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"Revolutionary strategies for improvement of health & nutrition"

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The Nutrition Society of Sri Lanka

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Dear Colleagues

Welcome to the annual scientific sessions 2019 of the Nutrition Society of Sri Lanka

The Nutrition Society of Sri Lanka is the leading organization with more than 500 members serving in multifaceted professions related to nutrition. The aim of the society is to promote nutrition science among Sri Lankans to enhance education and application influencing best practices and policies to improve health and nutrition.

The theme of this year is Revolutionary strategies for improvement of health & nutrition'. In two days programme we hope to convey you novel aspects of revolutionary foods for health, strategies for right food selection, prevention of life style diseases and essence for sustainable behavioral changes. In addition free papers presented by researchers will add much enthusiastic thoughts on nutrition issues.

This year the society complete 48 years. All throughout the years under the leadership of dedicated presidents and council members the society achieved remarkable success in advocacy, capacity building and communication in the field of food and nutrition. The membership is correctly matched with the multifaceted nature of the discipline of nutrition. Nutritionists are important fraction of the human resources. They can influence the thinking of people and the development of the country. The Nutrition Society of Si Lanka has expended its wings to wider length in the eve of its 50^{th} year celebrations which will be coming in the year 2022. In 2018, the Nutrition Society of Sri Lanka was awarded the consultancy to complete the first steps of implementing the Maldives Food Based Dietary Guidelines by the Food and Agriculture Organization (FAO) of the United Nations. It is a giant step the society has taken to spearhead the expertise and capacity of its members to the international level.

The scientific sessions are possible with the support of council, wider membership and well-wishers who volunteered time, energy and knowledge. Their contributions are invaluably acknowledged.

Prof Anoam Chandrasekara
President/NSSL

Prof CC De Silva Memorial Lecture

Interdisciplinary research supporting new discovery/ innovation on micro-nutrient status of the Sri Lankan population

Chandrani Liyanage
Faculty of Medicine, University of Ruhuna, Sri Lanka

''Micronutrients'' is the collective term applied to essential vitamins and trace minerals. Inadequate intake of them is now recognized as an important contributor to the global burden of disease. Micronutrient deficiency alters the physiological functions before they are manifested clinically. Subclinical forms of iron, zinc, iodine and vitamin A deficiencies that occur during foetal and early post-natal periods affect the individual's physical growth, immunological and cognitive maturation in ways that may be irreversible.

Some micronutrients have mutually beneficial or synergistic effects where as some interact negatively with one another. Factors such as, increased nutrient requirements, maturation of the gastrointestinal tract, type of diet, age and rate of growth including inhibitors of nutrient absorption such as phytic and oxalic acids will affect the bioavailability of micronutrients.

Bioavailability is broadly defined as the absorption and utilization of a nutrient. For orally administered nutrients, bioavailability generally designates simply the quantity or fraction absorbed out of the ingested dose. To determine the bioavailability nuclear techniques using both radioactive and stable isotopes have been used extensively. Stable isotopes can be used to assess the bioavailability in a completely safe and highly accurate fashion, in any subject population including children of all ages, as well as pregnant and lactating women. In Sri Lanka, the bioavailability of iron was first determined among young adults from leaf gruel using radioisope technology in early 90s. The absorption of iron was only 1.5% but increased to 4% when vitamin C was incorporated.).

Following this a stable isotopic method was introduced in late 90s to determine iron bioavailability among infants from supplements (microencapsulated iron sprinkles) when added to homemade complementary foods. The ferrous fumarate sprinkles had absorption of 11% and proved to be efficacious in increasing the available iron content of the infant diets. Bioavailability of iron and zinc was also determined using same technique in young children from the meals made out of Thriposha supplement and fortified rice flour preparations (with iron and zinc). It appeared that fortified rice flour can be considered to be a potentially effective strategy to ameliorate the prevalence of micronutrient malnutrition in Sri Lankan settings. From the Thriposha supplement the absorbed amounts

represented 65% and 13% of the estimated absorbed requirement (EAR) of iron (0.9mg) and zinc (1.2mg) respectively. The effectiveness of calcium and vitamin D3 through daily supplementation of Thriposha over a period of nine months was seen as improvements in total spine BMD among preschool children aged 3-5 years. Interestingly, an improvement on their cognitive function was also observed.

In addition, the body composition of exclusively breastfed infants and determination of human milk intake were also carried out by a stable isotopic method using Deuterium dose-to-mother technique. Breastmilk intake of the exclusively breastfed infants up to 6m of age was found adequate having an average of 750 (±170) g/day. Human milk of Sri Lankan mothers contained fairly high amounts of arachidonic acid & DHA. However, the linoleic & γ-linolenic acid percentages were low compared to the values reported. The body composition of the Sri Lankan lactating mothers assessed using the same technique was also comparable to those reported elsewhere.

Keynote Address

Obesity, diabetes and the microbiome

Ian D Caterson
Boden Institute, Charles Perkins Centre, University of Sydney NSW 2006 Australia
World Obesity Federation, London UK

There are many more organisms in our bowel than cells in our body. It is recognised that these organisms may (as well as altering the cellular lining of the bowel (IBD), bowel function and transport) play a role in producing, maintaining or exacerbating disease.

Studies in germ free mice that showed that the microbiome from obese mice could induce obesity. Other studies showed that in obesity there seemed to be specific microbiome profiles and that the gut was "leakier". Later studies (by our team) examined the effect of diet on the microbiome and looked at weight loss outcomes, showing that weight loss was associated with specific changes in the microbiome. In diabetes there appears, again, to be associated patterns in the microbiome and metformin, amongst other treatments may have some of its effect through microbiome changes. The possibility of probiotics for the management of metabolic disease is tantalising, early trials show some promise but there is more to be done.

Originally classes of organisms were studied, but as technology has advanced it is now possible to describe the complexity of the organisms and their classes, sub-classes, distribution and number. However, with this sophisticated technology and complexity it has become harder to link microbiome changes to outcomes. What is needed is an understanding of the mechanisms which link the microbiome and disease.

The relationship between the microbiota and metabolic disease is interesting and does offer the potential for prevention or management – but there is still a way to go in our understanding and the need for many more studies.

Plenary Lecture 1

Functional foods and nutraceuticals: roles in disease prevention and health

KKDS Ranaweera
Department of Food Science and Technology, University of Sri Jayewardenepura, Sri Lanka

Non-communicable diseases (NCDs), including cardiovascular diseases, cancer, diabetes and chronic kidney and respiratory diseases remain the leading causes of death locally and globally. Achieving targets for NCD prevention and control require a renewed and concerted action at the national level. Studies have demonstrated that changes in oxygen utilization in the body and increased formation of reactive oxygen species (ROS) are one of the causes of NCDs. There are enough evidences from epidemiological, *in vivo*, *in vitro* and clinical studies pointing out that, consumption of functional foods and nutraceuticals is associated with decreased risk of a range of NCDs.

Over the past 20 years, case-control studies have indicated an inverse correlation between regular fruit and vegetable consumption and the development of various types of cancer. Although the functional foods have no universally accepted definition, they can be considered as foods or food components that resemble traditional foods but possess demonstrated physiological benefits. On the other hand, nutraceuticals are commodities derived from foods, but are used in the medicinal form of pills, capsules or liquids and again render demonstrated physiological benefits.

Functional foods contain functional components such as functional dietary fibre (insoluble fibre, soluble fibre, Beta glucan), carotenoids (Beta-carotene, lutein, zeaxanthin, lycopene), polyphenols (phenolic acids, flavonoids [anthocyanins, flavanols, procyanidins, flavanones], stilbenes, and lignans), isothiocyanates etc. Fruits, vegetables, nuts, seeds, whole grains, and legumes are the best sources of these phytochemicals. The positive effects of a functional food can be either maintaining a state of wellbeing and health or reducing the risk of pathologic consequences. It is also now widely accepted that the protection supplied by fruit, vegetables and green leafy vegetables against diseases is due to the presence of various antioxidants. According to our studies carried out using 34 green leafy vegetables, *Sesbania grandiflora*, *Cassia auriculata*, *Murraya koenigii* Spreng, *Passiflora edulis*, *Gymnema lactiferum* and *Olax zeylanica* showed high carotene content, antioxidant activities and polyphenolics compared to other greens tested. A good correlation was observed between antioxidant assays and polyphenolics in the leafy vegetables as well.

Several mechanisms have been proposed to explain the biological actions of plant polyphenols in coping up with NCDs especially with cancer. Accordingly, polyphenols act as antioxidants scavenging free radical and metal sequestration. Some other studies suggest that polyphenols present foods like tea, grapes, fruit juices, and cocoa, can effect on carcinogenesis and tumour development. These polyphenols may interact with reactive intermediates and activated carcinogens and mutagens thereby may modulate the activity of key proteins involved in controlling cell cycle progression and control the expression of many cancer-associated genes. In addition, green tea containing flavanol and epigallocatechin gallate (EGCG) has shown to induce apoptosis and inhibit cancer cell growth by altering the expression of cell cycle regulatory proteins and the activity of signalling proteins involved in cell proliferation, transformation and metastasis.

