction of *dawul kurundu* kept in perforated polyethylene package on extending the storage life. The best formula of coating was selected based on preliminary trials and it was 75% of *Dawul Kurundu* leaf extract, 3% sunflower oil, 2% lecithin and 20% glycerol. Lime fruit at their optimum maturity was manually harvested from a commercial orchard and brought to the laboratory immediately. The bulk sample was divided into six lots each containing 100 fruit. Three lots were dipped in the developed coating for one minute. Then both coated and non-coated fruit was packaged in perforated polyethylene bag and plastic crate with and without polyethylene lining. Subsequently, all samples were stored at ambient ( $32 \pm 2^\circ\text{C}$  and RH 70%) and low temperature conditions ( $10^\circ\text{C}$  and RH 85%). Evaluation of physicochemical attributes were conducted prior to the treatment and thereafter at 2 days and 4 days interval for limes stored at ambient and cold room respectively until they exhibit limit of marketability. Fruit coated and packaged in perforated polyethylene bag showed highest storage life of 14 days under ambient conditions and more than 60 days when stored under cold room conditions. The fruit also displayed green color of peel at the end of 60 days. Lowest storage life was shown by uncoated fruit kept under ambient condition which stored in a plastic crate without polyethylene lining. Marketable life of these fruit was ended within a week. The lowest rate of peel yellowing ( $p < 0.05$ ), higher firmness, lowest physiological weight loss, higher acidity, and higher soluble solids were maintained by coated lime fruit packed in perforated polyethylene bag in both ambient and low-temperature conditions.

**Keywords:** edible coating, plant mucilage, storage life.

## Antioxidant and antidiabetic potential of five *thebu* (*Costus speciosus*) populations available in Sri Lanka

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In Sri Lanka, *thebu* - *Costus speciosus* leaves are used for consumption in daily diet and folklore medicine for their hypoglycemic properties. Five distinct *C. speciosus* populations (P-1, 2, 3, 4 & 5) have been identified in different geographical regions in the country. The present study was conducted to compare the phytochemical content, antioxidant activity and anti-diabetic properties of methanol extract and hot water infusion of the leaves of five *C. speciosus* populations as their therapeutic activity may vary among the populations. The plants were grown under same condition and leaves were collected from each population. Methanol extract and hot water infusion of the leaves were tested for total phenolic content (TPC), total flavonoid content (TFC), total chlorophyll content, total carotenoid content, total antioxidant capacity (TAC), DPPH radical scavenging activity and alpha-amylase inhibitory activity. TPC of leaves were in range of  $4.35 \pm 0.21$  to  $7.49 \pm 0.21$  mg GAE g<sup>-1</sup> with the highest from P-3. TFC of leaf extracts ranged from  $1.71 \pm 0.17$  to  $5.47 \pm 0.17$  mg GAE g<sup>-1</sup> with the highest shown by P-3. Meanwhile, the highest carotene content and chlorophyll content were shown by P-3 and P-1 respectively. Highest antioxidant capacity was observed in P-1 ( $10.91 \pm 0.52$  mg GAE g<sup>-1</sup>) followed by P-3 (10.39 mg GAE g<sup>-1</sup>). Both methanol extracts and hot water infusion exhibited significant DPPH radical scavenging activity with the highest from P-3 and P-2. There were remarkable variations in alpha amylase inhibitory activities among five populations where the highest inhibitory activity was shown by P-1. Therefore, the leaves of *C. speciosus* P-1 & P-3 can be considered as a potent antioxidant source and alpha-amylase inhibitor to develop a safe alternative to synthetic antidiabetic drugs.

**Keywords:** antidiabetic plants, diabetes mellitus, total phenolic content.

## **Varietal effect on physicochemical, nutritional, functional and sensory properties of the rice beverage developed from local rice varieties**

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Rice beverage is one of the best hypoallergenic forms of plant-based beverages while the enormous varietal difference among locally available rice is the main challenge in maintaining product consistency. A study was carried out to identify suitable local rice varieties for developing a rice beverage. Four rice varieties were selected including two traditional (*Suduheenati*, *Suwandel*) and two improved (Bg352, Bg406) varieties. Physical properties of four varieties were compared using amylose content, gelatinization properties, and scanning electron microscopic images. Proximate compositions, antioxidant activity, physicochemical, microbial and sensory properties were also determined in the developed beverages. Shelf life study was carried out for a 2 months period for the selected beverage. All varieties had low gelatinization temperature while the amylose content of *Suwandel* ( $28.20 \pm 0.04\%$ ) was higher than the others. Beverage from traditional varieties contained higher crude protein, crude fat, carbohydrates, and mineral content. Ash, fiber, energy content, pH, titrable acidity, TSS and density of beverages were not significantly different ( $p > 0.05$ ). The mean values of beverages from traditional and improved varieties were  $3.84 \pm 0.14$  and  $3.06 \pm 0.28$  mg GAE/g for total phenolic content,  $10.47 \pm 0.25$  and  $7.00 \pm 0.27$  mg RUE/g for total flavonoid content. Sensory properties of the rice beverage from *Suduheenati* were obtained higher mean rank than others. Variety does not significantly affect the microbiological properties of rice beverage. Overall, the beverage developed from the variety *Suduheenati* showed the best physicochemical, functional and sensory properties than others. Shelf life study showed that the rice beverage could be stored for 2 months' period at 4°C without any significant changes in physicochemical, microbial and sensory properties.

**Keywords:** amylose content, antioxidant activity, traditional rice.

## **Development of pumpkin (*Cucurbita maxima*) flour incorporated nutritionally enriched cookies and evaluation of functional properties**

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Pumpkin belongs to the family Cucurbitaceae and is widely grown vegetable all over the world. Pumpkin is a crop with high nutritional and medicinal value but so far has not been utilized extensively for processing into value-added products. Therefore, this study was conducted to develop nutritionally enriched cookies by using pumpkin flour and to evaluate the products for different functional, chemical, physical and storage stability. Pumpkin flesh was converted into flour by following standard methods with some modifications and used in the preparation of cookies. Varying amounts of pumpkin powder levels (0, 30, 40, 50 and 60% w/w) were added in making cookies. Sensory analysis was conducted with 30 un-trained panelists using 7 points hedonic scale and appearance, color, odor, texture, taste, after taste, mouth feel and overall acceptability were checked. On the basis of sensory qualities, ratio of 60:40 was found to be the best for cookies prepared by supplementing wheat flour with pumpkin flour. Prepared pumpkin cookies were assessed for proximate analysis (AOAC, 2000) and contained moisture 2.56%, crude protein 8.41%, crude fat 20.62%, crude fiber 6.00%, carbohydrates 57.75% and ash 4.66% respectively. Incorporation of pumpkin flour cookies resulted in significant increase in DPPH scavenging activity (0.96% inhibition), total phenolic content (7.3 mg GAE/100 g dw), total flavonoids content (14.66 mg CE/100 g dw), total carotene content (161.95 mg/100 g dw), total antioxidant capacity (81.91 mg AAE/100 g dw) respectively. Shelf life study revealed that the products can be safely stored up to a period of one month with minimal changes in physical, chemical and sensory attributes. Therefore, it can be concluded that pumpkin can be profitably converted into flour for preparation of good quality and nutritionally enriched processed products like pumpkin cookies.

**Keywords:** crude fiber, total antioxidant capacity, total carotene content.

## **Effect of 5-a-day fruit and vegetable serving consumption on blood pressure in adults**

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Eating fruits and vegetables is beneficial for the prevention of non-communicable diseases. World Health Organization has recommended eating 5 or more portions of fruit and vegetable per day to reduce the risk of non-communicable diseases. Studies conducted in different regions of the world have found that eating more fruits and vegetables can reduce the risk of hypertension. The objective of this cross-sectional study was to assess the fruit and vegetable intake and association of 5-a-day fruit and vegetable portions consumption with blood pressure in adults. A total of 308 adults including both males and females aged between 18-60 y were recruited. Height, weight, and blood pressure were measured. A semi-quantitative food frequency questionnaire was used to determine the fruit and vegetable intake. Majority of the population (68%) consumed less than 5 portions of fruit and vegetable per day. Only 32% of the population ate five or more portions of fruit and vegetable. The average consumption of fruits, vegetables and fruit and vegetable together were 1.83, 2.97 and 4.80 portions, respectively. High systolic blood pressure was significantly associated with eating less than 5 servings of fruit and vegetable per day (OR: 10.72 (1.42-80.99)). In conclusion, eating 5-a-day fruit and vegetable portions may reduce the risk of having high systolic blood pressure in adults.

**Keywords:** blood pressure, diastolic, fruits and vegetables, servings, systolic.

## **Phenolic content, antioxidant activities of herbal tea infusions as affected by particle size, weight, ingredients ratio, & infusion time**

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Herbal teas have been used for years for their therapeutic and energizing effects. Dried jack leaves (*Artocarpus heterophyllus*) and ranawara (*Cassia auriculate*) flowers have anti glycemc properties as they contain bioactive compounds like phenolic and antioxidants. The total phenolic content (TPC) and antioxidant activities (AOA) of herbal teas prepared with jack leaves and ranawara flowers can be varied on ingredient particle size, mixing ratio, infusion time and weight. The objective of this study was to formulate herbal tea bags while optimizing TPC and AOA of jack leaves and ranawara flowers. Collected jack leaves and ranawara flowers were cleaned, dried and ground. Different types of tea bags were prepared based on ingredient particle size, mixing ratio, tea bag weight, and infusion time. The infusions were prepared using 150 ml of boiling water per tea bag. Infusions were tested for TPC and AOA. Higher the tea bag weight and infusion time, the TPC and AOA of the formulated tea bags were higher. Tea bags with smaller particle size showed higher TPC and AOA. Optimization of TPC and AOA of the tea bag was done using Response Surface Methodology. AOA, TPC and  $\alpha$ -amylase inhibition activity of the tea bag were determined. Optimized tea bag had 2.49 mM Trolox eq/ml of DPPH radical scavenging activity, reducing the power of 0.77 mM ascorbic acid eq/ml, ferrous ion chelating activity of 201.57  $\mu$ M EDTA eq /ml, 1.81  $\mu$ M gallic acid eq /ml of TPC and 42.8% of  $\alpha$ -amylase inhibition activity. The optimized tea bag should be further studied for use in managing the glycemc levels of individuals.

**Keywords:** antioxidant activity, herbal tea, jack, ranawara.

## Effect of gamma irradiation on physicochemical and microbial properties of *iramusu* (*Hemidesmus indicus*) and *polpala* (*Aerva lanata*) herbal teas

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Herbal teas of *iramusu* and *polpala* have high demand in both local and export market due to their high medicinal value. However microbial contamination of herbal teas is highly reported. Irradiation is safe and acceptable method for elimination of microorganism load, though physicochemical properties might be altered during irradiation. The study investigated the effect of gamma irradiation on physicochemical properties and microbiological safety of *iramusu* and *polpala* teas. Samples were washed, air dried, cut into small pieces, packed in sterilized polyethylene bags and they were gamma (Cobolt-60) irradiated at 0, 2, 4, 6, 8, and 10 kGy doses. Physicochemical properties were analyzed by measuring the pH, water activity, moisture content, color, total phenolic content, total flavonoid content, total antioxidant content, and DPPH free radical scavenging activity. Microbial safety was assessed by total plate count, yeast and mold count. There was no significant difference in physicochemical properties of herbal tea among control and five doses studied ( $p > 0.05$ ). There were significant reduction in total plate count, yeast and mold count of both herbal teas due to irradiation. Average total plate counts of *iramusu* and *polpala* herbal teas were reduced up to an acceptable level at 10 kGy. Therefore, 10 kGy is recommended for herbal tea irradiation because, it did not cause any physicochemical changes.

