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Designing of Ready to Eat Convenient Mid - Day Meal for Children and Adolescents of Sri Lanka Based on Nutritional Perspective

ABSTRACT

Aim: To develop ready-to-reconstitute convenient mid-day meals in three categories of chicken, fish and soya, which match to the Sri Lankan local culinary style, with acceptable sensory properties to upgrade the nutritional status of children and adolescents.

Study Design: Those mid-day meals were designed according to the Food Based Dietary Guidelines (FBDG) of Sri Lanka.

Methodology: The ingredients were processed; rice to instant rice, vegetables to dehydrated vegetables and protein source of chicken, fish and soya to pre-cooked sterilized curry pouches.

The convenient mid - day meal packages were prepared using three portions of instant rice containing 10% of green gram flakes, dehydrated vegetables and retorted curry mix respectively. Labeling was performed according to the type of curry mix inserted into the package as Chicken, Fish or Soy mid-day meals. Physico - chemical and sensorial properties of meals were evaluated.

Results: Caloric value of mid-day meals ranged 575 - 640.82 kcal. Protein content of meals ranged from 25.88 g to 32.68g and there was no significant difference (p<0.05) between protein in chicken and fish meals**.** The fat contents and dietary fibre contents were significantly (p<0.05) differed and the highest contents of fat (3.15 g) and dietary fibre (4.40 g) were observed in **c**hicken meal and soy meal respectively. The mineral contents of tested meals were significantly differed (p<0.05) and the significant highest Ca, Fe, K, Fe and P were observed in soya mid –day meal. The highest mean rank scores for all sensory attributes in terms of odour, appearance, texture, taste and overall acceptability were observed in the chicken mid-day meal.

Conclusion: Ready-to-reconstitute mid-day meals in three categories of chicken, fish and soya, which match to the Sri Lankan local culinary style, were developed with acceptable sensory properties.

Key Words: Convenient Mid –Day Meals, Ready to Eat, Children, Adolescents, Healthy diet

1. INTRODUCTION

Nutrition has become a major problem for decades in all vulnerable groups in Sri Lanka. Childhood and adolescence are the crucial stages of life, where major physiological and psychological changes take place. The physical and mental development increases the requirement of macronutrients and micronutrients in children and adolescents [1,2]. These needs are influenced by the rapid cell division occurring during growth, which requires protein, energy,

and nutrients involved in DNA synthesis and metabolism of protein, calories, and fat. Higher intakes of protein and energy are recommended in the adolescent population since the physical growth is accelerated [3].

The deficiencies, excesses or imbalances in a person's intake of nutrients cause poor physical health, intellectual impairment, delays in reaching milestones, frequent infections/ disabilities and poor performance at the school [3]. Moreover, nutritional problems during early life have a great influence on health in adults [4]. For instance, increasing prevalence of non-communicable diseases (NCD) such as cardio vascular disease, diabetes, non-alcoholic fatty liver disease, gallstones, kidney diseases and cancers has become a major issue in the country which is one of the main causes of deaths. Furthermore, reduced IQ, reduced work capacity and higher risk of poor pregnancy outcomes will take place as a result of insufficient nutritional intakes in early ages [4].

In Sri Lanka, the most prevalent malnutrition issues are the protein-energy malnutrition (PEM), vitamin A deficiency, iron deficiency, overweight and obesity [5,6,7]. Prevalence trends of thinness, overweight and obesity in children and adolescents aged 5–19 years within the period of 2000 to 2016 were gathered in Country Nutrition Profiles Sri Lanka [8]. It showed that overweight and obesity has increased among both girls and boys and predicted further increment. However, thinness showed decreasing trend from 18.4% to 16.6% among boys while increased slightly among girls (12.4%-13.4%). Earlier, the adolescents aged 10 to 15 years showed high prevalence of underweight (47.2%) and stunting (28.5%) and anemia (11.1%) and a low prevalence of overweight (2.2%), and vitamin A deficiency (0.4%) [9]. Moreover, it was reported that, the prevalence of stunting and underweight was significantly higher (p>0.05) among students from rural schools than urban schools (stunting: 14.8% urban, 30.7% rural;

underweight: 35.8% urban, 49.0% rural) and further urban students were overweight than the rural students (5.3% vs. 1.7%). However, the prevalence of anemia among children from rural and urban schools were not significantly different (11.2% and 10.0%) [9].