Polyphenols through interactions with membrane lipids and proteins can facilitate certain biological effects on generating cell responses. Thus, polyphenols affect cell function by modifying plasma membrane structure and physical characteristics such as fluidity and electrical properties. These modifications can result in functional changes of several membrane-associated events including the activity of membrane-associated enzymes, ligand-receptor interactions, ion and/or metabolite fluxes, and the modulation of signal transduction. Adsorbing on to the membrane surface, polyphenols may provide a physical barrier for hydro-soluble radicals or getting inserted into the lipid bilayer, polyphenols would be in close proximity to scavenge lipid soluble radicals. Thus, polyphenols can protect membranes and membrane components from oxidation by providing an antioxidant protection through mechanisms not completely related to free radical scavenging or metal chelating actions.

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Exploitation of underutilized endemic plants possessing medicinal and functional properties with a view of enhancing health and wellbeing of Sri Lankans

RM Dharmadasa

Biotechnology Division, Industrial Technology Institute, Colombo, Sri Lanka

Functional foods (super foods/ health foods) are broadly defined as plants or, fortified, enriched or enhanced foods that provide health benefits beyond the provision of nutrients. Since the functional foods help to rectify many human health problems, the global demand for these foods is increasing gradually and expected to reach USD 255 billion by 2024. Creating awareness on functional foods and changing attitudes on food habits, it is expected, would help achieving the ambitious goal of hunger and malnutrition free healthy nation (UNDP, 2016). In addition, the fast changes taking place in the food culture, from slow to fast-food, that include increasing consumption of processed and value added food with known and unknown additives, not permitted colorings, sweeteners etc. could be a possible cause for the increasing incidences of food related health issues. Hence, there is a national need to campaign importance of healthy, functional foods to develop a physically and mentally healthy nation.

In this context, it is important to identify indigenous plants with higher functional and nutritional values for large scale cultivation and for use at house hold and commercial scale. Meanwhile, earlier people relied on wider range of naturally occurring resources including crop species and other natural resources for their day to day nutritional, health, social, cultural and religious requirements. However, with the introduction of commercial agriculture, crop diversity was drastically reduced and currently only 30 crop species provide 95% of the world's food and energy, whereas over 7000 species are considered as underutilized crops. Interestingly these underutilized crop species possess many favourable characters such as high macro and micro nutrients, essential vitamins and minerals, enhanced bioactivities, environmental adoptability and resistant to pest and disease conditions etc. Similarly, although Sri Lanka has approximately 4000 plant species distributed in 46 different agro-climatic zones, only 70 species are utilized for commercial cultivation. The remaining species are considered as underutilized species which have been widely used in traditional and Ayurveda systems of medicine for the treatment an array of human ailments since historic times. Therefore there is an immense potential of introducing these underutilized crops species as potential candidates for the prevention, control and treatment of major Non Communicable Diseases (NCDs) which expends a considerable amount of foreign exchange annually.

Being an island with a wide floral bio-diversity, Some of the key potential exploitable underutilized crops include 50 species of yams and tubers, 35 species of citrus, more than 20 Mangifera species, around 30 banana accessions, and many more leafy and other

underutilized vegetable and fruit species. These crops could be introduced into existing cropping systems to diversify the agricultural system with newer, high therapeutic potential plants. Moreover, introduction of these underutilized crops will directly help to strengthen food, pharmaceutical, and nutraceutical industries both quantitatively and qualitatively to meet existing demand of the country. In addition, launching an efficient awareness programme among interested parties, providing planting and other materials for large scale cultivation, establishment of commercial cultivation of crops with elevated bioactivities, commencement of nutritional labeling system, scientific validation of traditional claims by modern scientific high throughput technologies and commercialization could be suggested as key factors. Moreover, it will save the considerable foreign exchange, improve health conditions, reduce health burden to the country, create employment opportunities for unemployed youth and also earning of foreign exchange and automatically contribute to the Gross National Domestic Product (GDP).

Functional Beverages and Health

Viduranga Y Waisundara

Australian College of Business & Technology – Kandy Campus
Peradeniya Road, Kandy, Sri Lanka

The functional beverage sector is the fastest growing segment of the beverage industry, especially in countries such as the US and Canada. These drinks are popular because it is easy for a person to choose to drink a healthier beverage than a food, and beverages are a better vehicle for the consumption of healthy supplement-like additives than food. Functional beverages are divided into four types. They are, (1) hydration beverages contain defined concentrations of salts and minerals. Different vitamins and minerals are added to attract the consumers, (2) energy or rejuvenation beverages contain stimulants like caffeine, guarana, taurine, and yerba matte, (3) health and wellness beverages are developed for the people concerned about their general health and wellness and (4) weight management beverages target the obese consumer due to their weight loss claims; these beverages are added with polyphenols, green tea and green coffee extracts and are labelled with claims that they promote weight loss by increasing metabolism.

Along these lines, Kombucha tea is a novel fermented beverage, which has gained immense popularity due to several purported health benefits such as anti-cancer, antioxidant, detoxification, anti-microbial and Angiotensin-Converting Enzyme (ACE) inhibitory activities. While the term Kombucha is the most commonly used name for the beverage, it is also known by other names such as 'Chainii grib', 'Chainii kvass', 'Champignon de longue vie', 'Ling zhi', 'kocha kinoko' and 'red tea fungus' (Malbaˇsa, et al., 2011). As somewhat of a value-added form of tea – for which functional properties have already been established, the beverage itself has a history spanning several thousands of years in the East, while it soon became popular in the West as well owing to the comparatively acceptable taste, flavour and ease of preparation (Mohammadshirazi and Kalhor, 2016).

The Kombucha beverage is produced by the fermentation of tea and sugar by a symbiotic association of bacteria and yeasts – primarily acetic acid bacteria and osmophilic yeast, collectively forming a 'tea fungus' – a name owing to the mushroom-like growth appearing in the fermented broth. The yeasts in particular, convert added sugar in tea to organic acids and ethanol. The enzymes, bacterial acids, and other secondary metabolites produced by the microbes during the fermentation contribute the functional properties to the beverage. While several other bioactive compounds are also produced as a result of the fermentation, the process leads to the formation of cellulose pellicles due to the activity of some bacterial strains such as *Gluconoacetobacter xylinum* (Mohammadshirazi and Kalhor, 2016).

Similar to black or green tea, Kombucha can also be bottled for commercialization once the fermentation process is complete. As a functional beverage, Kombucha has shown much promise as a drink which can be easily prepared in households as well as with the potential to be upscaled into a commercially produced beverage. Its sensory properties are generally well-received by consumers, although areas for improvement such as reducing / modifying its presence of alcohol still exist.

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Bioactive Functional Cereals; Rice, the Sri Lankan Staple

WKSM Abeysekera
Department of Agricultural Technology, Faculty of Technology, University of Colombo, Sri Lanka

Cereals have been in the human diet since ancient times. They represent one of the world's major food sources and the staple food for the majority of the population world over. Apart from being an important part of the human diet by providing energy and nutrients, cereals are also important in enhancing human health. This is due to the presence of range of chemical substances which is often referred to as phytochemicals or the plant bioactive substances in the outer layers of the grain. Such bioactive functional cereals play vital roles in the prevention and dietary management of variety of chronic diseases.

Among cereals, rice is the staple food for many parts of the word including Sri Lanka. Rice cultivation in the country has very long history and during early days rice varieties cultivated in the country were exclusively indigenous/traditional rice varieties. However, after 1950's the rice varieties cultivated in the country were mainly new improved rice varieties. In Sri Lanka, rice is reported to provide significant amounts of nutrients to the rice consumers. However, its bioactivity or the functionality was discovered only in the recent past.

Research conducted by our group were able to show range of functional properties such as anti-diabetic, anti-inflammatory, anti-cancer, anti-lipidemic and anti-oxidant properties of Sri Lankan rice. Anti-diabetic activity of Sri Lankan rice was mediated by anti-amylase, anti-glycation, glycation reversing, anti-hyperglycemic, anti-acetyl and anti-butyrylcholinesterase activities. Anti-inflammatory activity was observed through the reduction of oxidative burst of human blood and immune cells, inhibition of nitric oxide and proinflammatory cytokines. As anti-cancer activity growth inhibition and cytotoxicity against range of human cancer cell lines were observed. Further, some varieties showed high glutathione S-transferase inhibitory activity indicating its potential to use as an adjuvant in managing cancer patients during chemotherapy. Anti-HMG CoA reductase, anti-lipase, anti-cholesterol esterase and cholesterol micellization inhibitory activities were observed as anti-lipidemic activity. Moreover, Sri Lankan rice also showed high anti-oxidant activities via multiple mechanisms. These functional properties were more prominent in traditional rices compared to the new improved rice varieties of Sri Lanka. Further, such properties were observed especially in the red rice bran. Recent studies by other scientists in the country have shown anti-bacterial activities in Sri Lankan rice. Further, low to high glycemic indices have been reported for Sri Lankan rice varieties. Considering all findings on bioactivities of Sri Lankan rice it can be concluded that traditional red rices are more biologically active than the other rice varieties of Sri Lanka. The presentation will provide an account of bioactive functional rice varieties of Sri Lanka.

Plenary Lecture 2

Building health capacity in early life- creative ways to engage children and youth with nutrition, health and wellbeing

Michelle Dickson
Sydney School of Public Health, The University of Sydney, Australia

My research into practice focuses on developing and delivering school-based programs in Sydney and in some rural areas in New South Wales, Australia that brings together nutrition, physical activity and culture in an effort to change health and wellbeing trajectories for Aboriginal and Torres Strait islander children, and their non- Indigenous Australian counterparts.