**Keywords:** herbal drinks, microbial properties, physicochemical properties.

## **Formulation of encapsulated rutin and evaluation of bioactivity and stability upon in-vitro digestive and dialysis conditions**

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Rutin is a flavanol glycoside that has received considerable attention as a potential protector against a variety of human diseases. Rutin has been prescribed for the treatment of diseases like varicose veins and hemorrhoids. It is also known as vitamin P with excellent antioxidant, anti-inflammatory, anti-diabetic, antiallergenic, antiviral, and anti-carcinogenic properties and has been demonstrated to scavenge superoxide radicals. However, bioavailability is low due to low stability, solubility, and low digestion and absorption by the intestine. The aim of this study is to encapsulate rutin with three types of carrier materials using three different techniques and evaluate their antioxidant activity and bioactivity retention under in vitro gastrointestinal and dialysis conditions. Results showed that the rutin encapsulated lipid carrier has the highest ABTS (2, 2'-azino-bis (3-ethylbenzothiazoline-6-sulphonic acid)) radical inhibition activity for all the digestive phases; ( $1.697 \pm 0.032$  RE/mL for digested fraction after gastric phase,  $1.767 \pm 0.027$  RE/mL after intestinal phase and  $0.623 \pm 0.012$  RE/mL after dialysis); compared to all other samples. It also has the highest singlet oxygen scavenging activity after the gastric phase compared to all other samples ( $0.383 \pm 0.003$  RE/mL). It has the highest anti-inflammatory activity for dialyzable fraction which was lowest in the undigested sample (undigested sample  $8.033 \pm 0.033\%$  and dialyzable fraction  $17.80 \pm 0.153\%$ ). HPLC results revealed that the rutin content of encapsulated lipid carriers for all the digestive phases was significantly higher ( $p \leq 0.05$ ) than that of all other encapsulated samples. Fourier Transform Infrared (FT-IR) spectroscopy, Particle size analysis, and Scanning Electron micrographs showed that rutin encapsulated lipid carrier was  $1.7 \mu\text{m}$  with a polydispersity index (PDI) of 0.909 indicating micro-encapsulation with heterogeneous dispersion.

**Keywords:** encapsulation, in-vitro digestion, lipid carriers.

## **Prebiotic activity and glycemic response of elephant foot yam (*Amorphophallus paeoniifolius*) flour incorporated cookies**

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Elephant foot yam (EFY) - *Amorphophallus paeoniifolius*, is one of underutilized locally available high yielding yam, belongs to the family Araceae (Aroidae). EFY is rich in glucomannan (49-60%) which is a water soluble dietary fiber. Product development diversification can enhance the utilization of such yams. This research was focus on the development of elephant foot yam flour (EFYF) incorporated cookie with prebiotic and anti-diabetic properties. This study was designed to evaluate prebiotic activity and glycemic response of EFY cookies. Glucomannan was extracted by using ethanol extraction method. Cookies were prepared with various percentages of EFYF (30, 35 and 40%) and ginger flour (5, 7.5 and 10%). The shelf life of cookie was evaluated during six weeks of storage life by using microbial quality, water activity, and free fatty acid value. Under the physical properties weight, width, thickness, texture, spread ratio, and color were determined. Prebiotic activity was evaluated using *Lactobacillus* culture and using different substrates. Glycemic index was determined by under approval from the Wayamba university ethics review committee and using postprandial blood glucose change according to cookies and glucose servings. From the results of proximate analysis, the moisture content of yam and control cookies was 1.27 and 2.05% respectively. The higher ash content (1.51%) of the yam cookie and control (0.27%), protein content of yam cookie and control cookies were 9.62 and 10.24% respectively. Total plate count and yeast and mold count were not detected for both cookies and water activity slightly increased during the six weeks shelf life period. Glucomannan, EFYF, and EFYF cookie contained high prebiotic activity and EFY cookie glycemic index was 39.97 and glycemic load was 9.97. In conclusion, EFY flour and ginger flour incorporated cookie were successfully developed with acceptable sensory, physicochemical quality, prebiotic activity, low glycemic index, and low glycemic load.

**Keywords:** glycemic index, glucomannan, prebiotic activity.

## Dietary patterns of type 2 diabetes mellitus patients

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Diabetes mellitus is one of the most prevalent metabolic diseases in the world as well as in Sri Lanka. Diet plays an important role in diabetic management among type 2 diabetic patients. A cross-sectional study was conducted to find out the association between dietary behavior and diabetic management among a selected sample of diabetic patients. Thirty (n=30, male=08, Female=22), type 2 diabetic Mellitus patients who attended Non-Communicable Disease clinics in Kurunegala district were recruited to the study. An interviewer-administered questionnaire was used in collecting information on demographics, socio-demographic and self-reported biochemical variables. A food frequency questionnaire was used to obtain a diet history. The study sample was divided into two groups on the guidelines of the American diabetes association as glycemic controlled and non-glycemic controlled subjects. Dietary data were analyzed using Food base 2000 software (modified using Sri Lankan food composition data). The mean fasting blood glucose level of the total study sample was 181.16 mg/dl and 70% (n=22) of the study sample was non-glycemic controlled and 30% (n=8) was glycemic-controlled. The mean energy intake of the study population was 1882 kcal/day. The mean carbohydrate intake of the total population was higher (64%) than the recommended levels (45-60%), mean protein intake was lower (10%) than the recommended levels (15-20%). However, the contribution of fat (25%) was within the recommended level (<35%). There was a positive association (statistically not significant) between fasting blood glucose level and the amount of carbohydrate intake ( $R^2 = 0.07$ ). The results showed a statistical difference ( $p=0.048$ ) of carbohydrate intake between non-glycemic controlled diabetics and glycemic controlled diabetics. However, the subject number is insufficient for the significant testing between groups. It is concluded that the amount of carbohydrate consumption may affect glycemic control of the diabetics. Further studies with a larger sample size are recommended.

**Keywords:** carbohydrate consumption, glycemic control level, nutrient intake.

## Comparative analysis of two coriander varieties and effect of roasting on stability of bioactive compounds

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Coriander fruit is widely used as a spice and herb. Large fruited variety with a diameter of  $4.3 \pm 0.30$  mm is *Coriandrum sativum* L. var. Vulgare Alef. (CSV) and small fruited variety with a diameter of  $2.9 \pm 0.30$  mm is *Coriandrum sativum* L. var. Microcarpum DC. (CSM). Roasting is a commonly practiced processing step for coriander fruit when preparing food, beverage and medicine. This research was conducted to investigate the effect of roasting of dried coriander fruit of two varieties on the stability of bioactive compounds, functional properties, and color of oleoresin. Coriander fruit of two varieties was roasted in three time-temperature combinations (20 minutes at 140 °C, 10 minutes at 200 °C and 20 minutes at 200 °C). Oleoresins were extracted using ethanol and subjected for analysis of functional properties using four assays; diphenylpicrylhydrazyl (DPPH) radical scavenging activity, total antioxidant capacity (TAC), total phenolic content (TPC) and total flavonoid content (TFC). The volatile oil was extracted by hydro-distillation using Clevenger apparatus and bioactive compounds i.e. Linalool,  $\alpha$ -pinene, Camphor,  $\gamma$ -terpinene and Geranyl acetate in volatile oil were investigated by gas chromatography-mass spectroscopy (GC-MS). CSV fruits roasted at 200 °C for 20 minutes exhibited the highest functional properties;  $59.72 \pm 7.34\%$  of DPPH radical scavenging activity,  $57.22 \pm 0.09$  mg AAE/g of TAC,  $0.72 \pm 0.02$  mg GAE/g of TPC and  $64.61 \pm 6.93$  mg RUE/g of TFC and highest content of bio-active compounds;  $4.24 \mu\text{g/g}$  of Linalool,  $0.25 \mu\text{g/g}$  of  $\alpha$ -pinene,  $0.23 \mu\text{g/g}$  of Camphor,  $0.55 \mu\text{g/g}$  of  $\gamma$ -terpinene and  $0.29 \mu\text{g/g}$  of Geranyl acetate. Functional properties of the oleoresin have remarkably increased with the roasting time and temperature for both varieties due to releasing of bioactive compounds by breakage of cellular structure. The study reveals that CSV shows higher functional properties and bioactive compounds over CSM. Optimum time-temperature combination is 20 minutes at 200 °C for roasting of CSM.

**Keywords:** antioxidant, coriander seeds, GC-MS, oleoresins, volatile oils.

## **Distribution of cis-octadecenoic acid and cis-eicosenoic acid positional isomers in commercially available plant oils**

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This study investigated the occurrence and distribution of cis-octadecenoic acid (c-18:1) and cis-eicosenoic acid (c-20:1) positional isomers in commercially available plant oils. The isomeric profile of fatty acids in edible plant oil is an important factor for the determination of health effects. Past in vivo and in vitro studies show the differential effect of monounsaturated positional isomers and geometric isomers on lipid metabolism. Edible plant oil samples including soybean, sunflower, corn, flaxseed, black seed, sesame, peanut, *mee*, mustard, and almond were analyzed for the fatty acid composition by capillary gas chromatography. The oil samples were methylated by using the BF<sub>3</sub>-methanol method and then the eicosenoic acid methyl ester fraction and octadecenoic acid methyl ester fraction were separated from total fatty acid methyl esters by reversed-phase HPLC and quantitatively analyzed using a GC-FID fitted with the Rt-2560 highly polar GC column. Accordingly, the highest content of C 18:1 was were found in almond oil (71.06%) and the lowest levels were found in mustard oil (14.02%). The occurrence of the c11, c13-18:1 isomer was not detected in the tested plant oils. The major c-18:1 positional isomer in the most plant oils is c9-18:1 followed by c6 & c7-18:1 isomers. The content of c-20:1 positional isomers in plant oils varied widely. Peanut oil had the highest levels of total c-20:1 (3.85%) and the lowest levels were found in flaxseed oil (0.17%). The occurrence of the c5-20:1 isomer was very low or not detected in most of the plant oils. The predominant c-20:1 positional isomer in most of the plant oil was c7-20:1. Mustard oil and corn oil contained c11-20:1 isomer. Results revealed that the occurrence and distribution of cis-octadecenoic acid and cis-eicosenoic acid positional isomers varied widely in commercially available plant oils.

**Keywords:** edible plant oils, HPLC, positional isomers.

## **Chitosan/TiO<sub>2</sub> nanocomposite edible coating for shelf life extension of giant guava (*Psidium guajava*)**

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Giant guava (*Psidium guajava* L.) is a highly perishable climacteric fruit that grows in subtropical and tropical countries. It has a limited shelf life of 3 to 4 days under room temperature (RT  $31 \pm 2$  °C) and postharvest loss of giant guava in Sri Lanka is about 46%. This study was conducted to evaluate the effectiveness of a nanocomposite edible coating of chitosan-TiO<sub>2</sub> to extend the shelf life of giant guava at RT. Chitosan-TiO<sub>2</sub> nanocomposite (1% w/w) solution was prepared by stirring TiO<sub>2</sub> (E171) (25 nm) in Chitosan (2% w/v in 1% acetic acid) solution for 2 hours. Three treatments of (24 fruit per each) were carried out as uncoated and coated with chitosan and nanocomposite and the dipping time was 2s. The shelf life of the coating was studied by analyzing physical appearance, hardness, percent weight loss, titratable acidity, pH, total soluble solids, moisture content, and ripening index (RI). Besides, prepared nanocomposite was characterized using powder X-ray diffraction, scanning electron microscopy, thermogravimetric analysis and Fourier transform infrared spectroscopy. SEM analysis demonstrated the existence of homogeneous thin coating (thickness 3-4  $\mu$ m) of nanocomposite covering all the natural openings like stomata, wounds, and stem scars of the treated fruit compared to the control. RI of uncoated guava increased from 9.2 to 27.9 in 9 days whereas RI of guava coated with chitosan and nanocomposite increased up to 19.4 and 16.8 respectively. Other parameters such as hardness, weight loss, moisture content, and pH also were in good agreement with RI. In summary, the prepared Chitosan/TiO<sub>2</sub> nanocomposite coating significantly retarded the rate of ripening, respiration and microbial spoilage and it showed a significant shelf life extension of giant guava for a period of 9 days.