Since the current lifestyle has basically changed with eating habits, school children are facing many adverse health-related matters led by nutrient deficient diets. Although maintaining a balanced, nutritious diet is essential, socio-economical and higher academic expectations have created a complex environment which often pushes the children and adolescents towards junk foods and unhealthy snacks during school time and after school activities. Further, teenagers find freedom to make their own decisions on food and heavily influenced by the peers. Unfortunately, they consider convenience, attractiveness, taste and appreciate slim feminine figure especially in girls rather than the healthiness. To aid this situation, a ready-to-reconstitute nutritional instant meal, which matches the local culinary fashion was developed aiming school children. The concept of ready to eat food i.e. instant food product is newly developed concept which is the result of the modern urbanization.

2. MATERIALS AND METHODS

2.1 Materials

Rice (samba), green gram, vegetables (carrot, pumpkin, wing beans and Ambarella) were purchased from local market. Other food grade ingredients were purchased from Super Market at Malabe. All the chemicals were purchased from Analytical grade unless otherwise specified.

Enzymes

Alpha-Amylase from Bacillus sp. (*Bacillus licheniformis),*EC 232-560-9, Novozymes A/S, a product of Denmark, Sigma Aldrich.

Pepsin from porcine gastric mucosa, EC 232-629-3, product of USA, Sigma Aldrich.

Pancreatin from porcine pancreas, EC 232-468-9, product of USA, Sigma Aldrich.

Standards

Fatty Acid Methyl Esters Standard Mixture: SMB00937, product of USA, Sigma Aldrich.

2.2 Methods

2.2.1 Designing of Mid-Day Meal

The designing of the convenient mid–day meal package was carried out based on the Food Based Dietary Guidelines published by Ministry of Health, Sri Lanka as given in Table 1[10]. This publication is designed to provide guidance for an average Sri Lankan on the consumption of a healthy diet in order to specialize in age groups.

Table 1: Recommended daily servings for children and adolescents in Sri Lanka

Material	Recommended daily servings per day	Recommended daily servings per meal
Cooked rice	6-11 cups (approximately 1000g)	300g
Cooked vegetables	9- 15 table-spoons(approximately 130 g)	45 g
Proteins	90-120g	30-40g

Source; Food Based Dietary Guidelines 2021, Sri Lanka

According to the FBDG Sri Lanka Table 1[10], the recommended daily servings of cooked rice for a healthy person are 6-11 cups (approximately 1000g) per day. Similarly, the recommended daily servings of cooked vegetables for a healthy person are 9-15 table-spoons (approximately 130 g) per day. Therefore the recommended daily servings per meal consists with cooked rice 300g, cooked vegetables 45g and protein source 30g.

The ingredients of the mid-day meal should be consisted of the form of instant preparation with sufficient shelf-life expansion. In the present study, it was designed to be consisted of dry form of instant rice and dehydrated vegetables mix and pre cooked retorted curry mix (i.e. protein

source). Instant rice has been incorporated (10%) with green gram flakes. The amount of instant rice and dehydrated vegetables were evaluated after determining the rehydration ratios.

2.2.2 Preparation of convenient Mid-Day Meal

A convenient mid-day full meal was developed with three types of chicken, fish, and soya. Those meals were consisted with three packs of instant rice, dehydrated vegetables and curry mix.

Portion 1 - Instant rice with green gram flakes pack

A method recommended by a previous reported study [11] was followed for preparation of instant rice. Rice was washed to remove dust and dirt, soaked in excess water at ambient temperature for 20 min. Then, the rice was boiled (at a ratio of rice-to-water 1:.3 w/v) for 12 min in order to completely gelatinize the starch. The rice was washed properly with distilled water to avoid lumps and frozen in sealed polyethylene bags at -18°C for 2 h prior to drying in a hot air oven at 60°C until the moisture content was reduced to 8-10% by weight. After returning to the room temperature the rice was packaged in polypropylene bags for further use.

Green gram were washed and soaked for 6 h. After draining the water, they were roasted in high flame for 7-10 min until it gave a pleasant odour. Then the grains were flaked using a flaking machine and dried in a hot air oven at 60°C for 4h. The flakes were packaged in polypropylene bags for further use.