Globally[1], childhood and adolescent obesity presents an urgent challenge, with obesity climbing from 11 million back in 1975 to 124 million in 2016. (1) While some plateauing of overweight and obesity has been recently witnessed in some higher income countries (including Australia), prevalence still remains at unacceptably high levels. (2, 3) For Australia, 27.4% (one in four) children aged 5-17 years of age is currently in the overweight or obese category (4, 5) with the issue growing in school aged children. Rates of overweight and obesity rise from 21% in preschool years (ages 2 to 5) up to 30.8% in 10 to 13 year olds. (5)

Aboriginal and Torres Strait Islander peoples are the traditional custodians and First Nations peoples of the land now called Australia. For Aboriginal and Torres Strait Islander children the overweight and obesity status paints even a more worrying picture, with 38.5% of 10-14 year old Aboriginal and Torres Strait Islander children experiencing overweight or obesity. (6)

Overweight and obesity can be the result of a complex combination social determinants of health and wellbeing including a growing sedentary lifestyle, lack of access to affordable and nutritious food, lack of knowledge about childhood and youth nutrition, and other factors related to food security. (9) Aboriginal and Torres Strait Islander Australians currently continue to face increasing health inequities, despite federal attempts to close the health inequity gap; with around 10 years lower life expectancy than non- Indigenous Australians, Aboriginal and Torres Strait Islander health continues to need urgent attention. (10) We believe this attention needs to start at a young age and developing whole of school programs provides scope for engaging at a school-population level rather than with an individual focus.

[1] I acknowledge the work currently being done by my PhD student, Simone Sherriff, focusing on food security and overweight and obese in Aboriginal and Torres Strait Islander children and youth in Australia and thank Simone for her work.

While there is mixed evidence about the potential for school-based nutrition and physical activity programs to positively impact overweight and obesity in school aged children and adolescents (11-14), our programs draw upon the lessons learned from the literature and engage children and youth in growing food, cooking food, learning about nutrition and becoming more physically active. As we do this, we maintain a creative approach, engage university public health students in the delivery of programs and link to culture as closely as possible.

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Sri Lankan Import Food Control Infrastructure in Assuring Food Safety

Niranjan Rajapakse
Department of Food Science and Technology, Faculty of Agriculture, University of Peradeniya, Sri Lanka

Food products have been the third most valuable commodity group traded internationally. The member countries of the World Trade Organization, including Sri Lanka have signed two international agreements namely Sanitary and Phytosanitary Measures (SPS) and Technical Barriers to Trade (TBT) that define a framework for control measures to protect the health and safety of consumers. The import food control infrastructure of the country monitor controls the incoming food items having inspections at three levels namely pre-boarder, boarder and post-boarder. All food importations should comply with the requirements of Imports and Exports (Control) Act of 1969 of Sri Lanka. The information of the custom declaration (CUSDEC) registered importers are recorded in an electronic database named, Automated System for Customs Data (ASYCUDA) and the information of the food to be imported is reviewed to analyze the safety, genuineness and the authenticity of the importation. Once the inspection of the consignment is done based on the risk profile of the goods, a departmental order (DOPL) is issued to notify the custom officers about the risky food, as an internal means of risk communication while updating the same information on the ASYCUDA database immediately.

Pro-boarder protection is secured through agreements with the exporting countries, to provide pre-export government certificates ensuring the compliance with Sri Lankan food safety requirements and to facilitate on arrival border clearance processes. Boarder control of incoming food is mainly administrated by the Food Control Administration Unit (FCAU) of the Ministry of Health as the authorized body of the national food control system to ensure the food reaching the consumers is safe in every respect according to the Food Act No.26 of 1980. Food and drug inspectors are the officers empowered by the Food Act to carry out inspection of all imported food items to provide recommendations in releasing abiding to the regulations coming under the Food Act. If any issue arises, the consignment details are brought to the notice of the Food Advisory Technical Subcommittee for the final decision. The Imports and Exports (Control) Act has adopted 47 Sri Lanka Standards Institution (SLSI) food standards where compliance with the specifications is compulsory for these 47 food items imported into Sri Lanka. Foods that are not regulated under the above 47 Sri Lanka Standards (SLS) are subjected to control under the Food Act. Officers of SLSI perform inspection activities to check the compliance of identified 47 food items under the imported inspection scheme operated by SLSI. Importation of live plants or plant-based agric produces is subjected to plant import

permit issued by the Additional Director of National Plant Quarantine Service (NPQS) according to the regulations made under the Plant Protection Act No.35 of 1999. Animal or animal based food products require permits that are obtained from the Department of Animal Production and Health (DAPH) and the veterinary surgeons are involved in inspection activities in deciding the recommendation in releasing consignments. Finally, all the imported foods on the market are subjected to inspection and market surveillance procedures of the Medical Officers of Health (MOH) as a measure of post-boarder control. In addition, all the food products available in the market need to abide by the regulations of the Consumer Affairs Authority Act No.09 of 2003, in assuring the safety of food consumed by Sri Lankans.

Current status of Sri Lankan food regulatory system and its impact on food safety

Eresha Mendis
Department of Food Science and Technology, Faculty of Agriculture, University of Peradeniya, Sri Lanka

Effective national food control systems are essential to protect the health and safety of domestic consumers. They are also critical in enabling countries to assure the safety and quality of their foods entering into international trade and to ensure that imported foods conform to national requirements.

Absence of a food safety policy in Sri Lanka particularly has resulted in undefined responsibilities, administrative lapses and overlapping of mandates in agencies engaged in addressing food safety. The main drawback arises in the system due to inability to apply a holistic food chain approach in the primary food regulatory system. In Sri Lanka, Ministry of Health holds the primary responsibility of the National food safety programme. However, the functions of ensuring food safety nationally are fragmented and shared by many department/divisions or agencies coming under different ministries and institutions. The fragmentation has resulted in lapses especially in coordinating activities among the organizations affecting the efficiency and the effectiveness of food safety assurance in the system.

The national food control system in Sri Lanka operates through a primary parliamentary act dating back to 1980 and functioning without major revisions focusing emerging food safety threats. It is administered by Food Advisory Committee of the Ministry of Health. The current activities of the food advisory committee focus on the latter part of the food chain consisting of secondary processing, marketing, food preparation and consumption. It does not adequately apply modern food safety concepts based on preventive actions along the food chain, farm to fork. Sri Lanka does adequately pay attention to harmonize with requirements specified by international organizations governing food safety such as CODEX, International Plant Protection Convention, International Organization for Animal Health and World Trade Organization. The national focal points of these organizations are spreaded among several Ministries, and the use of Codex information in the system is inadequate.

The voluntary standards of SLSI, which were adopted as food laws also address almost totally food quality aspects. Although amendments have done in food product standards, some essential areas related to food safety have not been covered adequately. There are no laws or standards addressing food safety aspects, especially in relation to mycotoxins, pesticide residues, heavy metals, dioxins, allergens, veterinary drugs, growth promoting hormones in animals and pathogenic microorganisms etc. in foods, which are the main issues of global health relevance and trade.

The laboratory system providing analytical services for the food industry operate under both state sector and private sector organizations. The official testing laboratories operate without any coordination of the activities or directions from a central body. The data generated in the laboratories are not collated and analyzed to recognize trends associated with food safety.

The changes are required to get the Government, legislative, administrative and scientific sectors leading a system that would engage in effective functioning to recognize the food safety problems, opening up the way for risk analysis, risk assessment and risk management so that the health of the population would be addressed scientifically, and trade would be facilitated meeting commitments of the country.

Food literacy in school curriculum: linking food, culture, health and the environment

KDRR Silva
Department of Applied Nutrition, Wayamba University of Sri Lanka

While malnutrition inherently stems from multiple causes and drivers, food plays a central role in determining nutritional wellbeing. A food system involves all the elements (environment, people, inputs, processes, infrastructures, institutions, etc.) and activities that relate to the production, processing, distribution, preparation and consumption of food, and the outputs of these activities, including socio-economic and environmental outcomes. In the modern world, citizens are less aware on food systems, processes associated with food moving from farm to plate and the impacts of these processes on health and environment. Dietary patterns in some low and middle-income countries have been changing rapidly in recent decades towards unhealthy dietary patterns and sedentary behaviours, which lead to increasing rates of undernutrition as well as overnutrition and non-communicable diseases. A report by High Level Panel of Experts on Food Security & Nutrition has recommended to improve "food and nutrition literacy" throughout society through popular education programmes and other appropriate schemes.

Dietary behaviours during adolescence contribute to the establishment of lifelong eating patterns. Moreover, healthy eating habit among adolescents and children are essential for healthy growth, cognitive development and reduced risk of chronic diseases in their future life. Health researchers and governments expect that education should reduce disease risks and promote wellbeing among young people. However, this view is too narrow and unrealistic in contrast to more holistic approaches such as emerging area of food literacy. Nutrition education in schools can support young people attain the knowledge and skills required to make healthful food choices and develop lifelong healthy eating patterns. School-based nutrition education curricula, which fit into subject areas like health, science, home science and food technology should aim to improve students' knowledge, skills and behaviour aligned with the dietary guidelines. However, secondary school curricula in many countries have not designed effectively to deliver food-related knowledge, skills and behaviours. It has been emphasized that nutrition education programmes should not be limited to health-related aspects of food consumption but need to educate students and other consumers, about food systems-related issues. A major reason for this emphasis on the different aspects of food systems is to promote informed food choices that aim to sustain and protect the environment while achieving personal health and wellbeing.