**Keywords:** edible coating, fruit quality, shelf life, X-ray diffraction.

## **Development of a composite flour-based pasta product enriched with *Bacillus coagulans* GBI-30, 6086**

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This study was conducted to develop composite flour-based pasta enriched with a probiotic: *Bacillus coagulans* GBI-30, 6086 and focused to select the appropriate flour blend, determine the cooking quality of pasta, viability of probiotic in uncooked and cooked pasta. Commercially available pasta was used as control. Physicochemical properties (water activity, color and texture, and cooking qualities: optimum cooking time, cooking loss, water absorption, volume expansion), proximate composition, the viability of probiotic was determined during storage of one month at  $30 \pm 1^\circ\text{C}$ . Sensory evaluation was conducted with 30 semi-trained panelists using 7 points hedonic scale and color, appearance, odor, flavor, chewing properties, and overall acceptability were evaluated. The highest acceptability was achieved by pasta formulated from wheat (50%), corn (20%), semolina (20%) and pumpkin seed (10%) flours. Color, flavor, the sensation of starch between teeth and tenderness of the developed pasta were significantly different ( $p > 0.05$ ) from commercially available pasta. Hence, this flour blend was selected for further analysis. Optimum cooking time was 10 minutes. The water activity of pasta was ranged between 0.3-0.35 and survival (%) of probiotic after cooking decreased from 91.7 to 87.5% during storage. The viability of probiotics has been achieved the daily requirement (1 billion CFUs/serving) for the specified period.

**Keywords:** composite flour, cooking quality, probiotics, viability.

## Development of cassava (*Manihot esculenta*) sticks using locally available varieties

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Cassava (*Manihot esculenta*) is one of the staple foods available in Sri Lanka. Value added cassava products are better solution to overcome postharvest loss and to increase the income of farmers. Therefore, the research was aimed to develop cassava sticks using locally available cassava varieties. Five different varieties at the same maturity level; *Kirikawadi*, *Swarna*, MU-51, CA-01, and *Suranimala* were selected for the study. Sticks were subjected to five different treatments: steam (5 min), hot water blanching (100 °C, 2 min), oil blanching (160 °C, 3 min), steam (5 min)+oil blanching (160 °C, 30 sec), hot water blanching (100 °C, 2 min)+oil blanching (160 °C, 30 sec). The sticks were then either fried (180 °C, 10 min, coconut oil: sticks: 2:1) or frozen (-18 °C, 48 h) to obtain the final product. The best variety and the treatment were selected by sensory evaluation. The nutritional composition, physicochemical properties and shelf life of the best fried and frozen sticks were determined. Steam + oil blanching from *Swarna* variety was selected as the most acceptable sticks for fried sticks while hot water blanching+oil blanching from *Swarna* variety was selected for frozen sticks. The fried sticks contained carbohydrate  $61.48 \pm 0.25\%$ , crude fiber  $7.54 \pm 0.82\%$ , fat  $23.34 \pm 0.94\%$ , protein  $0.23 \pm 0.30\%$ , ash  $1.14 \pm 0.87\%$  and moisture  $6.27 \pm 0.32\%$  whereas, frozen sticks contained  $29.51 \pm 0.58\%$  carbohydrate,  $3.32 \pm 0.77\%$  crude fiber,  $6.27 \pm 0.48\%$  fat,  $0.47 \pm 0.15\%$  protein,  $1.06 \pm 0.01\%$  ash, and  $59.37 \pm 0.61\%$  moisture. There was a significant difference ( $p < 0.05$ ) between the hardness of the two products, but there was no significant difference ( $p > 0.05$ ) in the retained cyanide content between fried and frozen cassava sticks. Yeast and mold count and total plate count were in the safe range which suggests that the sticks were safe for 2 months. In conclusion, consumer acceptable fried cassava sticks could be prepared by treatment with steam+oil blanching while frozen cassava sticks could be prepared by hot water blanching+oil blanching from *Swarna* variety.

**Keywords:** CA-01, MU-51, pretreatments, *Swarna*, *Suranimala*.

## **Formulation of a ready to serve green leafy porridge for Sri Lankan adults**

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Green leafy porridge known as *Kola Kenda* is a unique traditional semi-solid food in the Sri Lankan food culture and it is a reputed remedy for overcoming several ailments. It is used as an everyday breakfast food. Green leafy porridges made from leafy extracts, rice, and coconut milk have proven low glycemic index and low glycemic loads. The objective of this study was to develop a canned ready-to-serve green leafy porridge. Ingredients were Asiatic pennywort leaves (*Centella asiatica*), ginger roots (*Zingiber officinale*), garlic cloves (*Allium sativum*), rice whole grains (*Oryza sativa*) and salt. Cleaned ingredients were chopped and blended while cooking using a commercial cooking blender followed by canning and retorted under 121 °C temperature and 15 psi pressure. Three recipes were developed and each was subjected to sensory evaluation. Friedman's statistical analysis was done and the best canned herbal porridge recipe was selected. Estimated composition for a serving of the canned porridge (300 mL) was, carbohydrate 14.5 g, Protein 2.4 g, fat 4.9 g, fiber 3.6 g and the energy content of 439 kJ. Moisture and ash contents were 91% and 0.6%, respectively. The porridge showed a low glycemic index (GI) and low glycemic load (GL) values. GI of the product was 40 and the GL was 6 (n=10). Porridge had a higher satiety level compared to the common rice porridge (n=6). Developed ready-to-serve green leafy porridge could be recommended as a healthy instant meal option, convenient to use by any adult population.

**Keywords:** canned herbal porridge, *Centella asiatica*, glycemic index, RTS.

## **Effect of germination on nutritional and anti-nutritional factors of velvet bean (*Mucuna pruriens*) and winged bean (*Psophocarpus tetragonolobus*) with reference to soybean (*Glycine max*)**

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Germination has been suggested as a way of improving the nutritive value of legumes. *Mucuna pruriens* (velvet bean) and *Psophocarpus tetragonolobus* (winged bean) are tropical legumes which have high nutritional and medicinal value. However, they are underutilized in Sri Lanka due to the presence of some anti-nutrients such as tannins. The present study was done to investigate the effect of germination on nutritional and anti-nutritional factors of these legumes regarding soybean. Three hours (h) soaked samples of velvet, winged and soybeans were germinated under different conditions up to 72 h. The germinated seeds were oven-dried (45 °C) and milled for proximate and other chemical analyses. An instant soup mixture was developed using the germinated seeds of winged and velvet beans. Results revealed that moisture, protein, fat and fiber contents of bean samples differed significantly ( $p \leq 0.05$ ) with germination time in an increasing pattern whereas ash and starch contents in a decreasing pattern. The protein content was found to increase by 19% in winged bean and 45% in velvet bean within 72 h of germination (dwb). The total phenolic content of samples was significantly ( $p \leq 0.05$ ) changed with germination without any specific pattern. Total antioxidant capacity was found to decrease by 57% in winged and 38% in velvet beans (dwb). After 72 h of germination, 54% (dwb) of tannin were lost in winged and 35% (dwb) in velvet beans. In a similar pattern, 37% phytate were lost in winged bean and 42% in velvet bean. Saponin, alkaloid and oxalate contents of the beans significantly ( $p \leq 0.05$ ) differed with germination time in a decreasing pattern. The instant soup mix contained 11.5% moisture, 7.8% fat, 35.7% protein, 4.8% ash, 9.8% fiber, 46.04 mg/g starch, 5.07 mg/g tannin, 5.14 mg/g phytate, 0.43% saponin, 0.93% alkaloid and 2.2 mg/g oxalate. This study concluded that germination improves the nutritional value of winged and velvet beans and reduces the levels of anti-nutrients.

**Keywords:** germination, phytate, tannins, velvet bean, winged bean.

## **Evaluation of extrusion cooking qualities of blends of rice bran, soybean and wheat flour**

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Rice bran - brown outer layer of rice kernel contains considerable quantities of nutrients like protein, fat and dietary fiber. In developing countries, rice bran is taken into account as a byproduct of the milling process and commonly used in animal feed or discarded as waste. The study was focused to evaluate the usability of rice bran for an extruded product with soybean and wheat flour. Six composite flours (%) of rice bran (R), soybean (S) and wheat (W), (R 10/S10/W80; R15/S15/W70; R20/S20/W60; R25/S25/W50; R30/S30/W40; R35/S35/W30) were used for the study. Single-screw extruder was used for the preparation of textured vegetable protein (TVP) like extruded product from six blends. Prepared products were evaluated for proximate composition and antioxidant properties. Results revealed that the highest particle size identified in the rice bran and the lowest particle size identified in wheat flour. The viscosity of the slurries of the composite blends was increased with the increasing of rice bran. The crude protein, crude fiber, moisture, crude fat, and ash contents were increased with increasing of rice bran in the composite blends. However, carbohydrate content was decreased with increasing rice bran in the composite blends. The total phenolic content and total antioxidant capacity were increased with increasing of rice bran. The crude protein, crude fiber, crude fat and moisture contents of the extruded products were significantly ( $p \leq 0.05$ ) lower in extruded products compared with their composite blends by 3.5-13.3%, 7.2-8.8%, 4.8-21.2% and 13.6-34.4% respectively. However carbohydrate content (6.4-11.1%) was increased in the products after extrusion cooking process. There was no significant difference in the ash content of products after extrusion cooking process. The total phenolic content (by 8.1-11.2%) and total antioxidant capacity (by 3.2-14.2%) were decreased in the products due to extrusion cooking process. In conclusion, extrusion process could be applied for rice bran based composite flour to formulate TVP like products and the nutritional and antioxidant properties could be improved.

**Keywords:** antioxidant, composite flour, extrusion, TVP.

## Curcumin: ethanolic extraction and its stability in food applications

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Turmeric -*Curcuma longa* is extensively used as a spice, food preservative and coloring material in South Asian countries including India and Sri Lanka. Curcumin is the main active compound and the main coloring agent of the turmeric rhizome. The study consisted of incorporation of extracted curcumin as a natural colorant to produce biscuit filling, pasta and extruded snack through a mechanical beating at ambient temperature ( $30 \pm 1$  °C), exert pressure without temperature elevation and elevation of both pressure and temperature. Curcumin content of turmeric powder was  $5.32 \pm 0.01\%$ , the amount of curcumin in extraction was  $7.92 \pm 2.89\%$  (w/w) and IC 50 value of extracted curcumin sample was  $20.42 \pm 0.653$  µg/mL. Curcumin content of biscuit filling, pasta, and extruded snack were  $1.18 \pm 0.029$ ,  $0.27 \pm 0.017$  and  $0.63 \pm 0.022\%$ . IC 50 values of biscuit filling, pasta, and extruded snack were  $108.29 \pm 1.535$ ,  $255.26 \pm 3.142$  and  $236.06 \pm 3.671$  µg/mL respectively.  $L^*$ ,  $a^*$  and  $b^*$  values of the turmeric powder were  $48.17 \pm 0.262$ ,  $30.67 \pm 0.613$  and  $82.23 \pm 0.262$  respectively. The  $L^*$ ,  $a^*$  and  $b^*$  values of curcumin were  $64.74 \pm 0.372$ ,  $15.62 \pm 0.333$  and  $54.77 \pm 0.395$  respectively. Thus, it is concluded that there is a possibility to incorporate curcumin to the biscuit filling, pasta and extruded snack with desired sensory attributes using extracted curcumin through 80% ethanolic extraction at  $75 \pm 1$  °C. Further studies are needed to increase the yield of curcumin while preserving its functional properties.

**Keywords:** natural colorant, extruded products, stability, turmeric.

## **Teachers' perceptions of opportunities and challenges associated with food and nutrition education in primary schools**

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Primary school children are highly vulnerable to malnutrition and nutrition education in primary schools is an effective tool to combat that. Exploring teachers' perceptions of food and nutrition education is essential to increase the status of nutrition education in primary schools. However, such research evidence is scarce. Thus, the objective of this study was to explore teachers' perceptions of opportunities and challenges associated with food and nutrition education in primary schools. Individual face-to-face interviews were conducted with twenty-one primary school teachers from Giriulla educational zone. All the interviews were audio-recorded and the recordings were transcribed and then translated to English. NVivo qualitative data analysis software was used to manage data and to identify the themes. Six themes resulted from analysis of teachers' responses were as follows: available time for food and nutrition education, teaching and learning materials available for food and nutrition education, resources available for nutrition education, stakeholders related to food and nutrition education, inner food environment of primary school and outer food environment of primary school. Lack of time, lack of resources, unsupportive parents and the availability of unhealthy foods in the school canteen were the main challenges for nutrition education in a primary school setting. School meal programs and simple curriculum were identified major opportunities for food and nutrition education. The findings suggest that education officials and policymakers have to work with primary school teachers to deliver an effective food and nutrition education program to the primary school children. Future quantitative studies have to be conducted in this aspect to validate the results of the study.