Portion 2 -Dehydrated vegetable pack

Cleaned edible vegetables of Pumpkins, Carrots, Ambarella were washed, cut into appropriate slices, steam blanched for 2 minutes followed by dipping in 1% cold salt (NaCl) solution for 5 minutes. The dices were then dried in a hot air dehydrator at 60 ± 2°C for 8-10 hours until the texture became tough to brittle [12].

Wing beans cut into thin slices (0.2cm). Then the slices were blanched in hot water with 0.05% magnesium oxide (MgO) for 2.5 min and followed by dipping in 1% cold salt (NaCl) solution for 5 minutes. Then the drained slices were dehydrated at 60 ± 2°C for 5-6 hours until the texture became crisp. The dehydrated slices were then crushed into smaller particles by hand.

Table 2: Summary of the dehydration conditions of vegetables processing

Vegetable	Particle size (cm)	Blanching method	Blanching time (min)	Dehydration time	Final product quality
Carrot	0.5*0.5*0.5	Steam	2	8-10 h	tough to brittle
Pumpkin	0.5*0.5*0.5	Steam	2	8-10 h	tough to brittle
Ambarella	0.5*0.5*0.5	Steam	0	8-10 h	leathery to hard
Wing beans	0.2	Hot water	2.5	5-6 h	crisp

Dehydrated vegetables were mixed in the ratio of 40% carrots, 25% pumpkin, 20% wing beans and 15% Ambarella after few trials and sensory tests.

Portion 3- Curry packs

Curry packs (fish, chicken and soya) were prepared following the Sri Lankan culinary concepts. Among many trials, the curry mixes were chosen on the basis of primary sensory attributes and their physical properties.

Chicken and fish cubes (2.5±2 cm) were marinated in salt and spicy mix for 30 min and stir fried. 1% salt containing hot water (95°C) was added to the soya chunks and squeezed off the excess water. As described in food based dietary guidelines [10], the recommended daily servings of proteins are 90-120g. Therefore, considering per one meal (30±5g) of chicken, fish and soya chunks were separately filled along with 50±5g of previously prepared gravy into the rotatable pouches. After filling, pouches filled with curries were hermetically sealed using chamber type vacuum packaging machine (Model; DZQ 500T/B Vacuum Packer, China).

Vacuum sealed pouches were thermally processed with steam –air retort at Temperature 121 °C, Pressure 1.5 bar in the pre determined time period to obtain the desired commercial sterility. Product core temperature during processing was monitored using pair of thermocouples inserted into core of the product (chicken, fish or soy chunks) to determine the desired process time. The time required for optimum processing was determined based on real time calculated cumulative F_0 value targeting 12D destruction of *Clostridium botulinum* during the thermal processing. Three types of chicken, fish and soya retorted curry mix pouches were prepared and commercial sterility of the curry mixes were tested [13].

The convenient mid - day meal packages were prepared using three portions of instant rice containing 10% green gram, dehydrated vegetables and retorted curry mix. Labelling was performed according to the type of curry mix inserted into the package as Chicken, Fish or Soy mid-day meals.

2.2.3 Sensory evaluation

A convenient mid-day full meal developed in three types of chicken, fish, and soya was subjected to a sensory evaluation trial to select the most preferable meal. Sensory evaluation trials were conducted by using twelve trained panellists and the samples were evaluated in terms of colour, odour, appearance, texture, taste, aftertaste, and overall acceptability using the nine point hedonic scale. Since a commercial available convenient mid meal package with Sri Lankan taste is not available in local market a control sample was not used in the sensory test.

2.2.4 Determination of physical properties of convenient mid - day meal

The instant rice and vegetables pack was tested for rehydration ratio and water activity.

2.2.4.1 Determination of water activity ($a_{w)}$

The a_w of the instant rice was determined as operation instructions given in a water activity meter (Model: *Aqua Lab*4TE, USA).

2.2.4.2 Determination of Rehydration Ratio

A100 mL of water at 95°C were added to 10 g of instant rice samples and kept for 5, 10 and 15 min for rehydration. Excess water was drained away and the samples were weighed. Rehydration ratio was calculated using the following equation [11].

$$ReHydration\ ratio = \frac{WeigHt\ of\ instant\ rice\ after\ absorption\ of\ water\ (g)}{Initial\ dry\ weigHt\ (g)}$$

2.2.5 Determination of chemical properties of convenient Mid - Day Meal

2.2.5.1Proximate composition analysis

The proximate composition of the Mid-Day Meal package was determined according to the AOAC methods [14]: moisture content based on the weight loss after the sample was heated in an oven at 105 °C; ash content by incineration in muffle furnace at 550 °C; protein content by total nitrogen, using Kjeldahl method, considering conversion factor of % N x 6.25; fat content by Soxtherm method. Total dietary fiber was determined by enzymatic–gravimetric method [15]. The available carbohydrate content of the samples was calculated by difference (subtracting summation of moisture, ash, protein, fat, and dietary fiber by value of 100) [16].