Over the last few decades, junior secondary school students in Sri Lanka have been taught food and nutrition knowledge in "health and physical education" and "science" subjects,

and food preparation skills through elective subjects such as “home science”. In senior secondary schools “home economics” is taught as a subject in arts stream and “food technology” is taught in technology stream. These subjects, however, only cover the health domain of food literacy and focus on individual life skills. Whether broader aspects of food and food systems are integrated into these subjects taught in Sri Lanka is doubtful. In many countries such as Canada, UK and Australia, broader aspects in food systems have been incorporated to their secondary school curricula. This paper highlights the need for mapping of the present school curricula for the domains of the food systems and applying the findings in designing or modifying secondary school food literacy curricula in Sri Lanka. Also, the capacity of the teachers has to be built in delivering the food related subject curricula. Recognition of, and value for, the importance of food education at school and national levels needs to be improved.

Plenary Lecture 3
Obesity exists –what should we do now?

Ian D Caterson
Boden Institute, Charles Perkins Centre, University of Sydney NSW 2006 Australia
World Obesity Federation, London UK

The prevalence of obesity (which is a chronic, relapsing disease) is still increasing in many areas of the world, despite the knowledge of its deleterious complications (these include the metabolic syndrome, diabetes, cardiovascular disease, some cancers and musculoskeletal disorders) and despite attempts to prevent it.

Obesity is costly to the individual and to the health system. Yet, even with these facts and this knowledge our health systems are not able to manage the problem and there are few systematic and system approaches to managing those with obesity.

This presentation will consider

1. Obesity as a disease
2. Effectiveness of current management
3. The issue of weight regain and maintenance
4. Where treatment should be available and developing pathways for our health systems
5. Prevention and policy initiatives and their outcomes

Obesity is a chronic disease; it is treatable. We need to streamline our approach, have proper treatment pathways and prevention initiatives.

Diabrisk –sl: Early initiation of lifestyle modification reduces the risk of Diabetes and Heart Disease in Sri Lankans

Mahen Wijesooriya
National Diabetes Centre, Rajagiriya

There is a marked increase incidence and prevalence of Type 2 diabetes mellitus [t2dm] and related cardiovascular disease [CVD] in young urban South Asian who are predisposed. With an alarming decrease in age of onset and no cure in sight, the health consequences to persons living with diabetes, their families and country is are catastrophic. The effect of lifestyle modification (LSM) on the prevention of cardio-metabolic disease in young healthy urban Sri Lankan subjects is unknown.

Diabrisk-sl is a randomised controlled clinical trial where 23,298 [males 47%] healthy urban participants between 5-40 years were screened for 4 risk factors i.e. increased body mass index, elevated waist circumference, first degree family history of diabetes and physical inactivity in and round Colombo. 22% had two or more risk-factors and were invited to participate in an intervention trial. 50% were under the age of 18 years with no evidence of prediabetes with a mean age of 22.5 yrs.

4672 of whom 3685 [48% males] were eligible and randomized for the intervention which was individualized, peer related educators delivering life style modification [LSM] advice on healthy diet, increased exercise and reduction of stress without medication. The two interventional arms were intensive 3 monthly LSM (I-LSM) vs a less-intensive 12 monthly LSM (LI-LSM) to reduced and correct risk factors. The mean age of 22.5 and intervention being without medication makes this study unique compared with other similar global studies. It was performed at the National Diabetes Centre in Colombo in collaboration with Kings College London from 2008-2013.

During a median follow-up of 3 years, the cumulative incidence of the primary endpoint was n = 479 in P-LSM(74 per 1000 person years) vs. 561 in C-LSM (96 per 1000 person years), with an incident rate ratio (IRR) of 0.89(95% CI 0.83–0.96, P = 0.02). In post hoc analyses, new onset dysglycaemia (T2DM, IFG and IGT), was the major contributor to the composite and was significantly reduced by P-LSM (IRR 0.9, 95% CI 0.83–0.97, P = 0.01). A significant impact of P-LSM on the incidence of the composite endpoint was noted in 1725 participants (P-LSMn = 850, C-LSM n = 875) aged below 18; P-LSM n = 140 (48 per 1000 person years) versus C-LSM n = 174 (55.4 per1000 person years), with an IRR of 0.83 (95% CI 0.73–0.94, P = 0.004). In a young high risk South Asian population, translation of this intensive LSM reduces the development of T2DM, IGT and a composite endpoint of cardio-metabolic disease over 4 years.

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Reversing Type 2 Diabetes Mellitus, putting diabetes into remission?

Ananda Chandrasekara
Department of Applied Nutrition, Wayamba University of Sri Lanka

Type 2 diabetes is often associated with obesity and range of chronic diseases including hypertension, dyslipidaemia, coronary heart disease and certain types of cancers. The prevalence of obesity/overweight in developing countries continues to trend upwards in the past three decades accounting approximately 80% of the deaths from non-communicable diseases occur in moderate to low-income countries. Cardiovascular disease is the number one cause of hospital death in Sri Lanka. Obesity can be called as the underlying risk factor for the metabolic syndrome which refers as the co-occurrence of these cardiovascular risk factors including insulin resistance, hypertension, hyperglycaemia, atherogenic dyslipidaemia, proinflammatory state and prothrombotic state.

It has been established with available evidence that type 2 diabetes is a **chronic and progressive** disease which means not reversible. However, with light of recent research findings researchers explores for possible mechanism of reversing Type 2 diabetes. Some argue that the current management regimes which are dominated with immunotropic medications actually make the blood glucose levels better but not the disease and lead the condition to a chronic and progressive one. Reversing diabetes is a term that usually refers to a significant long-term improvement in insulin sensitivity in people with type 2 diabetes. If the People with type 2 diabetes can get their HbA1c below 42 mmol/mol (6%) without taking diabetes medication are said to have reversed or resolved their diabetes. This also known as putting diabetes into remission. A growing body of research found that lifestyle and behavioural modifications which leads to significant drop of body weight can be particularly beneficial in helping to reverse the progression of type 2 diabetes.

Dietary dilemmas over fats intake and cardio-metabolic risk

Kumari M Rathnayake
Department of Applied Nutrition, Wayamba University of Sri Lanka, Sri Lanka

Cardio-metabolic risk (CMR) expresses the collection of risk factors that account for much of the early, subclinical expression of cardiovascular disease (CVD) risk in populations. Globally, CVD remains the leading cause of death, with the 2016 Global Health Estimates study estimating that CVD accounted for 31% of all deaths and 15% of global Disability-Adjusted Life Years (DALYs). CVD mortality and morbidity rates remain high emphasizing a need for interventions that focus on tackling the modifiable determinants of CMR. CMR comprises a group of risk factors which includes central obesity, or increased waist circumference, raised triglycerides, reduced HDL-cholesterol, raised blood pressure, or hypertension and raised fasting plasma glucose. There is no accepted diagnostic criteria or set of accepted cut-offs for CMR, however the International Diabetes Federation and American Heart Association, any three or more factors are sufficient to increase risk of developing vascular problems leading to chronic illnesses.

Diet is an important modifiable risk factors for CVD risk. One of the key public health strategies to lower CVD risk is to reduce saturated fatty acid (SFA) consumption to ≤10% of total energy (FAO, 2008); however, what is not clear is which macronutrient should replace to SFA (Hooper et al., 2012). Previous data from pooled analysis of prospective cohort studies (Jakobsen et al., 2009) and a meta-analysis of randomised controlled trials (RCT) (Hooper et al., 2012) have indicated that replacement of SFA with carbohydrates was not associated with reductions in CVD mortality, but replacement with total (both n-3 and n-6) polyunsaturated fat (PUFA) was associated with a reduction in CHD risk (Jakobsen et al., 2009) and CVD events (Hooper et al., 2012). However, there is limited data on the effects of SFA replacement with monounsaturated fat (MUFA) on CVD mortality, or a direct comparison between SFA replacement with MUFA and n-6 PUFA. In the Dietary Intervention and Vascular Function (DIVAS) study, replacement of 9.5-9.6% TE of dietary SFA with either MUFA or n-6 PUFA for 16-wk reduced key CVD risk markers: fasting low density lipoprotein cholesterol (LDL-C) and total cholesterol (TC) to high density lipoprotein cholesterol (HDL-C) ratio, with differential effects of the unsaturated fats on markers of endothelial activation and blood pressure (Vafeiadou et al., 2015b).

CVD risk biomarkers, such as fasting lipids (total, LDL, and HDL-C, and triacylglycerol (TAG)), have been routinely measured in dietary studies, but more recently, novel markers such as postprandial lipaemia, vascular function and biomarkers of endothelial activation have been included to provide a more holistic measure of dietary fat composition on CVD risk. However, the majority of studies examining the effects of dietary fat composition on

lipids and vascular function have been conducted in the fasting state, with very little known about the acute effects of meal fat composition on postprandial vascular function and lipaemia. This is particularly important since individuals spend up to 18 h in the postprandial (fed) state, with non-fasting TAG levels now recognised as an important CVD risk factor particularly in women (Nordestgaard et al., 2007, Bansal et al., 2007). Endothelial dysfunction is characterised by reduced bioavailability of nitric oxide (NO), which leads to vasoconstriction, increased expression of adhesion molecules and pro-inflammatory cytokines, platelet activation and increased oxidative stress (Verma and Anderson, 2002), and has emerged as a critical early modifiable event in the development of coronary atherosclerosis (Widlansky et al., 2003). Exploring the potential for diet and lifestyle changes to manage and reduce CMR, and subsequent CVD risk, is therefore relevant for both clinical practice and public health.