**Keywords:** education, malnutrition, meal program, NVivo software.

## **Perceptions of diabetic patients and diabetes management team on self-management education of diabetes**

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Diabetes creates a burden on patients as well as the country's economy. Even though diabetes is a lifelong and progressive disease, patients still can have a better quality of life with proper management. The objectives of this study were to evaluate the perceptions about diabetes self-management education among diabetic patients and diabetes management team and to develop self-management education materials based on the perceptions of both diabetic patients and diabetes management team. The study was conducted by selecting subjects from Western and North-Western Provinces. The study sample comprised of 15 diabetic patients, 5 doctors, 5 dieticians, and 5 diabetes educator nurses. Face to face interviews was conducted using a script with open-ended questions. Data collection was done until the saturation point has achieved. Data were analyzed using the NVivo software. According to the perceptions of diabetic patients, they followed at least one diabetes self-management strategy to manage their condition. As they believe, dietary management was the common practice they followed for glycemic control. Almost all the members of the diabetes management team perceived that they educate their patients on diabetes self-management. According to their perceptions, most of the education materials distributed were paper-based. Less attractive, less interactive and overcrowded texts were identified as major limitations in these materials. Patients also believed that they are not user-friendly. Based on the responses of both patients and diabetes management team, education materials were developed. A fixed portion food plate and a postprandial blood sugar plotting chart were suggested as materials. In conclusion, the patients perceived that they follow self-management practices to manage their diabetes condition. Based on the perceptions given by diabetic patients and diabetes management team, many limitations were identified in the existing materials. However, the study further showed the need for better and interactive educational materials to reinforce patients' self-management skills.

**Keywords:** educational materials, interactive, perceptions, self-management.

## **Generation of information for developing food based dietary guidelines for Sri Lankans by diet modeling**

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Diet modeling is a procedure practiced before formulation of Food Based Dietary Guidelines (FBDGs) to optimize recommended dietary allowance (RDA) through available foods. Diet modeling considered the dietary patterns of different cultures and socioeconomic groups, food supply, food availability, sustainability, accessibility in the country and provides insight into energy and nutrient requirements of different age and gender groups. The objectives of the study were to translate the RDA into whole food diets in terms of serve sizes and to determine the minimum number of servings required to meet the nutrient recommendations. One thousand 24-hour dietary recalls from proportionately representing urban, rural and estate adult women populations were used as dietary intake data source. Study found that current nutrient intake of protein, Ca, Fe, Zn, folate, thiamin, vitamin A and vitamin C of women were lower than the RDA. Energy from carbohydrate (68%) is higher than the recommended level (55%). Cereal consumption was greater than the recommended serves in FBDGs and consumption of all other food groups was lower than the recommended serves. Foundation diets were developed using the food group composites for the smallest and least physically active person in several age/gender groups to achieve RDA for nine selected nutrients while optimizing the energy requirement. Foundation diets were extended to 7-day total diets for above groups by replacing food group composites with actual foods. Total diets developed for 7 days fulfilled RDA for macro and micronutrients considered except iron for adolescents and adult women. For all other nutrients, 90-110% of RDA was achieved. Developed diet models consist of relatively higher amounts of fruits, vegetables, fish and dairy groups compared to present intakes. In conclusion, even though current nutrient intakes of Sri Lankans do not meet the RDA, it is possible to achieve RDA using common foods available if planned properly.

**Keywords:** composite foods, foundation diets, recommended dietary allowance.

## **Developing low-energy density diet menus for overweight and obese adults**

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The prevalence of overweight and obesity is increasing at an alarming rate in Sri Lanka. The WHO has recommended reducing the energy-density of diets as a viable strategy to stem the global obesity epidemic. The energy dense of foods is a key determinant of energy intake. The diets of low energy density are effective for treating and managing obesity and overweight conditions. The present study was carried out to develop low-energy-density menus by incorporating low-energy-dense foods for weight management in overweight and obese adults. A preliminary survey was conducted to identify the food preferences, dietary patterns and commonly consuming menus of overweight and obese adults. Socio-demographic data were collected using a questionnaire. Anthropometric measures were taken and two 24 hour dietary recalls and food frequency questionnaires were used to collect dietary data. The commonly available low-energy-dense foods were identified by direct observations in local markets. A total of 30 subjects (16 obese and 14 overweight adults) were recruited. Seven whole-day meal planning including breakfast, lunch, dinner and two snacks was done incorporating low-energy-dense foods by following the American Society for Parenteral and Enteral Nutrition (ASPEN) dietary guidelines for overweight and obese adults. Nutrient compositions of developed menus were determined by using Food base 2000 software. The planned menus were compiled into a booklet by showing photographs of serving sizes. The acceptance of the developed menus by 30 overweight and obese adults was determined by showing portion sizes of menus using food models. The mean energy intake of overweight ( $2030 \pm 150$  kcal) and obese ( $2028 \pm 162$  kcal) adults were higher than recommendation. Developed seven-day menus consisted of energy levels ranged from 1200–1800 kcal. The amount of energy, carbohydrate, protein, and fat per day was included in the bottom of the menus. The booklet containing menus low in energy density may facilitate weight management of overweight and obese adults.

**Keywords:** diet menus, energy density, foods, obesity, overweight.

## **Nutrient extraction blender preparation of fruits reduces postprandial blood glucose responses**

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Fruits are an abundant source of vitamins, minerals, antioxidants, and fiber. However, it is believed that certain fruits and fruit juices tend to increase postprandial blood glucose levels. This study aimed to compare postprandial glycemic response and glycemic glucose equivalence (GGE) over 2 hours of homogenized nutrient extracted fruit with its whole fruit counterpart and glucose control. This study was conducted as a randomized controlled crossover study with healthy subjects (n=12) aged between 20-25 years. Subjects were assigned to five test fruits: watermelon whole fruit, nutrient extracted watermelon, pineapple whole fruit, nutrient extracted pineapple and glucose. In an acute study day, blood was taken at time intervals of fasting, 15, 30, 45, 60, 90 and 120 minutes after consuming each treatment using a glucometer. Glycemic Index (GI) and GGE were calculated. GGE values were calculated from the measurements of the incremental area under the curve for the test fruits per 100 g. Consumption of nutrient extracted watermelon resulted in a significant lowering of the GI (31, SEM 6.0) compared with whole fruit (56, SEM 12.2). Consumption of nutrient extracted pineapple resulted in a significant lowering of the GI (48, SEM 7.7) compared to whole fruit (83, SEM 10.1). Resulted in GGE values for watermelon whole fruit, nutrient extracted watermelon, pineapple whole fruit, and nutrient extracted pineapple were 2.8, 2.1, 8.3 and 6.2 GGE/100 g, respectively. In conclusion, nutrient extraction elicited a much favorable postprandial glycemic response than whole fruit. The mechanism responsible for this effect is not yet identified. These results suggest that fruit prepared by nutrient extraction could be considered as a potential glycemic control strategy.

**Keywords:** glycemic glucose equivalent, fruit juice, pineapple, watermelon.

## **The self-perceived food literacy level among young adults**

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Food literacy is interrelated knowledge, skills and behaviors related to the food. Being highly food literate is important to navigate the complex food environment. The objectives of this study were to find out the food literacy level among young adults and to explore the association between demographic factors and their food literacy level. A cross-sectional survey was employed in this study. The first-year students studying in Faculty of Livestock, Fisheries & Nutrition, Faculty of Agriculture & Plantation Management, and Faculty of Applied Sciences at Wayamba University of Sri Lanka (n=296) were recruited for this study. A self-administered questionnaire was used as the data collection tool. This included a validated food literacy scale (Self Perceived Food Literacy Scale-SPFL) along with socio-demographic questions. The food literacy score was calculated by coding the responses given for the food literacy scale. Independent sample t-test, one-way ANOVA, and binary logistic regression analysis were conducted to explore the relationship between food literacy score and demographic factors. The mean food literacy score of this group was 89.2 (SD=7.21) out of a total score of 145. The students were divided into high and low food literacy groups based on the median food literacy score (89). The proportion of students in the high food literacy group was 47.6%. Females had significantly higher mean food literacy scores compared to males (90.8 Vs 86.4,  $p < 0.001$ ). There were no significant differences in food literacy scores based on the faculty of studying and ethnicity. Logistic regression analysis showed that males were less likely to be highly food literate than females (OR=0.246, CI=0.140-0.431). In conclusion, less than half of the young adults were in the high food literacy group. The food literacy level of female young adults was higher than male young adults.

**Keywords:** food literacy, demographic factors, young adults.

## **Effect of low versus high glycemic index breakfast on satiety and subsequent food intake among obese subjects**

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Obesity is becoming an increasing health problem. It is a major burden for healthcare costs because it is related to many chronic diseases such as elevated blood pressure, type 2 diabetes and cardiovascular disease. Therefore, simple strategies to regulate food intake have increasingly become an area of interest. This study investigated the impact of a low glycemic index (LGI) breakfast with a high glycemic index (HGI) breakfast on glycemic response over 2 hours, satiety over 3 hours and subsequent food intake over rest of the day among obese subjects. A randomized, cross-over, postprandial study was conducted in 12 obese subjects [mean  $\pm$  SEM ages:  $24 \pm 0.4$  y; mean  $\pm$  SEM body mass index  $29.0 \pm 0.9$  kg/m<sup>2</sup>. After overnight fasting, participants consumed isocaloric test meals with HGI (GI=77) or LGI (GI=44) on separate occasions each 3 days apart. Satiety was self-reported using a visual analog scale and postprandial plasma glucose concentrations were measured. Dietary intakes were assessed using a 24 h food diary. The incremental area under the curve for the glycemic response was lower after the LGI meals than after the HGI meals (mean  $\pm$  SEM:  $1653.8 \pm 270.5$  compared with  $3531.9 \pm 454.1$  mg/dL  $\times$  min;  $p < 0.0001$ ). The LGI breakfast elicited a significantly higher level of satiety than the HGI breakfast ( $p = 0.0001$ ). Subsequent food intake (energy, carbohydrate, protein, and fat intake) did not differ between the test meals. Our study showed a differential impact of meal glycemic index on glycemic response and subjective satiety, however no effect on subsequent food intake in obese subjects.

**Keywords:** glycemic index, obesity, response, satiety.

## Effects of different packaging materials on quality of palmyrah palm (*Borassus flabellifer* L.) jaggery

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Palmyrah palm jaggery is obtained by concentrating the unfermented sweet sap. Jaggery is healthier than sugar due to the slow digestion and releases energy slowly compared to sugar. At present, palm leaves and polyethylene are used for jaggery packaging in Sri Lanka. Moisture absorption and microbial invasion cause liquefaction and color deterioration of stored jaggery which reduces its market value. Hence, this study aimed to investigate the effect of different packaging materials on the quality of Palmyrah palm jaggery and select the best packaging material to extend its shelf life. Eight different packaging materials were selected; yoghurt cup, aluminum foil wrapping in a disposable lunch box, 40 microns (M40) polyethylene with vacuum, 150 microns (M150) polyethylene with vacuum, M150 polyethylene, M40 polyethylene with silica gel, glass jar. M40 polyethylene was used as the control. Selected chemical and microbial properties of Palmyrah jaggery were then determined and under chemical properties moisture (MC), reducing sugar (RS), color, and pH were analyzed. Total plate count (TPC) and yeast and mold count (YMC) were analyzed under microbiological properties in two weeks intervals up to 10 weeks. Reducing sugar and moisture contents and color increased with storage time. TPC decreased suddenly on 28<sup>th</sup> day and showed no significant changes towards the end. However, no YMC was detected during the whole storage period. According to MC, M150 polyethylene and glass jar showed least changes (2.0% and 2.1% respectively). From the initial RS (0.99% ± 0.02) increment was lowest in jaggery packed in M150 polyethylene with vacuum (119.2%) followed by glass jar (137.4%). Lowest color changes were observed in jaggery packed in M150 polyethylene with vacuum and glass jar. At the end of 70 weeks, storage period jaggery in glass jar had significantly ( $p < 0.05$ ) lower TPC ( $69.33 \pm 9.61$ ). Results showed that appropriate packaging materials for palm jaggery are M150 polyethylene with vacuum and glass jar due to the least changes in RS and color while limiting the bacterial growth.