Data were means of triplicates and were expressed as g/100 g.

2.2.5.2 Determination of fatty acid profile

Fatty acids were analysed as method described by AOAC 2001 (996.06) [17].

The extracted fat was trans-esterified using 2 mol/L methonolic KOH to form fatty acid methyl esters (FAME). Fatty acids were estimated by GC (Model: 7890B of Agilent Technologies with 7693 Auto sampler, equipped with flame ionization detector and split injector).

2.2.5.3 Determination of mineral content

Detection of mineral content was carried out by microwave digestion followed ICP-MS method of AOAC 2012 (999.10) [14].

2.2.6 Statistical Analysis

Results were statistically analyzed by using SPSS computer software; SPSS, 2000 [18]. The calculations carried out by using one way analysis of variance ANOVA and significant differences among the various score were established at 95% confident level. Mean separation was carried out using Tukey HSD_{α} test. Sensory analysis of mid-day meals were carried out using Kruskal Wallis Test.

3. RESULTS AND DISCUSSION

3.1 Ready to eat meals

The most of the ready-to-reconstitute foods normally popular among the South-East Asia region is the breakfast meals. They are in dry forms and needed to be reconstituted with milk or water before consumption. There were reported studies on instant breakfast meals [19, 20]. Further a ready-to-reconstitute protein rich instant poha (beaten rice) – a traditional Indian breakfast was reported using groundnut, moth beans and seasoning ingredients [21]. Paradhi had reported on the development of instant sprout meal on processes of soaking, germination, dehydration and rehydration [22]. Since the most of the children and adolescents are not obtaining mid - day meals from home due to the complex environment, three types of convenient mid-day meals with Sri Lankan style were designed.

The reported studies on preparation of mid - day meals were rare and further detailed nutritional quality evaluation was not reported. There was a reported study described five types of ready to eat meals, that were prepared using potatoes, potatoes with chicken fillet, potatoes with

amaranth, potatoes with quinoa and potatoes with bulgur using thermal processing (at 120 ± 0.5 C^o for 10 minutes) followed by evaluation of fibre content, moisture and hardness [23]. Another research was reported at Bangladesh that development of an instant food product in powder form (Nutri-mash) from plant sources which would be a nutritionally low cost balanced diet for all the categories of people of the society containing potato, legumes, vegetables and spices [24].

3.2 Designing of mid - day meal

Since presently, the most of the children and adolescents are not gaining a proper nutritious mid-day meal, the designing of the convenient mid –day meal package was carried out based on the Food Based Dietary Guidelines published by the Ministry of Health, Sri Lanka as given in Table 1[10]. Selection of raw materials was carried out considering the consumer perspectives, nutrient values, local availability and cost of materials.

The main characteristic of the meal package is all the ingredients were properly pre-processed and reconstituted within 5 min with boiling water except curry mix which could be directly consumed. Curry mix in three forms of chicken, fish and soya beans were prepared in a way of Sri Lankan culinary fashions and packed in retort pouches followed by retort sterilization technique on ready to serve concept. Those curries could be directly used without any prior preparations.

The dry form of instant rice and dehydrated vegetables were separately packed considering their rehydration ratios as given in Table 2. Instant rice was processed to reconstitute into normal cooked rice within 5 min while reconstitution of dehydrated vegetables also in compatible to reconstitute in the same time period. The rehydration ratio of instant rice and vegetable mix was determined and results were given in Table 3.