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Plenary Lecture 4

Food system approach in improved health & nutrition

DBT Wijeratne
FAO Representative Programme Sri Lanka

The UN has declared 2016-2025 as the Decade of Action on Nutrition and the country level actions are focusing on malnutrition in all its forms to include undernutrition, micro nutrient malnutrition and over nutrition. In Sri Lanka, even though the health related indicators are satisfactory, one cannot be happy about the Global Hunger Index, which is 67 out of 119 countries. In this scenario, to combat malnutrition, this brief will focus more on strategies on nutrition sensitive approaches of the food system. Food System consists of people environment, inputs, outputs, infrastructure and activities related to production, processing, handling/distribution and consumption. As about 30% of the local population are directly dependent on agriculture for livelihood, agriculture sector initiatives offer enormous potential for improving household level food security as well as diet quality. Hence, Promotion of Nutrition Sensitive Agriculture will improve the dietary diversity and the nutrient supply of the farming community. Initiation of Good Agricultural Practices will enhance the food safety of agricultural produce. As the food production is now challenged with the climate shocks, it may be necessary to adopt Climate Smart Agricultural practices. Also, change of cultivation process and promoting Future Smart Foods, may help to overcome the productivity barriers. In Sri Lanka, the post-harvest losses are in the range of 30-40% and 5-10% for fruits/vegetables and cereals, respectively. Taking measures to reduce the postharvest losses will improve the food availability and have a positive effect on affordability improving the food security status. As a tropical country, seasonality and glut of produce could be handled only through processing and extending shelf life. However, due attention should be given not to over process and to preserve the nutritional values of the commodities. Most importantly, consumption pattern of the general public needs to be improved through awareness creation. Also, with the rapid changes of socio-economic status of the general public, food waste may also play a major role in the near future. Hence, presence of functional and sustainable food systems will ensure food security and nutrition for all and will provide food that is healthy, of sufficient quantity, affordable, safe and culturally acceptable.

Achieving Zero Hunger- Pathways to improved health and nutrition

Saman Kalupahana
World Food Programme, Sri Lanka

Sustainable Development Goal 2 – Zero Hunger – pledges to end hunger, achieve food security, improve nutrition and promote sustainable agriculture. It is the priority of the World Food Programme (WFP) to mobilize the world's population closer to achieving the zero-hunger challenge. Being the world's largest humanitarian agency, WFP's role in the health and nutrition sector is globally recognized. WFP works on scaling up nutrition, school meal programmes, community resilience building, and emergency assistance and preparedness, all of which are considered as key interventions to support the development of the health and nutrition sectors.

In the nutrition sector, WFP provides support through nutrition specific and nutrition sensitive approaches. Regarding nutrition specific approaches, WFP helps to prevent malnutrition by implementing supplementary feeding programmes, which help to ensure vulnerable groups have regular access to a nutritious, age-appropriate diet. Specialised nutritious foods are being used by WFP for addressing malnutrition among groups who are at risk to become malnourished. While, WFP's nutrition sensitive interventions are providing more sustainable solutions for nutrition issues among vulnerable communities through awareness raising, rice fortification and the promotion of nutrition sensitive agriculture.

In emergencies, WFP's primary role is to ensure that those affected by emergencies receive adequate nutrients – good nutrition – not just sufficient food. With humanitarian food assistance, WFP provide nutritious food to those in urgent need. Meanwhile, WFP's complementary programmes address the root causes of hunger and help build community resilience.

WFP has been in Sri Lanka since 1968 supporting the Government to improve food security, nutrition, and health. Currently, WFP is implementing its Country Strategic Plan 2017–2020, which includes "Improve nutrition" as one of its five Strategic Objectives.

Over the past decades, WFP has been working with governments in Asia, Latin America, and Africa to introduce and scale up rice fortification to fight micronutrient deficiencies. Using its global, regional, and national nutrition and food technology expertise, WFP has been supporting rice fortification initiatives in Sri Lanka since 2014.

Globally, WFP implemented or supported school feeding programmes in 71 countries including in-kind or technical support, and it directly provided school meals to 18.3 million children in 60 countries. In Sri Lanka, WFP has been a long-time supporter of the school meal programme through various mechanisms, including in-kind food donation,

coordination, capacity building, and most recently, through the incorporation of fortified rice into the programme's mid-day meals.

Moreover, Social and Behaviour Change Communication (SBCC) is widely recognized as one of the essential actions to improve nutrition. Globally, SBCC will help WFP to successfully implement its Nutrition Policy (2017 – 2021). To help overcome the nutrition challenges in Sri Lanka, particularly those related to diet diversity and balanced diet, WFP is currently working on an evidence-based SBCC campaign.

Further, WFP understand the importance of information management in the development of the health and nutrition sector, as such, WFP has introduced various data management tools to gather and analyse nutrition and food security data for proper programme planning. Fill the nutrient gap (FNG) and the Platform for Real Time Monitoring Information Management system (PRISM) are some of the tools WFP has introduced to streamline the data management at country level.

Finally, it is well established no organization can end malnutrition alone, WFP continues to work hard to foster partnerships with governments, other UN agencies, NGOs, private sector, academia, as well as local producers, retails and communities. Thus, while working towards the achievement of SDG 2, WFP is contributing to the achievement of SDG 17: Partnership.

Civil Society Involvement in Scaling Up Nutrition

Dilka Peiris
World Vision Lanka

Civil Society is a strong stakeholder in support of national multi-stakeholder efforts towards scaling up nutrition in a sustainable manner, and increasingly recognized as such. It contributes to ensuring the efforts address national priorities defined by the needs of populations suffering from multiple burdens of malnutrition. Many countries have civil society representatives on the national multi-stakeholder platform for scaling up nutrition. This collaboration embodies the collective action needed to scale up nutrition.

Civil society makes a unique contribution to the country's nutrition agenda. Here are some of the ways Civil Society Organizations (CSOs) supporting the fight against hunger and malnutrition:

• **Advocating** – through social mobilization, advocacy and campaigning; to raise awareness of the impact of malnutrition and encouraging governments to make it a priority;
• **Implementing –** through programming reaching affected communities and delivering nutrition-sensitive and specific services;
• **Monitoring –** from a local to a global level we are tracking progress, by monitoring nutrition spending, collecting data to ensure no one is left behind and holding governments accountable for their promises.

Civil Society actors are an important stakeholders in support of government efforts, at all levels, through; multi-stakeholder landscape mapping; advocacy, social mobilization and communications; monitoring and evaluation and development of policies / common results framework; national nutrition information systems development; building sustainability beyond political cycles for prioritization of nutrition through close work with parliamentarians and building cross-party support in advance of national elections; working with government to advocate for cross- ministry participation; sensitizing everyone, including CSOs, and the workforce, to national nutrition efforts and the importance of nutrition-sensitive efforts; raising awareness and building ownership by communities for nutrition as an important human rights, social justice and development issue; identifying and supporting champions, coordinating efforts for alignment behind national priorities and representing grassroots voices; supporting capacity strengthening (e.g. community health workers for nutrition service delivery or linking to other programmes like social protection programmes). Civil society organizations have a very powerful voice when united: engaging grass-roots and community-driven support for scaling up nutrition locally and globally.

In order to Work together to scale up nutrition, there should be a strong network at country level. The intention of the county level Civil Society Alliance (CSA) is, whenever possible build on existing networks or CSO platforms for coordinating civil society within the country, advocate for an increased focus on nutritional outcome in national policies and programmes, as well as work to ensure that Civil Society efforts to tackle malnutrition are aligned with national plans. Each CSA comprises a number of CSOs, with the aim to amplify the voices of communities affected by the double burden of malnutrition and focus on the need for greater accountability to them. In addition CSAs comprise international, national non-governmental organizations, professional /academic organizations, research entities who are actively engaged in scaling up nutrition at country level.

"Alone we can do so little. Together we can do so much." Helen Keller

Implementation of Food based Dietary guidelines; Field experience from Maldives

Visakha Thilekeratne and Roshan Delabandara

Double burden of malnutrition is a universal issue holding back human development with unacceptable consequences throughout life[2]. Food Based Dietary Guidelines (FBDGs) is a key strategy to promote healthy daily food compositions and appropriate lifestyles[3].

Many countries now comprise a wider perspective, which includes recommendations on meal options, eating modes, food safety and safe water, physical activity, and sustainability aspects in their FBDGs. There are two main pillars in FBDGs, one is development of FBGGs and second is implementation action plan and communication strategy.

Nutrition Society of Sri Lanka was tasked for this and the broad objective was *"to contribute to eradicate hunger, food insecurity and malnutrition" and* to coherently use the Maldives Food-based Dietary Guidelines (FBDG) in different settings and sectors (reference). This task took place between December 2017 to December 2018 in Maldives.

Four focus group discussions (FGDs) were carried out covering a range of urban/rural settings, in order to contextualize the task. Then a stakeholder mapping, prioritizing guidelines, identifying constraints in implementation, formulating terms of reference for the implementation committee, and agreeing on envisaged outcomes for the 2-day Planning Workshop that was to follow was done.