**Keywords:** chemical quality, color, microbiological properties, packaging materials.

## **Changes in food consumption patterns in Sri Lanka from 1961 to 2017: are we on right track?**

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Along with changes in demographics and socio-economic factors, the composition of the Sri Lankan diet has been markedly transformed into a low fiber, high refined sugar and saturated fat containing high-calorie diets referred to as nutrition transition. Identification of specific changes occurred in food consumption is important to investigate whether the country's food supply adequately meets the nutritional requirements of the population and the way that changes in the composition of the diet influence the growing trends of non-communicable diseases. This study examined the patterns of food and nutrient supply in Sri Lanka from 1961 to 2017 using food balance sheets published by the Food and Agriculture Organization. Trends in daily per capita calorie, macronutrient, and micronutrient supply have been analyzed using Food base 2000, and compared with the World Health Organization (WHO) recommendations. Of the cereals, rice (244 g/day in 2017) is the main source for calories, carbohydrates, and protein. Per capita supply of energy, carbohydrates and protein has increased from 1961 to 2017. Calories derived from protein (12.6% from total energy), per capita supply of fruit and vegetables (480 g/day in 2017), and the supply of nutrients—iron (15.3 mg/day), folate (243.9  $\mu$ g/day), vitamin B12 (0.21  $\mu$ g/day), and vitamin A (704  $\mu$ g/day) were below the WHO recommendations in almost all years up to 2017. During the reference period, the per capita supply of animal food sources showed a sharp upward trend. Per capita supply of sugar and alcohol has also shown a prominent increase in recent years, showing an unfavorable trend. Although there are limitations associated with the use of food balance sheets in evaluating food availability, the results showed a lack in availability of healthy food supply for Sri Lankans.

**Keywords:** food balance sheets, nutrient availability, nutrition transition.

## **Incorporation of fruit peel powder in development of milk cookies as a potential source of dietary fiber**

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Fruit waste generates more than 45% during industrial fruit processing in Sri Lanka. Since, fruit wastes are possibly good sources of bioactive compounds the scope of this study was to determine the best source of dietary fiber (DF) among five types of fruit peels (watermelon, pineapple, banana, mango, and papaya) and utilizing them as a nutritional and functional ingredient in milk cookie preparation. Total dietary fiber (TDF), insoluble dietary fiber (IDF), soluble dietary fiber (SDF), water holding capacity (WHC), oil holding capacity (OHC) and swelling capacity (SWC) of dried fruit peel powders (DFPP) were analyzed in dry basis. Milk cookie was prepared by incorporating DFPP (5, 7, & 9%) with the best source of DF and evaluated for their proximate composition, physical characteristics, texture, and color. Results of DFPP analysis revealed that TDF of peels contained as pineapple (43.11%) > watermelon (39.54%) > banana (36.24%) > papaya (33.14%) > mango (29.54%). Furthermore, pineapple peel showed the highest IDF and SDF as 27.68% and 15.43% respectively. WHC, OHC, and SWC of pineapple peel were 10.53 g water/g of DFPP, 4.45 g oil/g of DFPP and 12.84 mL/g of DFPP respectively. Sensory evaluation revealed that 5% pineapple peel powder incorporated milk cookie was the best having reduced hardness with 10.48% of TDF. In summary, pineapple peel was the best source of DF among the fruit peels analyzed and it could be successfully incorporated into cookies as a functional ingredient.

**Keywords:** pineapple peel powder, fruit peels, functional ingredients.

## **Teachers' perceptions of secondary school on food and nutrition education**

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The secondary school food and nutrition education has a higher potential to reinforce healthy dietary habits among adolescents. Teachers play a significant role in this education and they can provide valuable insights into the problems and potentials associated with this education. The objective of this study was to explore the teachers' opinions of challenges and opportunities associated with secondary school food and nutrition education. The qualitative study design was used in this study. Teachers who were teaching home science, science, health and physical education, agriculture, and practical and technical studies in Giriulla and Kuliyapitiya education zones were selected as the participants. They were interviewed using face-to-face individual interviews. An interview guide had ten explainable questions and associated probing questions. Twenty-five teachers were interviewed until the data saturation is achieved. All the interviews were done in Sinhala language and these interviews were recorded. Thereafter, interview audio records were transcribed, and the transcripts were translated into English. The final transcripts were uploaded to N-Vivo qualitative data management software. Based on the teachers' opinions the main challenges were: need for changes in food and nutrition curricula, the influences of internal and external food environment on food and nutrition education, concerns regarding the time allocation for food and nutrition education, need for more teacher training programs and problems associated with the practical application of food and nutrition education. The main opportunity was the supportiveness of school management in the delivery of food and nutrition education. In conclusion, the findings suggest that teachers face many challenges in teaching food and nutrition in secondary school settings and these must be addressed to improve this form of education. The identified opportunities should be considered by the policymakers and education officials in school food and nutrition education enhancement efforts.

**Keywords:** child nutrition, food and nutrition education, N-Vivo software.

## **Determinants of dietary diversity among mothers and children in estate communities in Nuwara-Eliya district**

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Mothers and young children are the most nutritionally vulnerable groups having malnutrition. Hence, this study was conducted to assess to dietary diversity and identify its determinants among mothers and their children aged 6-23 months in estate communities in Ambagamuwa in Nuwara-Eliya district. A total of 123 mother and child pairs were selected using a multi-stage simple random sampling technique for this cross-sectional study. Information on socio-demographic characteristics, food purchasing behaviors, dietary habits and believes, and child feeding practices were obtained through the interviewer administrated questionnaire. The single 24-hour dietary recall was used to determine individual dietary intakes and minimum dietary diversity. Both bivariate and multivariate logistic regression analysis were used to identify the determinants of dietary diversity. A 10 food group scale and 7 food group's scale were used to determine dietary diversity scores for mothers and children respectively. The mean dietary diversity score of studied mothers and children were  $5.1 \pm 1.2$  and  $3.9 \pm 1.3$ . Further, 84 (68%) mothers and 74 (60%) children had a minimum dietary diversity score of 5 and 4 food groups, respectively. Monthly income (AOR= 5.75), mother's educational level (AOR=3.17), food ratio (AOR=4.07), mother's occupation (AOR=7.48), engaging livestock farming (AOR=1.48), and meal skipping (AOR=1) were the determinants of dietary diversity among mothers while monthly income (AOR=1.65), mother's educational level (AOR=2.42), age of child (AOR=2.46), engaging the home gardening (AOR=1.62), meal frequency (AOR=3.36), and following the instruction on child feeding practices from maternal and child health clinics (AOR=1.25) were the determinants of child's dietary diversity. This study emphasizes the need for incorporating identified determinants of dietary diversity among mothers and children for the nutrition intervention programs to improve the nutritional status of the estate population.

**Keywords:** child feeding practices, dietary habits, food purchasing behavior.

## **Effect of low carbohydrate diet on risk factors of metabolic syndrome in overweight and obese adults**

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Obesity is a complex disorder characterized by excessive adiposity and a cause for immoderate morbidity and mortality. There is an increasing trend in the global and local prevalence of obesity. Although dietary interventions play a major role in the management of obesity, conventional dietary strategies often fail to produce sustainable weight loss and to prevent comorbidities. A low carbohydrate diet has been shown improvement in cardiovascular and metabolic risk factors although still inconclusive. Therefore, a quasi-experimental study was conducted to evaluate the effect of low carbohydrate diet on metabolic syndrome risk factors associated with obesity using 18 overweight and obese participants recruited from 3 non-communicable disease (NCD) clinics in Kurunegala district. Eligible participants were adults with BMI > 23 kgm<sup>-2</sup> and/or waist circumference > 80 cm (women) and > 90 cm (men). The treatment group (n=9) was provided with an individualized low carbohydrate diet plan and the control group (n=9) was provided with an individualized conventional low-calorie diet plan. Data were collected at the baseline and after 12 weeks of the follow-up period. There were no significant changes that occurred in anthropometric, biochemical, clinical and dietary parameters in the low carbohydrate group. Body fat percentage, plasma total cholesterol, and LDL were significantly reduced in the low-calorie group ( $p < 0.05$ ). The available evidence is conflicting to decide the effectiveness of low-calorie diet over low carbohydrate diet in terms of improvements in body fat, total cholesterol, and LDL while the compliance was lower for low carbohydrate diet. The study approach used in this study did not produce enough dietary and behavioral changes. Further extended studies are needed with a modified dietary approach to reevaluating the effect of low carbohydrate diet in risk factors of metabolic syndrome in overweight and obese adults.

**Keywords:** BMI, body fat, cholesterol, clinical parameters.

## **Development and evaluation of e-nutrition course for secondary school adolescents in Sri Lanka**

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Adolescence is a critical period of development and the influences on their eating practices begin to change. Skipping breakfast, inadequate consumption of fruits and vegetables, and high consumption of sugar-sweetened beverages are common adverse dietary habits among this group. Nutrition education promotes healthy eating by giving knowledge and skills to make healthy food choices. Computer-tailored nutrition education courses are effective nutrition education tools. The objectives of this study were to design an electronic nutrition course suitable for Sri Lankan secondary school adolescents and explore the opinions of students and teachers about it. This study composed of two phases: phase one - development of the electronic course and phase two - the exploration of teachers' and students' opinions about it. The course was developed by focusing on healthy dietary habits. Based on the previous literature and current school food and nutrition-related subject matters, learning outcomes of the course were formulated. Then 12 units of learning were created to achieve the learning outcomes and contents and activities were developed for each unit. After several iterations, the course contents were finalized and transferred to an electronic version. In phase two, the opinions of 10 teachers and grade 8-10 students regarding the course were obtained through face-to-face interviews. The respondents were recruited using the convenience sampling approach. The recorded interviews were transcribed, and the transcripts were analyzed manually to identify the general opinions of the participants. Teachers appreciated the course and suggested to include some new topics such as Sri Lankan traditional meals, the contribution of foods in the prevention of non-communicable diseases, and the effect of nutrition deficiencies on educational achievements. Students stated that they got knowledge about healthy dietary habits in an attractive manner through this course. In conclusion, teachers and students liked this e-course and they were willing to use it for secondary school nutrition education.

**Keywords:** breakfast, dietary habits, healthy food choices, nutrition education.

## **Oxidative status and physicochemical quality parameters of oil in deep fat fried foods**

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Lipid is a major energy source that provides 9 kcal of energy per 1 g of lipid. Deep-fried foods are popular among people because of their pleasant flavor and odor. The quality of deep fat fried foods is questionable due to the quality of oil used in the frying process, repeated use of frying oil and higher temperature used in frying. Quality of fried food can be evaluated in detail using physicochemical parameters. The study describes the oxidative status and physicochemical quality parameters of oil in deep fat fried foods. Chemical parameters such as free fatty acid (FFA) value, peroxide value (PV), conjugated diene (CD), p-anisidine value (p-AV), iodine value (IV) and saponification value (SV), and physical parameters such as specific gravity (SG) and refractive index (RI) were evaluated in oil extracted from deep fat fried foods. AOAC method was used for FFA, PV, and IV and the AOCS method was followed for SV, AV, and CD. The data were analyzed using SAS software. The results revealed that the overall oil quality of the selected samples varied significantly among sample types. FFA, PV, IV, SV, AV, and CD of extracted oil varied as  $0.45 \pm 0.02$  to  $3.90 \pm 0.02$ ,  $0.25 \pm 0.02$  to  $1.93 \pm 0.02$  meq O<sub>2</sub>/kg,  $34 \pm 0.02$  to  $49 \pm 0.02$ ,  $200.1 \pm 0.0$  to  $364.0 \pm 0.03$  mg KOH/g,  $5.0 \pm 0.02$  to  $24 \pm 0.02$ , and  $10.19 \pm 0.0$  to  $13.38 \pm 0.02$  mmol/L, respectively. There was no significant difference in SG values and RI values in the extracted oil. In conclusion, the overall quality of oil extracted from fried food was significantly different from resulted values for fresh oils with respect to the physicochemical quality parameters.