Table 3: Physical properties of instant rice and dehydrated vegetable pack

Component	Moisture	Water Activity (a_w)	Rehydration ratio
Instant rice and flakes mix	6.92 ± 0.26 %	0.3601±0.2	1:3 (w/v)
Dehydrated vegetable pack	10.98 ± 0.51%	0.4365±0.3	1:2 (w/v)

Results were given in mean ± SD of triplicate samples

Instant mid- day full meal was prepared according amounts given in Table 4. In considering the rehydration ratio of instant rice (1:3), 100g of instant rice containing 10g of dehydrated green gram flakes were packed in Poly Propylene bags. Similarly considering the rehydration ratio of dehydrated vegetables (1:2), 22.5 g of vegetable mix was packed in metalized film pouches. A pack of retort pouch containing chicken, fish or soya chunks (30 ± 5g) and gravy (50 ± 5g) mix was directly included to the mid - day meal package together with instant rice and vegetable pack.

Table 4: The main portions in the mid-day meal per serving

Component	Weights
Rice and green gram pack	100 g
Curry pack	80 g
Vegetables pack	22.5 g
Water	250 ml (1 cup)
Total weight	**452.5g**



Figure 1: Ready to Serve Mid-Day Meals with three portions

3.3 Commercial sterilization of curry packs

Since *Clostridium botulinum* is the most critical microorganism in planning of commercial sterility of thermally processed of low acid canned foods, 121.1°C was selected as the reference temperature while z = 10 °C and D = 0.21 minutes for the determination of thermal process time of selected products. The thermal process time required to achieve 12D destruction (F0=2.5 min) of the target microorganism was determined by calculating the cumulative F_0 value in each thirty second. According to the Commercial sterility of low acid and acid canned foods SLS 516, part 10 [13], those products are commercially sterile where all pathogenic and spoilage organisms including both vegetative and their non-vegetative spores that can grow in food under normal storage and handling conditions are destructed.

3.4 Compositional analysis of mid - day meals

3.4.1 Proximate composition

The proximate analysis of mid - day meals of chicken, fish and soya were presented in Table 5. Moisture contents of mid - day meals (per serving) were ranged from 273.44 to 291.63 g. The protein contents of meals were ranged from 25.88g to 32.68g and the significantly lowest (p<0.05) protein content was observed in soy mid-day meal. Further there was no significant different (p<0.05) between in protein content of chicken mid-day meal and fish mid-day meal**.** The fat contents of mid- day meals were significantly (p<0.05) differed and the highest fat content (3.15 g) was observed in **c**hicken mid- day meal. A significant difference was not observed in ash contents between meals. Dietary fibre contents of meals were significantly (p<0.05) differed and the highest dietary fibre content was observed in soy mid- day meal (4.40 g). It may be due to the

curry mix of soya containing plant materials of extruded soya beans and it contributes to the enhancement of dietary fibre content in the meal. Fish and chicken, since they are not coming under the plant sources, will not contribute to the dietary fibre. Available carbohydrate contents of the meals were significantly (p<0.05) differed. Among three meals chicken and rice meals showed the highest energy content.

Table 5: Proximate composition of the mid-day meals

Parameters	Chicken mid-day meal		Fish mid-day meal		Soy mid-day meal	
	Per 100g	Per serving (g)	Per 100g	Per serving (g)	Per 100g	Per serving (g)
Energy (Kcal)	146.47	640.82	131.43	575.00	145.54	636.73
Moisture (g)	63.16±0.21^{a}	276.33	66.66±0.13^{b}	291.63	62.50±0.46^{a}	273.44
Crude protein (g)	7.47±0.23^{b}	32.68	7.11±0.04^{b}	31.09	5.91±0.17^{a}	25.88
Crude fat (g)	0.72±0.01^{c}	3.15	0.39±0.01^{a}	1.73	0.53±0.05^{b}	2.31
Ash (g)	0.70±0.22^{a}	3.66	0.72±0.13^{a}	3.14	0.77±0.15^{a}	3.36
Dietary fiber (g)	0.65±0.2^{a}	2.86	0.68±0.2^{a}	2.99	1.01±0.2^{b}	4.40
Available Carbohydrates(g)	27.53±0.65^{b}	120.43	24.86±0.46^{a}	108.76	29.28±0.42^{c}	128.11

Values of meals were given in mean ± SD of triplicate samples. Serving size: 452.5g

Values with same letters are not significantly different.

3.4.2 Fatty acid profiles

Fatty acid profiles of mid - day meals in terms of saturated, mono unsaturated and poly unsaturated fatty acids were presented in Table 6. The fatty acid contents of all meals were significantly differed and the significant highest saturated, mono unsaturated and poly unsaturated fatty acids were observed in chicken mid day meal. All three meals showed the lesser amount of poly unsaturated fatty acids than mono and saturated fatty acids.