In the Maldevian FBGDs there are 14 key messages and out that 4 messages were prioritized; *1. Eat a variety of food from the main five food groups. 2. Limit intake of sugar, 3 Limit intake of junk food and ultra-processed food, 4. Be physically active most days of the week.*

Further for FBDGs implementation Four settings were identified to implement FBDGs; health, education, food services, and agriculture. The goal for the implementation plan was "to have improved eating habits among Maldivian people by 2021". A detailed implementation plan and a results measurement table were developed followed by stakeholder workshops to mobilize resources and FBDG communication tools and dissemination plan development.

FBDGs implementation plan leached with Media day and Advocacy workshop where FBDGs required policies and enabling environment for the FBDGs to take off. The importance of effective implementation highlighted to the respective government

[2] Development Initiatives, 2018. 2018 Global Nutrition Report: Shining a light to spur action on nutrition. Bristol, UK: Development Initiatives

[3] Prapaisri P Sirichakwal and Kitti Sranacharoenpong, 2008, Practical experience in development and promotion of food-based dietary guidelines in Thailand, Asia Pacific Journal of clinical Nutrition.

authority. The State Minister of Health on what was seen as the role of government to push the FBDGs, the Secretary Health who appreciated the efforts of the whole team, both Maldivian and Sri Lankan to move the process forward and the technical exercises that were completed. Special Features: The Nutrition Society of Sri Lanka did a presentation in the form of a lobbying campaign at the end of this event with hard hitting take home messages.

Effective and creative implementation of FBDGs with strong government support and scientific facilitation will definitely leverage the much needed effectiveness of healthy nation and national development in the Maldives.

Oral Communications

Lifestyle perceptions of obese young adults

WNC Jayaweera and HP Gunawardena
Department of Applied Nutrition, , Wayamba University of Sri Lanka, Sri Lanka

Background: Lifestyle pattern determines the occurrence of obesity. Appropriate lifestyle perceptions are important for weight management.
Objective: Present qualitative study was conducted with the objectives of assessing lifestyle perceptions of the obese young adults and identifying the perceived barriers for weight management.
Methods: Thirty obese (BMI>25kgm^{-2}) apparently healthy undergraduates were recruited as subjects. Focus group discussions were conducted using 5 membered groups with a semi-structured questionnaire and thematic analysis was performed.
Result & Discussion: Nearly 63% of young adults perceived themselves as obese and 60% knew that they were centrally obese. Planned meal (53%), increased fruits and vegetables intake (57%) and reduction of junk food consumption (53%) were perceived as effective weight management methods. Nearly 33% of perceived the importance of nutrition education for weight management. Lack of motivation, monotonous diet, lack of access to healthy foods, income were identified as barriers for adopting a balanced diet. Seventy three (73%) percent were aware about the importance of physical activity in weight control. However, majority (60%) perceived that exercises are more effective in weight management than engaging in sports. Lack of time and motivation were identified as the major barriers for engaged in physical activities.
Conclusions: It emphasizes urge of nutrition education to promote the healthy eating habits and physical activities among young adults.

Keywords: Perceptions, young adults, obesity, diet, physical activity

Phytochemical properties and the satiety index score of newly developed breakfast cereal

KAC Madumali, A Jathuwarn, P Ushanthi and GAP Chandrasekara
Department of Applied Nutrition, Wayamba University of Sri Lanka, Sri Lanka

Background: Whole grain cereals and legumes help to prevent a number of non-communicable diseases due to the presence of bioactive substances which are considered as lifespan essentials. **Objectives:** The objectives of this study were to determine the total phenolic content (TPC), antioxidant activity (AOA) and the satiety index (SI) score of the newly developed breakfast cereal which was a blend of horse gram, red rice and coconut flour.

Methodology: The TPC and AOA of raw ingredients, intermediate mixtures and the final product were analyzed. A Total of 425 kcal of energy was provided with reference food and breakfast cereal to determine the satiety index (SI) score. Satiety rating was obtained for every 15 min over 120 min after consumption of the food.

Results & Discussion: The TPC of the rice, horse gram, coconut flour, product mixture and final product were 27.9 ± 6.3, 129.3±16.0, 9.0±1.4, 40.2±9.3 and 27.6±4.2, µmol of ferulic acid equivalent per gram of sample, respectively. The DPPH radical scavenging activity of the rice, horse gram, coconut flour, product mixture and final product were ranged from 74.3±1.2 to 2.7±0.5 as µmol of trolox equivalent per gram. The satiety index score of breakfast cereal was 184%. The developed breakfast cereal provides a considerable amount of phenolics which possessed antioxidant activity and high satiety index score.

Conclusion: Future studies are warranted to examine the suitability of the product as a substitute breakfast for wellness and management of non-communicable diseases.

Keywords: Antioxidant activity, breakfast cereal, non-communicable diseases, horse gram

Evaluation of the Driving factors Related to Salt Consumption Patterns: A Case Study from the Districts of Anuradhapura & Colombo

NWBAL Udayanga[1], KDBN Tarsha[2], AHMN Chamara[1], LEMCS Sumanaratne[3] and HMLK Herath[2] *

[1]Department of Bio systems Engineering Management, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Sri Lanka [2]Department of Agribusiness Management, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Sri Lanka; [3]Puttalam Salt Limited, Kalpitiya Road, Palavi, Puttalam, Sri Lanka

Background: Regardless of being a daily consumptive commodity, the consumers concerns on the nutritional quality of salt remains limited, while the loss of sensory pleasure associated with the reduced salt in food remains as the major consideration of the community.

Objective: Therefore, the current study was conducted to evaluate the salt consumption patterns with emphasis on driving factors and incidence of salt related diseases.

Methods: Salt consumption patterns of 200 stratified randomly selected households located in the districts of Anuradhapura and Colombo (100 from each), were evaluated by using a semi structured and pre-tested interviewer administrated questionnaire. The Chi-square test of association was used to investigate the significance in influence of driving factors related to salt consumption patterns within the study population.

Results & Discussion: In both districts, the age group of 21 to 35 years remained prominent accounting for 58% and 52%, in Anuradhapura and Colombo, respectively. The monthly average total salt consumption by a household remained as 844g and 703g, respectively in Anuradhapura and Colombo districts, while daily individual consumption rates remained as 9.37g and 7.82g, respectively, which significantly differed ($p<0.01$) from the WHO prescribed daily per capita consumption of salt (5.00 g/day/person). Residing locality remained as the only significant driving factor for salt consumption ($p<0.05$), while income, age, gender, education level and religion remained non-significant. Interestingly, a significant association between high levels of salt consumption and salt related disease incidence was noted in both communities ($p<0.05$). **Conclusion:** Therefore, the awareness of general public on salt consumption should be more focused to promote safe consumption patterns of salt.

Key words: Salt consumption, Salt related disease incidence, WHO standards

Phenolic content and antioxidant activities of cereals and legume mixed dishes

HMAJ Herath, T Kanthasamy and GAP Chandrasekara
Department of Applied Nutrition, Wayamba University of Sri Lanka, Sri Lanka

Background:Cereal and legume combined dishes are rich with both nutrient and non-nutrient compounds.
Objectives: This study was aimed to determine the phenolic profile of mixed dishes prepared using different cereal and legume combinations and different food processing methods.
Methodology:Different dishes were prepared as Mungbean+ parboiled rice, Cowpea+ parboiled rice, Mungbean milk rice, Cowpea milk rice, Mung bean added pittu and Cowpea added pittu using Cowpea Varuni (*Vigna unguiculata)* Green gram Ari (*Vigna radiate*) and BG 358 variety. The soluble and bound phenolic contents of the dishes were extracted and total phenolic content (TPC) and total flavonoid content (TFC) were determined. Antioxidant activity (AOA) were determined using ferrous ion chelating activity (FICA), DPPH (2,2-dipenyl1-1-picrylhdrazil) and radical scavenging activity (DRSA).
Results & Discussion: The results showed that pittu varieties contain higher TPC, TFC and AOA. Further Cowpea pittu exhibited the highest TPC than other foods prepared using Cowpea, revealing the potency of steaming method in retaining more phenolics than open boiling (Table).
Phenolic content and the AOA of the prepared mixed dishes based on sensory analysis.

Diet	Soluble phenolics			Bound phenolics		
	TPC	TFC	DRSA	TPC	TFC	DRSA
Mungbean+parboiled rice (2*:1)	10.52±0.01^{a}	1.25±0.21^{a}	2.78±0.4^{a}	1.35±0.37^{a}	1.56±0.0^{a}	0.267±0.08^{a}
Cowpea+parboiled rice (3*:2)	10.91±0.13^{a}	1.80±0.23^{b}	2.98±0.7^{a}	0.98±0.09^{b}	0.51±0.17^{b}	0.163±0.07^{b}
Mung milk rice (3*:2)	10.64±0.76^{a}	5.76±0.39^{c}	3.34±0.29^{b}	0.69±0.08^{b}	1.68±0.00^{a}	0.148±0.02^{b}
Cowpea milk rice(3*:2)	9.65±0.46^{b}	6.05±0.35^{d}	2.91±0.26^{a}	0.26±0.06^{c}	2.62±0.17^{c}	0.087±0.03^{c}
Mung bean *pittu*(1*:4)	13.32±0.70^{c}	5.37±0.09^{e}	4.17±0.29^{c}	1.48±0.30^{d}	4.15±0.77^{d}	0.263±0.03^{a}
Cowpea *pittu*(3*:1)	12.37±0.56^{d}	6.10±0.78^{d}	3.64±0.52^{d}	1.03±0.18^{b}	3.21±0.55^{e}	0.286±0.06^{a}

Represent the ratio of rice used for the food preparation; Different letters in each column represent the mean differences among the different dishes($P<0.05$) using one way ANOVA with multiple comparisons. TPC –Micromoles of ferulic acid equivalents/g of dry matter, TFC - Micromoles of catechin equivalents/g of dry matter, DRSA- Micromoles of trolox equivalents/g of dry matter.