**Keywords:** conjugated diene, free fatty acids, peroxide value, refractive index.

## **Food consumption pattern of type 2 diabetic patients**

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Diabetes mellitus is a group of chronic, non-communicable, metabolic disorders characterized by elevated blood glucose levels. This is a major health problem in many developing countries including Sri Lanka. Diet is a key determinant of glycemic control. The study of food consumption pattern represents the most suitable approach to assess the role of diet on diabetes management. The objectives of this cross-sectional study were to determine the food consumption pattern of type 2 diabetic patients and to determine its association with glycemic control. One hundred and twenty type 2 diabetic patients (n=120), who had been already diagnosed were selected from Dankotuwa district hospital. Their dietary intake was collected using a semi-quantitative food frequency questionnaire (FFQ). Both carbohydrate (67%) and saturated fat (14%) intake were higher than the recommendations given in Sri Lankan clinical practice guidelines for the management of diabetes. The total energy intake (1410 kcal/day) was lower than the recommendation. Around 32% skipped at least one main meal from the three major meals and the frequently skipped meal was breakfast. The majority (70%) of the diabetics were unable to meet the recommendation for the intake of fruits and vegetables and dairy products. The consumption of sweetened foods and beverages was low among the subjects. There is a significant moderate negative correlation between the fasting blood glucose level and number of servings of vegetables consumed by the subjects. In conclusion, the overall food consumption pattern of type 2 diabetic patients was not in accordance with recommendations. The study showed the importance of educating type 2 diabetic patients about their food consumption patterns to improve the quality of their life.

**Keywords:** fasting blood glucose, food frequency questionnaire, glycemic control.

## **Acute effect of herbal tea on glycemic response in healthy and hyperglycemic individuals**

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High prevalence of diabetes mellitus (DM) characterized by hyperglycemia, has led to a concurrent increase in the usage of herbal teas to treat diabetes due to their hypoglycemic property, natural origin, free availability, and lesser side effects. The objective of this study was to determine the acute effect of herbal tea prepared from *Cassia auriculata* (ranawara) buds & flowers and *Artocarpus heterophyllus* (Jack) leaves on glycemic response in healthy and hyperglycemic individuals when ingested with two types of carbohydrate load meals. A total of 34 subjects were recruited and categorized into three groups. On the first visit, 13 healthy (1<sup>st</sup> group), 12 healthy (2<sup>nd</sup> group) individuals and 9 hyperglycemic individuals (3<sup>rd</sup> group) were given 50, 25, and 25 g carbohydrate load meals, respectively. On the second visit, they were given the same meal with herbal tea. Their plasma glucose concentration was obtained over 2 hours with different time intervals (fasting, 30, 45, 60, 90, and 120 min). Glycemic responses were calculated using the incremental area under the curve (IAUC) and paired t-test and independent-sample t-test were done to compare means. The mean plasma glucose concentration of healthy individuals showed a significant ( $p < 0.05$ ) reduction with the herbal tea at 25 g carbohydrate load. A significant difference was not observed for the healthy and hyperglycemic groups at 50 g of carbohydrate load. The herbal tea showed 42.8%  $\alpha$ -amylase inhibitory activity. The study concluded that the herbal tea has acute hypoglycemic effect in healthy individuals, but effectiveness varies with the carbohydrate load.

**Keywords:** *Artocarpus heterophyllus*, *Cassia auriculata*, diabetes mellitus.

## **Dietary intakes, blood lipids and nutritional status of Alzheimer's disease patients and matched non-Alzheimer subjects: a case control study**

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Alzheimer's disease (AD) is a progressive neurodegenerative disorder usually seen among elderly people. Few studies have been conducted to determine diet-related risk factors. Investigation of nutritional status and dietary intakes of AD patients will help in improving the quality of life of AD patients. The aims of this study were to compare the past dietary patterns, present dietary intakes, fasting plasma lipids and overall health status of AD patients and non-Alzheimer (NA) individuals. A case-control study comprised of 36 AD patients and 36 age and gender-matched NA controls was carried out. A general information questionnaire, Food Frequency Questionnaire (FFQ), 24-hour dietary recall, Mini Nutrition Assessment (MNA), and Mini-Mental State Examination (MMSE) were used for data collection. Fasting plasma lipids of the subjects were analyzed. AD patients were less likely to have consumed greater frequency of white rice, seafood, coconut oil, and nuts in the past compared with NA subjects (Odds ratio = 0.356 (CI 95%, 0.178-0.719), 0.211 (CI 95%, 0.0710-0.627), 0.337 (CI 95%, 0.115-0.990) and 0.241 (CI 95%, 0.084-0.692), respectively). AD patients were more likely to have consumed bakery-product at a greater frequency in the past (Odds ratio of 10.65 (CI 95%, 1.291-87.841)) compared with NA subjects. The mean consumption of the percentage of energy from macronutrients was similar in both groups at present. MNA showed that 31% of AD patients and 41% of NA individuals were at risk of malnutrition, and none of the AD patients and 6% of NA subjects were already malnourished. Of the study population, 22% of AD patients and 37% of NA individuals had dyslipidemia. In conclusion, the observed significant associations from the past dietary consumption patterns warrant further studies on diet-related risk factors for developing AD. Interventions should be planned to reduce the risk of malnutrition and dyslipidemia condition in AD and NA subjects.

**Keywords:** dyslipidemia, nutritional status, dietary pattern, dietary intake.

# **Food Production and Technology Management**



## **Trend analysis and short-term forecasting of goat and sheep population and their meat production in Sri Lanka**

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Trend analysis and forecasting of the population have become major tools in current livestock researches. A small ruminant sub-sector is an important part of animal production in Asia which reared for food purposes including Sri Lanka. Although the products of small ruminants have a good market with a range of products from meat to cheese to fiber, the commercial production of those are limited in Sri Lanka. The study was conducted to identify the best trend and the best exponential time series model to forecast the goat and sheep population and production in Sri Lanka. The findings were based on the goat population and sheep population data during the last 60 years (from 1960 to 2018) and mutton production and numbers of slaughtered goat & sheep data based on the past 30 years (from 1991 to 2017). Data were analyzed and the best model was selected according to the mean absolute percentage error. Single exponential smoothing (SES) and double exponential smoothing (DES) models were used for the short-term forecasting. Among the exponential models, the SES model was fitted than DES only for short term forecasting of sheep population while the DES model was fitted than the SES model for short term forecasting of goat population, mutton production and numbers of slaughtered goat and sheep. Sheep population showed a decreasing trend from 1960 while the mutton production and numbers of slaughtered goat & sheep showed a decreasing trend from 1991. Goat population showed an increasing trend from 1960 to 1977 and then showed a declining trend with 95% accuracy level.

**Keywords:** double exponential smoothing, goat, sheep, single exponential smoothing.

## **Dietary levels of crude protein and crude fiber in dairy farms of Jaffna district**

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The dairy industry of Sri Lanka has tremendous potential in the economy of the country. Per capita availability of milk in the country is about 56 L and the country still depends on the imports for about 60% of the total needs. The milk production system of Jaffna district is a kind of peri-urban system with an average production of about 3.12 L/day/cow. There is a space for the increment of milk production from the district. The quality and quantity of feed can be stated as major limiting factors. In that case, this investigation was designed to analyze the dietary levels of crude protein and crude fiber in dairy farms of the Jaffna district. Out of 13 veterinary divisions in Jaffna district, five were selected randomly. In each division 6 farms were selected based on three categories as two farms per each category: < 5 animals, 5-20 animals and > 20 animals and all farms were visited. According to their feeding practices, feed samples were collected and analyzed for concentrations of crude protein and crude fiber. Dietary crude protein concentration was 135.03 g/kg DM and it was below the standard requirement specified in the National Research Council (NRC) 2001 as 205.56 g/kg DM. Dietary crude fiber concentration was 198.10 g/kg DM and it was below the standard requirement specified in NRC as 480 g/kg DM. The findings emphasized that awareness should be created among farmers about the feed quality and there is a need for change in the feeding practice for cows of Jaffna district.

**Keywords:** dairy cows, feed quality, milk production.

## **Distribution and abundance of giant mimosa and its impacts on the socio-economic status of fishers around Victoria Reservoir**

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Giant mimosa was identified as one of the fast-spreading invasive species. In Sri Lanka, it was first reported in 1997 along the Mahaveli riverbanks. Giant mimosa has been severely spread around 30 to 35 km belt along with upper catchment areas of Mahaveli River. It is spreading at an alarming rate at the upstream of the Mahaveli River, around the Victoria Reservoir, threatening the agricultural ecosystem, biodiversity, human and animal health. During dry seasons giant mimosa spreads all over the starved river area and causes heavy disturbance for fishers to operate gillnets when the river gets inundated, leading to considerable economic losses. Therefore, this study was conducted in determining the distribution and abundance of giant mimosa along the Victoria Reservoir, in constructing a distribution map and to investigating the favorable habitat type for giant mimosa. Further, the socio-economic impacts of giant mimosa were estimated. Four fishing sites around Victoria Reservoir; Ambagahalandha, Nithulemada, Kumbukandhura, and Maberiyatenna were sampled from March-May 2019 using 50 m line transects and quadrats. Socio-economic data were gathered from randomly selected 60 fishers in the area through interviewer-administered questionnaires. Fisher's willingness for a monetary contribution was assessed for a mimosa removal program and data were used to estimate the fishers' willingness to pay (WTP) in removing the plant. Giant mimosa distribution and abundance maps constructed in Arc GIS software showed that plant was found in the entire Victoria Reservoir having high abundance at Ambagahalandha, Kumbukandhura, and Maberiyatenna. In 50% of the study site, giant mimosa density was found to be more than 3-5 shoots/m<sup>2</sup> and no significant difference among 3-habitat types (*i.e.* sandy, rocky and muddy) indicating its severity of spreading. The average WTP per person is 35.41 LKR. The perception of the respondents indicated that giant mimosa has negative impacts on the livelihood of fishers around Victoria Reservoir.

**Keywords:** giant mimosa, distribution, abundance, socio-economic impacts.

## **Dietary concentration of protein and fiber of dairy farms in Mannar district**

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The dairy cow must be fed a balanced diet with enough energy, protein, fiber, water, minerals, and vitamins to cover her maintenance and growth as well as milk production and the needs of a growing fetus. This study was conducted to study the socio-economic characteristics and to determine the average dietary concentrations of crude protein and crude fiber of dairy cows in the Mannar district and compare those values with National Research Council (2001) recommended level. Thirty dairy farms were selected randomly from five veterinary divisions in the Mannar district of Sri Lanka. The questionnaire was used to record the farm characteristics on the day of the visit and feed samples were collected from all the types that farmers provide to dairy cow and grass were collected from the field. Samples were analyzed for dry matter, crude protein and crude fiber. The average value of crude fiber and crude protein was calculated. The feed consisted of 178.77 g/kg DM/d crude fiber and 104.14 g/kg DM/d crude protein. The study revealed that the mostly distributed breed type in the Mannar district was Local breed (48%). A high percentage of farmers (40%) used both AI and natural service. In most farms (66.67%) animals were allowed to free grazing only, while 33.33% of farmers provided concentrates along with free grazing. The average protein and fiber intake per day of the animal was not up to the recommended level (NRC, 2001) presumably due to lack of knowledge regarding dairy feeding and management practices.