Table 6: Fatty acid profile of meals

Parameters	Chicken mid-day meal		Fish mid-day meal		Soy mid-day meal	
	Per 100g	Per serving	Per 100g	Per serving	Per 100g	Per serving
Saturated fat (g)	0.29±0.00[c]	1.15	0.16±0.01[a]	0.64	0.23±0.03[b]	0.90
Mono unsat. Fat(g)	0.32±0.00[c]	1.23	0.18±0.00[a]	0.68	0.22±0.03[b]	0.85
Poly unsat. Fat (g)	0.09±0.00[c]	0.38	0.06±0.00[a]	0.23	0.08±0.00[b]	0.32

Percentage values of meals were given in mean ± SD of triplicate samples. Serving size: 452.5g

Values with different letters in the raw are significantly different

3.4.3 Mineral contents

Mineral contents of mid-day meals in terms Ca, Mg, Fe, Zn, K and Na were presented in Table 7.

Table 7: Mineral composition of mid - day meals

Micro nutrients	Chicken mid-day meal		Fish mid-day meal		Soy mid-day meal	
	mg/100g	Per serving (mg)	mg/100g	Per serving (mg)	mg/100g	Per serving (mg)
Ca	13.6±0.00[a]	59.4	11.0±0.00[a]	48.1	29.75±0.00[b]	127.75
Mg	12.7±0.00[a]	55.8	22.7±0.02[c]	99.4	18.67±0.00[b]	82.41
Fe	0.5±0.0[a]	2.4	0.3±0.00[a]	1.3	1.36±0.00[b]	6.12
Zn	0.8±0.00[a]	3.7	0.8±0.00[a]	3.3	0.84±0.00[a]	3.71
K	101.5±0.20[b]	444.0	91.9±0.20[a]	401.9	139.84±0.00[c]	609.665
Na	45.1±0.10[b]	197.4	74.8±0.10[c]	327.4	27.96±0.00[a]	122.629
P	59.2±0.20[b]	259.2	44.4±0.00[a]	194.1	76.53±0.00[c]	334.82

Percentage values of meals were given in mean ± SD of triplicate samples. Serving size: 452.5g

Values with same letters are not significantly different

The mineral contents of all tested meals were significantly differed and the significant highest contents of minerals of Ca, Fe, K and P were observed in soya mid –day meal. There was no significant different in Zn contents among the meals while Na content is highest in Fish mid-day

meals. In the preparation of curry mix 30 ± 5g of fish or chicken or soaked and drained extruded soya was used as ingredients. Since the moisture content of extruded soya is lesser than fish and chicken, the dry weight of the soy content is high in soya mid-day meal and thereby the mineral content of the soy meal showed higher values than other meals. Further, plant source of soya beans contributed to higher mineral content than the fish and chicken meals.

3.5 Sensory evaluation of products

Three types of chicken, fish and soy convenient mid - day meals were evaluated for sensory attributes of odour, appearance, texture, taste and overall acceptability according to the nine point hedonic scale. Results of the mean rank scores from sensory evaluation trial were presented in Table 8 which was further illustrated in the radar chart (Figure 2). It was seen that the chicken mid-day meal had the highest mean rank scores for all sensory attributes while soy mid-day meal had the lowest mean rank scores. However significant differences ($p<0.05$) were not observed in each parameter among the meals. All the parameters were not significantly varied with respect to type of meal. This observation of insignificance of sensory attributes of meals may be due to the flavour attributes given by the gravy of the curry mix where it was same formula to all the meals. Meals give the characteristic flavour and taste with respect to the gravy.