Conclusion: Legume variety and food preparation methods are important determinants of the phenolic profile of the prepared dishes.

Keywords: Cowpea, Mung beans, Rice, TPC, TFC

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Poster Communications

Relationship between nutritional status and educational performance of grade 04 and 05 students of selected rural schools of Batticaloa educational zone

WMAT Veenavi, KAIK Kumari, TDN Madushika, KBWPP Widanage, S Sujendran and K Karthijekan*

Department of Supplementary Health Sciences, Faculty of Health-Care Sciences, Eastern University, Sri Lanka

Background: Nutrition supposed to directly impact on children education. Less research attempts have been taken to determine the relationship between nutritional status and educational performances of preadolescent in Sri Lanka, especially in Batticaloa.

Objectives: The present study aims to identify the relationship between nutritional status and educational performance among grade four and five students of the selected rural schools of Batticaloa educational zone.

Methods: A sample of 200 students including 109 females and 91 males from selected 10 rural schools in Batticaloa educational zone was selected by using simple random sampling technique. A pre-tested interviewer administered questionnaire assessed the socio-demographic characters. Chi-squire test was used to find out the association between selected variables.

TResults &Discussion: By measuring height and weight using standard methods, indicators such as Height-for-Age Z score (HAZ), weight-for-Age Z score (WAZ) and Body Mass Index-for-Age Z score (BAZ) were assessed and stunting, underweight and thinness were determined to indicate nutritional status. Mathematics, Language, English, Religion marks and overall subject average marks in 2nd term test were used to determine educational performance of children. The prevalence of underweight, stunting and thinness of the study sample were 10.3%, 14.8% and 37.6% respectively. The prevalence of thinness was higher in males than females. There was no any significant association between average marks and WAZ, HAZ score and BAZ.

Conclusion: It shows that thinness is highly prevalent and educational performance was not depend on the nutritional status of children in selected rural schools in Batticaloa educational zone.

Keywords: Nutritional Status, Educational performance, School children, Rural schools, Batticaloa educational zone

This study was approved by the Ethics Review Committee, Faculty of Health-Care Sciences, Eastern University, Sri Lanka. It was conducted by self-funding of the authors.

Adherence to Food based dietary guidelines by adults

AR Monisha and AMNT Adikari
Department of Applied Nutrition, , Wayamba University of Sri Lanka, Sri Lanka

Background: Preventing diet related non-communicable diseases in adults are useful to development of the country through people with healthy nutritional status. It is essential to evaluate the effectiveness of the food based dietary guidelines issued by the Ministry of Health for Sri Lankan.

Objectives:This study aimed to assess the adherence to food based dietary guidelines by healthy adults aged between 20-55 years.

Methodology:A cross sectional study followed by stratified random sampling method was used and it was conducted in Jaffna, Vavuniya, Batticaloa and Ampara districts. A total of 150 adults (males=63 and females=87) were recruited. A pre-tested, interviewer-administrated questionnaire that includes questions on food based dietary guidelines was used to collect information. A food frequency questionnaire, includes 106 food items was used to gather information regarding food consumption frequency and patterns of adults. The average consumed servings of foods from each food-groups were calculated and compared with recommended servings. Adherence to guidelines was measured by using 8-dietary recommendations (scale: 0–8; ≤4: non-adherence and ≥5: adherence).

Results & Discussion: The mean age of the study sample was 32(SD 6) years. Only 18% of the study sample adhered to all food based dietary guidelines while the lowest adherence was obtained for guidelines on fruits and vegetables consumption.

Conclusion: Awareness programs on importance of having balanced diets are essential for healthy life of the studied adults.

Keywords: Adherence, adults, food-based-dietary guidelines, food frequency questionnaire, non-communicable diseases

Demographic profile of the diabetic patients and their impact on blood glucose levels and sexual health

SG Sukhjindar, N Sahni, V Kumar, SK Bhadada, A Singh, S Malhotra and AK Mandal

Department of Dietetics, PGIMER, Chandigarh; Department of Food Technology & Nutrition, LPU, Punjab; Department of Endocrinology, PGIMER, Chandigarh; Department of Community Medicine, PGIMER, Chandigarh; Department of Dietetics, PGIMER, Chandigarh;Department of Urology, PGIEMR, Chandigarh, India

Background: Diabetes mellitus patient's number is increasing and has become a major cause of mortality and morbidity all over the world. Sexual dysfunction in diabetic patients is more than 50 percent or three fold increased risk than normal person.

Objective: To analyse demographic profile and its relation to blood glucose levels and sexual dysfunction in Type 2 diabetic male patients.

Method: Questionnaire cum interview methods were used. A total of 282 diabetic patients were enrolled, age ranging from 25-60 years. Their blood glucose reports data taken and International Index of Erectile Function (IIEF) questionnaire filled to check their sexual dysfunction.

Results: A total of 282 patient's data was analyzed, maximum 30.5 percent (n=86) were matric level education and 25.3 percent (n=71) were graduate, middle level 14.5 percent (n=41), 12th level 12.1 percent (n=34), primary level 11.7 percent (n=34) and above and 6 percent (n=17) were illiterate. Maximum 91.5 percent (n=258) were employed & 8.5 percent (n=24) unemployed. 61.7 percent (n=174) were from low income group and 38.3 percent (n=108) from high income group. 63.1 percent (n=178) were physically active and remain 36.9 percent (n=104) physically inactive.

Conclusion: It was concluded that the Type 2 adult male diabetic older age groups patients with higher education level, government working group, high income group and physical active patients have better control over their blood glucose levels. Younger age group patients with higher education, private job working group, higher income and moderate active have better sexual health (high IIEF score).

Keywords: Diabetes mellitus, Fasting Blood Glucose, HbA1c, Postprandial Blood Glucose, Sexual health.

Dietary intake pattern and assessment of mineral intake in urolithiasis patients

M Sunita[1], KD Sudheer[2]

[1] Department of Dietetics, PGIMER, Chandigarh-160036, India; [2] Department of Urology, PGIMER, Chandigarh-160036, India

Background: Dietary factors play an important role in the formation of kidney stones. Diet is the key to many of the factors thought to promote and inhibit the process of kidney stone formation and alter urinary composition. Calcium oxalate is the most common constituent of kidney stones.

Objective: The main objective of this study was to assess the patient's habitual dietary pattern to identify the relationship of various minerals in stone formation because the salt forms of oxalate, whether sodium, potassium, calcium or magnesium is likely to affect absorption.

Methods: Enrolled 95 patients from 18-70 y in Advance Urology center of Postgraduate Institute of Medical Education and Research. Demographic, biochemical profile and 24-h dietary recall along with Food Frequency Questionnaire used to assess the dietary pattern.

Results & Discussion: Seventy percent were first time stone formers. Twenty eight percent (28%) had the family history of nephrolithiasis. About half (54%) patients were non vegetarians. The intake of meat and milk products was higher in males than the females. The study revealed that the intake of sodium, calcium, phosphorous and magnesium was higher than the RDA's. Statistical significant difference was observed in the intake of cereals & pulses in females than males. The younger age group (18-34 y) was taking significantly excess amounts of cereals, milk and meat than the other age groups.

Conclusion: Assessment of mineral intake is necessary for kidney stone patients in reducing the risk of prevalence and for further recurrence. A tailored nutritional approach to minimize the patients' lithogenic risk factors is recommended.

Keywords: Calcium oxalate, Dietary factors, Dietary pattern, Minerals, Urolithiasis

Ethical clearance: Ethical permission has been taken; **Funding:** There was no financial support.

Lead mothers as change agents to address malnutrition

SVN Susangi, RK Dela Bandara, and RPM Sandamali
Child Fund Sri Lanka, Nawala, Nugegoda, Sri Lanka

Background: ChildFund Sri Lanka's Lead Mother Program is based on the concept of peer to peer education on positive parenting and is focused on strengthening mothers' engagement in child nutrition and development.

Objectives: The primary focus of the program are to enhance nutrition of children aged 0-5 years, educate and empower mothers and other caregivers to bring about behavioural changes leading to positive health, nutritional and development outcomes of young children.

Methodology; Lead mothers were identified considering being a mother to a child in 0-5 years of age, possessing minimum reading and writing skills and willingness to participate at the programme voluntarily. Altogether 105 Lead mothers formed discussion groups with 5-7 neighboring mothers and a pair of lead mothers were allocated for each group. Eight half a day training sessions were conducted for lead mothers by Nutrition Specialist, Public Health Midwives and Medical Officer Health government professional. The trainings were held once a week. Basic nutrition and hygiene knowledge and skills based on the community nutrition manual were taught during training sessions. The trained lead mothers cascaded the knowledge they gained to mothers in their discussion groups. In addition, lead mothers practiced visiting households in order to monitor the behavioral changes of mothers regarding nutrition and hygiene.