**Keywords:** crude fiber, crude protein, feeding management.

## **Investigation of post-partum ovarian resumption of crossbred dairy cows in selected farms of Kurunegala district**

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Effective reproductive management is a major concern in the dairy industry and it is a key component of successful dairy farming which affects profitability. Missed estrous and delayed cyclicity are two major causes that reduce the reproductive performances of dairy cows. The objective of the present study was to determine the postpartum ovarian cyclicity of crossbred dairy cows in selected farms of Kurunegala district by measuring milk progesterone concentration using ELISA and thereby detect the estrous, pregnancy and another reproductive status of postpartum cows. Altogether 21 crossbred dairy cows of two National Livestock Development Board (NLDB) farms in Kurunegala district were selected for the study. Milk samples were collected twice weekly from selected cows, starting from 14 days postpartum until 3 months. Around 15mL of milk was collected from each animal during evening milking into tubes with a preservative, transported to the laboratory and stored in the refrigerator until assay. Individual cow data were obtained from farm records. Progesterone concentration in whole milk was measured by competitive ELISA. Progesterone profiles of individual cows were created by plotting the progesterone concentration against the days postpartum. Normal resumption of ovarian cyclicity was defined when ovulation occurs < 35 days after calving followed by two regular ovarian cycles or more. According to the study, 16 cows (76.19%) showed a normal resumption of ovarian cyclicity and 5 animals (23.81%) showed abnormal postpartum cyclicity which was identified as prolonged luteal phase (A luteal phase of  $\geq 20$  d of duration after first, second or third ovulation without preceding insemination). In conclusion, the majority of the crossbred dairy cows monitored in this study showed a normal resumption of ovarian cyclicity postpartum.

**Keywords:** crossbred, dairy cows, ELISA, ovarian cyclicity, progesterone.

## Effect of bitter gourd (*Momordica charantia*) seed oil on fatty acid profile of body fat in dogs

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Bitter gourd seeds contain more than 40% of  $\alpha$ -eleostearic acid (9c, 11t, 13t- 18:3; ESA). This study mainly aimed to determine whether the dietary ESA is converted into conjugated linoleic acid and deposited in the body fat of dogs. Besides, this study aimed to determine the effect of dietary ESA on body weights of dogs. In this study, twelve healthy female dogs were selected as subjects and divided into two groups (n=6 per group) as control (no bitter gourd seeds oil was fed) and treatment group (fed with bitter gourd seeds oil at daily dose of 1g/dog). After 21 days of feeding, all 12 dogs were subjected to ovariohysterectomy surgery. Then fat mass was isolated from tissues of the reproductive tract and fatty acid profiles were analyzed using liquid gas chromatography. Most of the saturated fatty acid levels in the fat samples in bitter gourd seed oil-fed dogs were considerably low as compared with the control group. Furthermore, monounsaturated and polyunsaturated fatty acid levels in the fat samples of dogs fed with bitter gourd seeds oil were also considerably high as compared with control group. This was observed in conjugated linoleic acid (CLA) (9c, 11t) levels as well. However, none of these changes were statistically significant. The reduction of body weight was also considerably high in the bitter gourd seeds oil-fed group. Interestingly, no ESA was detected in body fat of both groups and it confirms the previous findings that ESA is completely converted into CLA (9c, 11t) within the body. In the conclusion this study showed that there was a tendency to deposit more CLA in body fat with the treatment of dietary ESA and a considerable effect is exerted by dietary ESA on body weight reduction in dogs.

**Keywords:** CLA, ovariohysterectomy surgery,  $\alpha$ -eleostearic acid.

## **Ichthyofaunal diversity in upper *Maha Oya* River in Sri Lanka**

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Fish species in *Maha Oya* River have not been systematically studied although it has been considered as a transitional river in between wet and dry zone through its ichthyofaunal diversity. Present study was conducted to investigate the ichthyofaunal diversity, distribution and to identify the threats to fish fauna in upper *Maha Oya* river basin from 2019 March to 2019 June. Three main sampling areas were selected from three branches of *Maha Oya* namely; *Kuda Oya* (KO), *Rambukkan Oya* (RO) and headwaters of the main river (Horewala & Aranayaka area, MR). Each branch consisted of four sampling sites in their upper stream tributaries. Cast net (mesh size 0.5 mm) was the main sampling gear for the study. Visual observations were performed in sampling sites to identify the available fish species using published fish guides and keys. Photographs of fish species were taken at the site for further confirmation of identification. A pretested questionnaire was used to identify threats to fish fauna at sampling sites. Fish fauna belonging to 11 families were reported. Among 25 species reported in the sampling sites; 06, 15 and 04 species were endemic, indigenous and exotic respectively. *Belontia signata*, *Clarias brachysoma*, *Garra ceylonensis*, *Channa orientalis*, *Acanthocobitis urophthalmus*, and *Dawkinsia filamentosa* were the endemic fish species reported from the sampling sites. *Poecilia reticulata*, *Pterygoplichthys spp.*, *Osphronemus goramy*, and *Oreochromis niloticus* were recorded as exotic species. Shannon wiener index in KO, MR and RO were reported 2.7726, 2.4849, and 2.9444 respectively. Simpson index of respective streams was 0.8286, 0.8594, and 0.8946. Jaccard's index indicated that 47% similarity between KO and RO, 25% similarity between KO and MR, 43% similarity between MR and RO. These results concluded a rich ichthyofaunal diversity in the three main branches and dissimilarities of the diversity between them. Habitat destruction due to increasing population, introduction of invasive species, waste disposal and factory discharges to streams and lack of awareness about fish species are main threats for fish fauna in *Maha Oya* River.

**Keywords:** diversity indices, endemic species, environmental threat, fish.

## **In vitro antibacterial activity of leaves and flower extracts of *Lantana camara* against fish pathogenic bacteria**

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The continuous and careless use of antimicrobial agents in aquaculture has resulted in the development of bacterial strains in the aquatic environment. Antimicrobials of plant origin have enormous therapeutic potential in the treatment of infectious diseases while simultaneously mitigating many of the side effects that are often associated with synthetic antimicrobials. Accordingly finding new resources of antimicrobial agents based on natural products for aquaculture is the main aim to study the extract of leaf and flower of *Lantana camara* (Verbenaceae). This study investigated the antibacterial activity of varying concentrations of *L. camara* leaf and flower extract against certain fish pathogenic bacteria *Edwardsiella tarda*, *Streptococcus agalactiae*, and *Staphylococcus aureus*. The dried leaves and flower powder were subjected to an ethanolic extraction procedure. A panel of bacteria that are pathogenic to fish were treated by *L. camara* extracts of leaves and flowers based on disk diffusion method and broth microdilution technique. The significantly different highest inhibitory activity compared to negative control dimethyl sulfoxide was exhibited by leaf extract in the concentration of 100 mg/mL against *Streptococcus agalactiae* where the value of the zone of inhibition was  $21.08 \pm 0.02$  mm. There is a significant difference in the inhibitory activity among leaf and flower extract against the tested fish pathogenic bacteria compared to the negative control. The significantly higher inhibitory activity against the tested fish pathogenic bacteria was exhibited by the leaf extract of *L. camara*. The significantly higher inhibitory activity of flower extract against *Streptococcus agalactiae* was  $12.15 \pm 0.02$  mm. The results indicated the significant capacity and future scope for the use of *L. camara* plant extract against a wide range of bacterial strains in the aquaculture industry.

**Keywords:** antimicrobial activity, broth microdilution, leaf extract, zone of inhibition.

## **Improvement of growth rate and survival of juvenile *Macrobrachium rosenbergii* using locally available shelter materials**

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The giant freshwater prawn *Macrobrachium rosenbergii* has been identified in the world as a potential culture animal. A very problematic characteristic of *M. rosenbergii* culture is its aggressive and cannibalistic behavior, which induces intraspecific cannibalistic nature during molt and post molt stages, growth variation in the male population, and morphotype-related dominance hierarchy. Ultimately it negatively affects the economic returns of the farmer due to low growth and survival. In order to effectively address the problem, previous researchers have evaluated several types of shelters, but not using locally available environment-friendly materials as a means of waste utilization. The present study investigated the effect of three types of shelters constructed from coconut shells, waste bamboo, and coconut frond on the survival and growth of juvenile *M. rosenbergii*. Culture experiments were conducted in glass tanks in triplicate including a non-sheltered control. According to the results, the presence of shelter affected the survival rate and the growth of juvenile *M. rosenbergii*. The growth rate of prawns in shelter-based tanks was significantly higher than that of the control tanks. The relatively higher growth rate was achieved in tanks supplied with coconut shell structures, which was followed by bamboo structures and coconut frond strip structures. A relatively higher survival rate was also achieved with coconut shell structures, but this was followed by coconut frond strip structures and then bamboo structures. Survival, net production and specific growth rate of prawn were superior in the coconut shell structure treatment. The use of coconut shell structures was thus recommended for increasing the growth rate and survival of juvenile *M. rosenbergii*.

**Keywords:** bamboo structures, coconut frond, giant freshwater prawn.

## **Effect of bitter gourd (*Momordica charantia*) seed oil on hematological parameters of domestic dogs (*Canis lupus familiaris*)**

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Bitter gourd (*Momordica charantia*, family Cucurbitaceae), also known as; bitter melon, bitter apple, and wild cucumber, is traditionally known a vegetable with different medicinal values. Seed oil from bitter gourd consists of more than 40% of a conjugated linolenic acid called as alpha-eleostearic acid (ESA), which exerts various therapeutic effects including potent anti-cancer actions. Previous studies have revealed that the ESA is converted into Conjugated Linoleic Acid (CLA; 18:2; cis-9, trans-11) inside the body. The CLA can modulate immune functions in the body. Thus, this study was conducted to examine how a small dose of bitter gourd seed oil would influence the hematological parameters namely, granulocyte: lymphocyte ratio (GLR), lymphocyte count, total WBC count, and differential count of dogs fed with a small dose of bitter gourd rich in ESA. A special emphasis was given for the estimation of GLR because it is considered as a prognostics indicator for cancer. Dried bitter gourd seeds were used to extract oil using an expeller. The experiment was conducted with twelve healthy female dogs aged less than six months, who were then grouped into two groups as treatment (n=6) and control group (n=6). The "treatment feed" was prepared by incorporating bitter gourd seed oil into tallow in 1:5 (bitter gourd fat: tallow). The control feed was prepared by repeating the same method replacing bitter gourd seed oil with fat source solely comprised of a saturated fatty acid (palmitic acid). Blood samples were drawn from each subject before the commencement of feeding and after feeding for 21 days. The sample was collected into tubes added with anticoagulants. The hematological parameters were analyzed using a blood analyzer at PETSVCARE. The results revealed that there was no significant impact on GLR or other parameters such as WBC, eosinophil, granulocytes, lymphocytes, and monocytes by feeding of bitter gourd seed oil for 21 days for healthy female dogs. Therefore, long term feeding trials may be needed to be performed to examine whether the bitter gourd seed oil with ESA can exert any significant effect on hematological parameters in dogs.

**Keywords:** alpha-eleostearic acid, bitter gourd, CLA

## **Dietary concentrations of protein and fiber of dairy farms of Anuradhapura district in Sri Lanka**

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Milk production in Anuradhapura district was found to be low and feeding practice of dairy cattle plays a major role in getting a higher milk yield. Dietary concentrations of protein and fiber are vital for maintaining cow health and increasing milk production. This study was conducted to determine the dietary concentrations of protein and fiber of dairy farms in the Anuradhapura district and to compare those with the National Research Council (NRC, 2001) recommended levels. To determine the dietary concentrations of protein and fiber, samples of forage, compound feed and supplementary sources which are being given to dairy cows were collected from thirty farms of five veterinary divisions in Anuradhapura district. Details of farm characteristics, animal characteristics, feeding systems, mineral supplementation, and water usage along with any nutritional details on supplements being used were recorded using a structured questionnaire. Collected feed samples were analyzed for protein and fiber to determine the dietary concentrations of protein and fiber. It was revealed that the mean dietary concentration of protein was 135.4 g/kg dry matter (DM)/day while the mean dietary concentration of fiber was 291.6 g/kg DM/day. Dry matter intake of a dairy cow was 9.34 kg/day and average milk yield was 3.88 L/day/cow. According to NRC (2001) recommendation, dietary concentration of protein for a dairy cow should be 205.6 g/kg DM/day and fiber concentration should be 480 g/kg DM/day. The low dietary concentration of protein and fiber may affect low milk production of the district. In the dry season, there was not enough forage for feeding the dairy cows. Under extensive management system, dairy farmers do not give much concern about the feed of dairy cows. In conclusion, dietary concentrations of protein and fiber of dairy farms in Anuradhapura district were far below the NRC (2001) recommended levels.