Table 8: Mean rank scores for the convenient mid-day meals

Type of meal	Appearance	Colour	Texture of Rice	Texture of Chunks	Odour	Taste	Overall Acceptance
Chicken	10.67	10.67	10.25	11.00	10.50	11.25	12.67
Fish	10.25	9.25	9.42	9.00	8.08	9.50	8.67
Soy	7.58	8.58	8.83	8.50	9.92	7.75	7.17

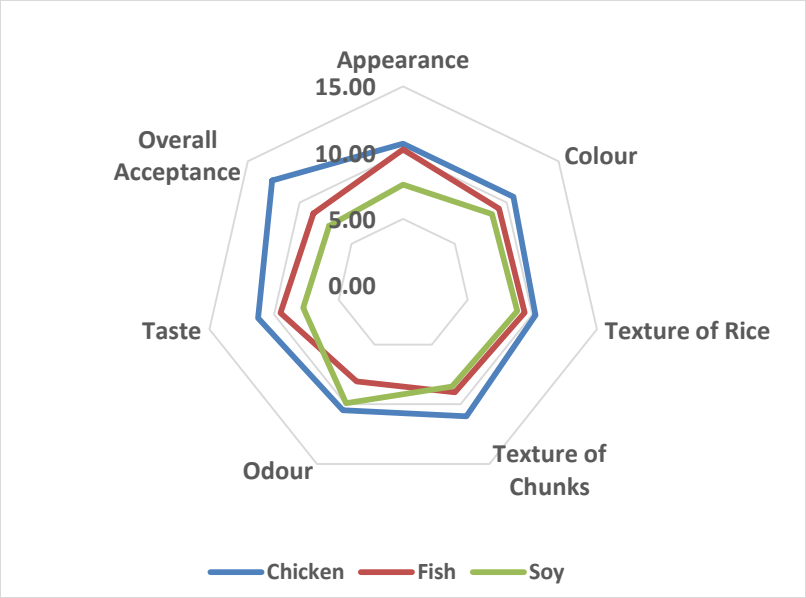

Figure 2: Radar chart of variations of sensory attributes of three types of mid-day meals.

3.6 Comparison of mid-day meals with Recommended Dietary Allowances (RDA) for Sri Lankan Young children and Adolescents

According to the data published by Department of Nutrition, Medical Research Institute, Colombo in 2007, the average vales of Recommended Dietary Allowances (RDA) for Sri Lankan young children at the age of 6-11 yrs and adolescents at the age of 12-18 yrs were presented in Table 9 [25]. Further the mean values obtained from the composition analysis of protein, calcium, iron, zinc and magnesium in prepared mid-day meals were presented in Table 9.

Table 9: Comparison of mid -day meals with Recommended Dietary Allowances (RDA)

	Energy (kCal)	Protein (g)	Calcium (mg)	Iron (mg)	Zinc (mg)	Magnesium (mg)
AVG RDA*	1963	42	850	19	7	163
AVG RDA**	2788	67	1000	36	8	225
Chicken mid-	640.82	32.68	59.4	2.4	3.7	55.8

day meal							
Fish meal	mid-day	575.00	31.10	48.1	1.3	3.3	99.4
Soya meal	mid-day	636.73	25.88	127.75	6.12	3.71	82.41

*Recommended Dietary Allowances for Sri Lankan Young children at age of 6-11 Yrs (RDA, 2007)

**Recommended Dietary Allowances for Sri Lankan Adolescents at age of 12-18 Yrs (RDA, 2007)

In considering the caloric values of the three types of meals, it was ranging from 575.00 - 640.82 Kcal and those meals provide approx. 1/3 of energy contributions to the RDA for young children (1963 kcal) while approximately 1/4 -1/5 of energy contributing to the RDA value for adolescents (2788 kcal). Energy contribution to RDA from chicken mid-day meal is higher than other meals. More than half of the protein requirement to RDA for young children (42 g) will be fulfilled by all three meals while less than half of the protein requirement to RDA for adolescent (67 g) will be fulfilled by all meals.

The highest contributions to the RDA value for calcium, iron and zinc will be contributed by soya mid-day meal. The contribution of calcium to the RDA will be approx. 1/6 for young children while and 1/8 for adolescents respectively from soya meal. As well as the contribution of iron to the RDA value made by soy meal will be 1/3 and 1/6 for young children and adolescents respectively. Chicken, fish and soy meals were shown the same zinc contents and contributions made were in the similar portions. Results further showed that soy and fish both meals were contributing more or less similar contribution to RDA value for manganese while chicken meals contributing less value.

4. CONCLUSION

Ready-to-reconstitute instant mid-day meals in three categories of chicken, fish and soya, which match to the Sri Lankan local culinary style, were developed with acceptable sensory properties. Those mid-day meals were designed according to the Food Based Dietary Guidelines (FBDG) of Sri Lanka, with special guidance to children and adolescents.

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COMPETING INTEREST

Authors have declared that no competing interests exist.

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