Results & Discussions:Program review findings indicated that lead mothers program has positively contributed to the enhanced knowledge of parents and caregivers resulted in changes in behaviours and attitudes of parents towards food habits and nutrition, parenting behaviours that are detrimental to child development. The mothers reported that purchasing processed and fast food is reduced while engagement in home gardening is significantly improved. Proper hygiene and sanitary practices were maintained at households. After 8 months, 75-80% of the malnourished children (-3SD) had reached proper nutrition status (> -2SD). As the whole training and knowledge cascading process took 8 months to be completed and this procedure has enough time to strongly establish behavioral changes in the community.

Conclusions:According to above findings, it can be concluded that lead mother programme has a great potential of being used as an effective intervention to address children malnutrition in community level.

Keywords: community intervention, mother support groups, nutrition education, behavioral change

Development of nutritionally balanced dietary menus for undergraduates

STK Hikma and AMNT Adikari*
Department of Applied Nutrition, Wayamba University of Sri Lanka, Sri Lanka

Background: Although good nutrition, an adequate and well-balanced diet plays a major role in a healthy life to develop a successful graduate there is no documentary evidence on nutritionally balanced dietary menus for University students in Sri Lanka.
Objectives: Hence, the objective of this study was to develop low-cost nutritionally balanced dietary menus for undergraduates.
Methodology: A preliminary survey was conducted to identify food consumption patterns of undergraduates. A pre-tested self-administered questionnaire, 24-hour dietary recall, direct observation, market survey and key informant interviews were used as data collection techniques. Dietary menus were developed and presented with serving sizes of each menu items to fulfill the recommended dietary intake for young adults. Ten whole-day meal planning were developed and menus for breakfast, lunch, dinner and snacks were given by incorporating low-cost, nutritious foods. Required amount of each cooked menu items portions were determined and prices of each menus were calculated. Nutrient compositions of menus were determined by using Food-Base 2000 software, consists of Sri Lankans' food and recipes' nutrient composition. Finally, a booklet was developed compiling low-cost nutritionally balanced dietary menus. The booklet was pre-tested among 20 undergraduates to check the acceptance of developed menus by the target group.
Results & Discussion: Majority of the students obtained their foods from the University canteen. The nutrient composition of developed menus for whole day confirmed that the adequacy of energy (1800 – 2000 kcal/day) and nutrients (protein 44 – 64 g/day; fat 55 – 70 g/day). The average price of breakfast, lunch, dinner and snack menus were 45, 60, 57 and 24 LKR respectively.
Conclusion:The developed menus may be helpful to choose low-cost nutritionally balanced foods for the undergraduates.

Keywords: Dietary menus, Low-cost, Meal planning, Nutritionally-balanced, Undergraduates

Comparison of food consumption patterns between households with and without patients of Chronic Kidney Disease (CKD)

GAP Chandrasekara and GGKHS Gunasena
Department of Applied nutrition, Wayamba University of Sri Lanka, Sri Lanka

Background:Diet plays a pivotal role in the progression of chronic kidney disease (CKD). CKD of unknown etiology (CKDU) is an emerging health problem in several geographical areas in Sri Lanka.
Objectives: The purpose of this study was to examine the difference of food consumption patterns between CKDU and non-CKDU households.
Methodology:The study included 50 households with CKDU patients and 50 control households those free of CKDU patients. Dietary intake pattern and nutrient intake of individuals of those households were determined using 24 hour dietary recall and food inventory method. Consumption of different food groups of CKDU households were compared with non- CKDU households.
Results & Discussion: Results of food inventory method showed that there was no difference in consumption of food groups between CKDU and control households except consumption of yams and tubers ($p< 0.05$) and pulses ($p<0.05$). However, results from 24 recalls indicated significant differences in energy percentage obtained from fat, saturated fat and carbohydrate between two groups. The significant differences were not obtained for total energy intake, percentage energy from protein and added sugars between CKDU and non CKDU households.
Table - Mean consumption of selected food groups between CKDU and non CKDU groups

	Mean consumption		
Food groups	**CKDU** (n=50)	**Non CKDU** (n=50)	**P value**
Cereal (g)	351.35 ± 101.41	373.20 ± 102.16	0.283
Roots and tubers (g)	27.80 ± 19.12	19.48 ± 10.89	0.008
Pulses (g)	42.74 ± 23.14	57.09 ± 26.92	0.005
Non starchy vegetables (g)	126.69 ± 87.61	102.76 ± 32.68	0.071
Green leafy vegetables (g)	22.19 ± 12.04	24.79 ± 12.47	0.289
Fruits (g)	32.81 ± 34.64	33.40 ± 20.42	0.917

Conclusion:Irrespective of the CKDU condition, nutrient intake and food consumption pattern shows a similar trend in both groups. Further studies on other components in the diet such as water, is warranted to see an association of diet with CKDU.

Keywords- Dietary recall, Food inventory method, Ginnoruwa, Nutrient intake
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Evaluation of the Consumer Perceptions on the Quality of Salt in the Districts of Anuradhapura and Colombo

KDBN Tarsha[1], AHMN Chamara[2], NWBAL Udayanga[2], LEMCS Sumanaratne[3], and HMLK Herath[1]

[1]Department of Agribusiness Management, Faculty of Agriculture and Plantation Management; [2] Department of Biosystems Engineering Management, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka,Makandura, Gonawila (NWP), Sri Lanka;[3]Puttalam Salt Limited, Kalpitiya Road, Palavi, Puttalam, Sri Lanka

Background: Salt remains as an everyday commodity, which is more focused for its sensory pleasure rather than its nutritional value. Quality or the fitness for use of salt has remained a less focused topic in Sri Lanka and especially the consumer perspectives on the quality of salt have never been studied.

Objective: Hence, the current study aimed to evaluate the consumer perceptions on the quality of salt in the districts of Anuradhapura and Colombo.

Methods: Public knowledge and perceptions in quality parameters of salt, focusing on eleven physical, chemical and marketing attributes, were gathered from 200 stratified randomly selected households located in the districts of Anuradhapura and Colombo (100 from each), by a pre-tested semi structured questionnaire survey. Ordinal logistic regression (OLR) was used to determine the factors that affect the consumer perception on different quality characteristics of salt.

Results and Discussion: Physical attributes such as colour of salt (> 80%), particle size (>65%) were dominant predictors of quality along with the iodine content (>85%) as the only chemical parameter. Further, few marketing attributes namely, certification, brand name, proper labeling and proper packaging also emerged as important quality parameters that influence the purchase decision making of salt. As depicted by OLR, region and income level significantly affected the priority on chemical attributes, while regardless of the region and other covariates, only the quality parameters are more valued in terms of market and physical attributes (at 95% confidence level).

Conclusion: Therefore, a disparity between the quality parameters defined by the producers and the consumers is revealed, which should be taken up and used to redefine the quality definitions of salt.

Keywords: Consumer perceptions, Quality parameters, Salt quality

Antioxidant properties of horse gram and cereal mixed porridges

MM Dissanayaka, HMAJ Herath, and GAP Chandrasekara
Department of Applied Nutrition, Wayamba University of Sri Lanka, Sri Lanka

Background: Horse gram has been recognized as an underutilized legume in tropical countries. Combination of cereals and legumes are known to give health benefits due to their antioxidant profile.

Objectives: The present study was aimed to determine antioxidant activity (AOA) of horse gram and cereal mixed porridges.

Methods: Four different porridges were prepared by mixing horse gram with finger millet (M1HP), foxtail millet (M2HP), proso millet (M3HP) and red rice AT- 311 (R1HP) based on ingredient ratio of legumes to cereal as 3:1. Soluble phenolics of cooked porridges and corresponding raw flour mixtures were used for the analysis. Total phenolic content (TPC) and total flavonoid content (TFC) were determined. AOA was measured using DPPH (2,2-dipenyl 1-1-picrylhdrazil) radical scavenging activity (DRSA) and reducing power (RP).

Results & Discussion: The soluble phenolic content and AOA were generally higher for porridge prepared with horse gram and red rice compared to other cereals (Table).

Table: TPC, TFC, RP and DRSA (per g of defatted meal) of cooked porridges

Porridge	TPC µmol ferulic acid eq	TFC µmol catechin eq	DPPH µmol trolox eq	RP µmol ascorbic acid eq
M1HP	$50.35^{a} \pm 0.5$	$40.63^{a} \pm 0.6$	$12.15^{a} \pm 0.6$	$20.60^{a} \pm 0.1$
M2HP	$38.98^{b} \pm 0.5$	$37.80^{b} \pm 0.6$	$16.27^{b} \pm 0.8$	$18.77^{b} \pm 0.5$
M3HP	$43.41^{c} \pm 2.3$	$31.59^{c} \pm 0.4$	$10.18^{c} \pm 1.5$	$19.60^{ab} \pm 0.7$
R1HP	$51.06^{d} \pm 0.5$	$60.73^{d} \pm 0.8$	$15..20^{b} \pm 0.6$	$20.43^{a} \pm 0.6$

Same letters in each column for values are not significantly different (>0.05) by ANOVA

Conclusion: In conclusion, cereal porridges mixed with horse gram have beneficial functional properties which can be utilized in management of the non-communicable disease risk.

Keywords; Finger millet, Foxtail millet, Proso millet, Rice