**Keywords:** dairy industry, dietary fiber, dietary protein, milk.

## **Growth performance of *Poecilia reticulata* in aquaponics system with *Bacopa monnieri***

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The aquaponics system focused on increasing economically sustainable indoor and outdoor fish farming. Aquaponics is a system that mutually integrates aquaculture and plant cultivation. Plants can grow without soil using natural nutrient available in the system which produces by nitrification process. Fish can survive and grow well in the aquaponics system. This study aims to evaluate the growth performance of Red Blonde Guppy fish (*Poecilia reticulata*) and the Lunuwila plant (*Bacopa monnieri*) in a combined aquaponics system. For the experiment raft system using a Styrofoam base with a small hole made for a plant to float in a small pot. Three different plant densities (3 plants/tank, 6 plants/tank, 9 plants/tank) used as the treatments. The fish weight of three treatments are significantly different from the control ( $p=0.009$ ), but fish length is not significantly different from control. Phosphate concentrations of three treatments are significantly different from the control ( $p=0.001$ ). The concentration of nitrite in treatments is not significantly different from control. Ammonia concentration of treatment three is significantly lower than control ( $p=0.02$ ). According to the results, the tested aquaponics system with high plant densities (6 plants/tank, 9 plants/tank) improved the water quality in aquariums by lowering nitrogen compounds and phosphate. Hence, this study could be important to enhance the ornamental aquaculture industry.

**Keywords:** aquaponics, nitrification, growth performance, raft system.

## Extraction of acid soluble collagen from fish discards and processed jellyfish

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Collagen was synthesized in the animal body and used in many industries such as food, medical, cosmetic, pharmaceutical, etc. The use of bovine, poultry and porcine origin collagen is limited due to disease outbreaks. Underutilized aquatic resources such as jellyfish and fish discards especially from fish processing factories have been reported as good and safe sources of marine collagen. The higher amount of jellyfish from Sri Lankan coastal waters are processed with simple methods targeting the export market as food, without considering the potential of getting higher profit through the extraction of bioactive materials such as collagen. Therefore, this study aimed to extract acid-soluble collagen (ASC) from jellyfish and fish waste. Fish waste was taken without sorting because sorting waste into different body parts mounts additional cost at the industry level. The yield of ASC extracted from Yellow fin tuna (*Thunnus albacares*) and Mrigal (*Cirrhinus mrigala*) discards and three jellyfish species (*Crambionella orsini*, *Lobonemoides robustus*, and *Rhopilema hispidum*) were compared. A significantly higher collagen yield in wet weight basis was reported from *T. albacares* (43.8%) compared to *C. mrigala* (39.9%) ( $p < 0.05$ ). Significantly low collagen yield,  $< 5\%$  in wet weight basis, was reported from all three jellyfish species in descending order as *C. orsini*, *L. robustus*, *R. hispidum*, than the fish ( $p < 0.05$ ). Proximate analysis of the raw fish waste recorded no significant difference in moisture, ash, crude protein, crude fat and crude fiber contents between the two fish species. Among the three jellyfish species *C. orsini* had significantly higher ash content (23.40%,  $p < 0.05$ ) while *L. robustus* had a significantly higher crude protein content (36.74%,  $p < 0.05$ ). This study showed the potential of utilizing fish processing waste and underutilized jellyfish for extracting collagen at a considerable yield.

**Keywords:** acid soluble collagen, fish discards, jellyfish

## **A novel method to remove excess phosphate ions in water using vaterite polymorph of calcium carbonate nanoparticles**

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Eutrophication is one of the most adverse impacts of nutrient contamination of water bodies. Recent studies have shown that the primary limiting factor for eutrophication is phosphorus. In aquatic environments, orthophosphate is the only form, which can be utilized by bacteria, algae, and higher plants. We developed a vaterite polymorph of porous calcium carbonate nanoparticle which can be used to remove orthophosphate ions in water. In this study, the vaterite polymorph of porous calcium carbonate nanoparticles was synthesized chemically using calcium acetate and sodium bicarbonate in a water-ethylene glycol media at a temperature of 100°C in a reaction time of 24 hours. Synthesized nanoparticles were characterized by X-Ray Diffraction (XRD) to analyze the vaterite crystal structure, Fourier transform infrared spectroscopy (FT-IR) to analyze the available functional groups, particle size analysis to analyze the particle size distribution and Scanning Electron Microscopy (SEM) coupled with Energy Dispersive X-Ray Analysis (EDAX) to analyze the morphology and the elemental composition of the synthesized particle. Furthermore, the phosphate removal efficiency of synthesized nanoparticles was tested with different concentrations of phosphate solutions, pH levels, adsorbent dosages and contact times. Before and after the treatment with synthesized nanoparticles, phosphate concentration in water was analyzed using ion chromatography. A maximum phosphate removal percentage of 100% was obtained with 50 mL of 2 mg/L phosphate solution and 0.15 g of synthesized porous calcium carbonate nanoparticle. Adsorption data were fitted with Langmuir adsorption isotherm and adsorption kinetics were fitted with a pseudo-second-order model with  $R^2=0.98$ . Phosphate adsorption is not influenced by the presence of competitor ions. The study presents a viable option for removing excess phosphate in natural water to desirable levels as a means for controlling eutrophication

**Keywords:** adsorption, phosphate, nanoparticle, removal efficiency.

## **Bacteriological quality of raw milk and dairy products in Pannala veterinary division**

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Milk and dairy products are excellent source of nutritious food for human beings, as well as it serves as an excellent medium for the growth of many microorganisms, which leads the foodborne diseases. There are recent outbreaks of bacterial foodborne diseases related to the consumption of milk and dairy products. This study was conducted to determine, the bacteriological quality of raw milk and dairy products available in the Pannala veterinary division. Out of the total of 66 samples, 30 raw milk samples were collected from 10 milk collecting centers through 3-day visits for each and 36 dairy products samples namely ice cream (12), flavored milk (12), and Ultra-High Temperature processed (UHT) milk (12) were bought. Dairy products were selected from 3 brands as three different batches in each brand from the market in Pannala veterinary division. Samples were analyzed for Total Plate Count (TPC). The result of this study showed the mean of TPC was  $1.425 \times 10^{14}$  CFU/mL in raw milk,  $4.967 \times 10^6$  CFU/mL in ice cream,  $1.838 \times 10^5$  CFU/mL in flavored milk and these findings failed to meet FAO standards. However, TPC of raw milk, pasteurized dairy products (ice cream & flavored milk) and UHT milk were within the acceptable range. In conclusion, the study revealed that there is a necessity for improvement in bacterial quality for raw milk and pasteurized dairy products. This study indicates that there is a need of implementation in good hygienic practices, particularly in the milking process and effective monitoring throughout the production line.

**Keywords:** dairy products, raw milk, TPC, UHT.

## **Physicochemical and organoleptic properties of ready to eat chicken meat snack**

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The chicken meat production has increased many folds in the preceding years while meat consumption habits are gradually changing from fresh and frozen meat towards processed meat products. It creates the potential to produce value-added chicken meat products. This study was aimed to develop ready to eat chicken meat snack with desirable composition and sensory quality. After conducting a series of preliminary trials, gram flour was incorporated into the basic formulation of chicken meat snack replacing lean meat at 5, 10, and 15% levels. As the cooking methods, microwave and deep-frying techniques were separately used. The best formulation was selected through a sensory evaluation at seven-point hedonic scale using thirty untrained panelists. The most preferred microwaved blend (15% gram flour, 85% minced meat) and fried blend (15% gram flour, 85% minced meat) were selected to carry out proximate composition and storage stability evaluations. Total plate count (TPC) and yeast and mold count (YMC) were determined within one month of storage period to evaluate storage stability. Protein, fat, fiber, carbohydrate, moisture and ash contents in microwaved chips were  $48.28 \pm 0.40\%$ ,  $9.62 \pm 0.37\%$ ,  $1.58 \pm 0.29\%$ ,  $32.33 \pm 0.99\%$ ,  $0.82 \pm 0.02\%$  and  $7.37 \pm 0.06\%$  respectively. The protein and ash contents were significantly higher ( $p < 0.05$ ) in microwaved chips compared to fried chips. The TPC and YMC were slightly increased during the storage period in both microwaved (TPC - 1.25 cfu/g in 1<sup>st</sup> week - 4.34 cfu/g 4<sup>th</sup> week/ YMC - 1.06 cfu/g in 1<sup>st</sup> week - 8.95 cfu/g in 4<sup>th</sup> week) and fried chips (TPC - 4.34 cfu/g in 1<sup>st</sup> week - 18.34 cfu/g in 4<sup>th</sup> week/ YMC - 1.20 cfu/g in 1<sup>st</sup> week - 19.45 cfu/g in 4<sup>th</sup> week). The results suggested the ready to eat chicken meat snack can be developed with optimum consumer preference by incorporating 15% gram flour using microwave technique. Further studies are required to investigate the microbial composition to extend the shelf life of the product.

**Keywords:** chicken meat, deep-frying, microwave, snack.

## ***Aloe (Aloe verais barbadensismillar)* incorporated herbal milk beverage with acceptable food quality.**

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Herbs and nutraceuticals are natural substances with a broad spectrum of health attributes. Milk has always been an innovative option to fulfill the ever-changing consumer preferences for product novelty and it has been a potent carrier for the herbs that can contribute functional characteristics to the product and well-being of consumers. Aloe-vera has been identified to have many nutritious plant compounds. The present study investigated the possibility of developing a novel herbal milk beverage incorporated with aloe-vera for commercialization and to evaluate its sensory, nutritional, physicochemical and microbial quality parameters. The herbal milk beverage with the incorporation of aloe-vera pulp was prepared through various prototype trials based on different levels of sugar, pH, and various flavors. The organoleptic properties such as appearance, flavor, aroma, texture/ mouth-feel, overall taste, and overall acceptability were studied and consumer acceptance was observed. The nutritional composition of the product was evaluated through the proximate analysis. Aerobic plate count and coliform count were carried out to evaluate the safety and keeping quality of the product and also physicochemical parameters such as pH, total solids, total soluble solids, and discoloration were tested. The study led to the conclusion that the aloe-vera incorporated herbal milk beverage was acceptable to the consumer, nutritional composition matched with Food Act No. 26 of 1980 and constitutes of food quality according to Sri Lankan standards for pasteurized milk products. The product possessed good overall acceptability, physiochemical quality and shelf life of 14 days. The product was acceptable for commercialization in terms of consumer preference and cost.

**Keywords:** nutritional beverage, organoleptic properties, pH, TSS.

## Effect of fly ash from coal power plant on shrimp culture around Noracholai area

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The Lakvijaya coal power station in Norochcholai is the largest coal power plant in Sri Lanka. Thermal power stations use coal as a fuel for electric power generation. They produce large quantities of fly ash and bottom ash as by-products of combustion. The annual fly ash production in Norochcholai is 150,000 tons. Only a portion (30%) is used for cement production and the remaining is dumped in yards located about 100 m away from the power plant. Site selection is one of the major factors for shrimp culture and the fly ash released from coal power plants may affect the water quality of shrimp farms around the area. In this regard, the area bordering the Puttalam lagoon has been identified as a good site for shrimp cultivation. Unfortunately, shrimp farmers recently experienced water quality problems probably related to fly ash. Hence, this research aimed to study the effect of fly ash on shrimp culture and the water quality parameters of shrimp farms around the Noracholai area. Fourteen shrimp farms located around the Lakvijaya power plant were selected for this study. At different distances from the plant, the water pH, soil pH, Secchi disc depth, salinity, and alkalinity were monitored. The amount of fly ash deposition was also estimated bi-weekly. Results showed that water and soil pH, salinity, and deposited fly ash weight decreased with the distance from the coal power plant. The average ash deposition rate in farms near the plant is around  $7.2075 \pm 0.710$  g/m<sup>2</sup>. Water pH, soil pH, and salinity declined due to fly ash deposition, while alkalinity and Secchi disc depth increased. Shrimp farms situated up to 6 km from the plant were affected by fly ash deposition.

**Keywords:** bottom ash, coal, fly ash, water pH.

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