

# NUTRITIOUS, LOW COST, ATTRACTIVE MENUS FOR SCHOOL CHILDREN

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**Abstract:** School going age is one of the best stages of life cycle to cultivate good dietary habits. Nowadays children have fewer opportunities to get nutritionally balance meals at school canteen and it may affect their nutritional status. Hence improving the quality of food in school canteens is important. To address this issue, this study was carried out to develop nutritious, low cost menus for school children.

Food policy for school in Sri Lanka was reviewed and existing food menus were analysed. Five new menus were developed by modifying available menus and incorporating nutritious, locally available food ingredients. Hundred grams of developed menus contained energy and macro nutrients were analysed by using food composition database and Nutrient Quality Index (NQI) scores. One serving was considered as 200kcal energy giving portion of each menu. Acceptance of the developed menus by the school children was determined by using food quality measuring scale.

All five developed menus were made with low cost locally available ingredients to increase the affordability for the foods. All five menus could be developed with nutrient adequacy for school children according to the nutrient density score. The sensory evaluation result showed that children acceptance for the menus is different and bread pizza was the most acceptable menu.

Since the developed menus for school children are nutritionally balanced and cheap they may appropriate for improving the quality of dietary intake and nutritional status of school children.

**Keywords:** School children, nutritionally balanced, acceptance, low cost, food menus.

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## 1. INTRODUCTION

The school population in Sri Lanka consists of about 4.2 million children of the age group of 5-18 years. Of this about 60% belongs to the adolescent age group of 10-18 years [1]. Nutritional status of the school children has a significant influence over their educational performances.

A survey done by Medical Research Institute (MRI) has revealed that 13.1-20% of the adolescent children are anemic, 8.6-26.2% are stunted and 10.4-22% are wasted [2]. The same survey has shown that 5-10% of the urban children are overweight and one-third (29%) of children (aged 5-10 years) in Sri Lanka suffer from under nutrition [2]. These nutritional problems unless addressed during the adolescent period will result in malnourished mothers and low birth weight infants and a high incidence of non communicable diseases in the future generation including overweight, developing weak bones, and developing diabetes [3].

Due to socio economic condition prevailing in Sri Lanka, many parents used to give junk foods to their children who are in a hurry to go to school. Because junk foods are easy options for parents for their children, Public Health Forum (PHF) of the college of community physicians of Sri Lanka understood that changing such a pattern instantly is likely to be practically impossible and most importantly doing it without giving proper option may create a lot of practical issues. Therefore PHF of the college of community physicians of Sri Lanka which is an advocacy group of experts from different disciplines and key stakeholders aiming to strengthen public health policy, services and research in Sri Lanka analyzed the situation in relation to school canteen policy of Sri Lanka and identified that non availability of attractive food items/drinks that are nutritious, low cost and can be made from locally available food ingredients on a continuous basis has contributed to difficulties in implementation of this policy [4].

Many international initiatives including World Health Organization (WHO), UNICEF, UNESCO, the U.S. Centers for Disease control and prevention (CDC), the International Union for Health Promotion and Education (IUHPE) and others recognized that school can make a substantial contribution to a student's health wellbeing. In some countries there are regulations regarding the quality of the school canteen foods, in terms of nutrient content or consistency with national dietary guidelines [5]. School going age is the best time to cultivate good nutritional practices and dietary habits. A healthy lifestyle during childhood support optimal health, growth, maturation, and academic achievement, as well as reduce risk factors for diseases during childhood and later in life [6]. School age children spend a significant period of their time in school. Therefore getting a nutritious meal in the school is equally important as their in the home. Because of their physiological and psychological changes during this age period, the nutritious meal should be considered vitally. Otherwise they tend to face nutritional problems including deficiency diseases such as anaemia as well as over nutrition problems like obesity.

It is obvious that school environment can strongly influence children's eating behaviours through the cafeteria. As the same time, nutritious, locally available school canteen foods are spares in Sri Lanka. School canteen foods in Sri Lanka are mostly high fat, high sugar junk foods. Thus it appears that health promotion in school children by producing the new food items for school canteen is a greater requirement now.

Before moving to the new food options, it is necessary to analyse the food choices and nutrient intake by the school children. According to the study done using 1456 pupils attending primary and secondary schools the U.K in 1997, foods and drinks containing high levels of fat or sugar were the most commonly chosen food group. Within this group, the main contributors were desserts and cakes (35%), 31% of fizzy drinks and 27% of chips and other potatoes cooked with oil or fat [7]. This study concluded that most of the student prefer to have higher fat foods and sugary foods.

In addition to that, when giving new food options have to consider on availability, acceptability (having good taste), attractively presented, affordability (appropriate pricing policy) and more importantly their nutritional value. Since they are children they consider about appearance on foods when they select their foods. Therefore it should be considered to present the food attractive way for the school children. Otherwise they refuse those foods although those foods are more nutritious. Since their food selection skills and habits result in long-term health effects and there can be a risk of developing chronic diseases their nutritional needs are critical. Therefore it is very important to think of their critical nutritional requirement as well.

School children's nutrient requirements have to be considered when developing food menus for the school age children. Using their requirement for energy, macr nutrient, and critical micro nutrients new menus can be developed as well as existing menus can be modified according to their nutrient requirements to be made available in school canteens. Recommended Dietary Allowances (RDA) for energy, macro, and micronutrients can be followed for developing the menus.

When considering essential micro nutrient requirements for school children; a recent review of research on the effects of deficiencies in zinc, iodine, iron and folate on the cognitive development of school-aged children showed that nutrition has an impact on children's ability to think. For example, deficiencies in iron and zinc have been associated with impairment of neuropsychological function, retardation of growth and development, reduced immunity and increased vulnerability to infectious diseases. The essential nutrients for optimal health are energy, protein, essential fatty acids, calcium, and iron.

Improving the quality of student's dietary intake in the school setting is clearly challenging, yet critically important. For many children, meals and snacks consumed at school make a major contribution to the total day's consumption of food and nutrients. Therefore this study was carried out to develop nutritious, low -cost attractive food menus for school age children.

## **2. MATERIALS AND METHODOLOGY**

### **2.1. Study site**

The study was conducted at the Wayamba University of Sri Lanka, Department of Applied Nutrition, Makandura, Gonawila (NWP).

### **2.2. Study design**

A descriptive study was carried out to develop nutritiously, low cost and attractive food menus to be made available in school canteens.

### 2.3. Study population

Students from grade 6 to 12 were selected randomly from Sadalankawa National School, Sadalankawa, Sri Lanka.

### 2.4. Data collection

RDA for children under age 6- 18 categories was collected using the Sri Lanka MRI reports. School canteen's food policy report was checked to investigate the requirements to be considered when developing the menus for school canteens. Existing food menus were selected for the modification and low cost, locally available ingredients were selected for incorporate into developing menus.

### 2.5. Data analysis

#### 2.5.1. Analyze of nutrients content in 100g and one portion of developed menus

Energy, macronutrients and micronutrient contents were calculated for 100 g of existing menus used to be developed using Foodbase 2000 software (Institute of Brain Chemistry). Nutrient Quality Index (NQI) scores were calculated for all developing menus for several critical nutrients for evaluating the nutrient density of the foods. Energy, macro and selected micro nutrient contents received from Foodbase 2000 soft ware and Recommended Dietary Allowances (RDA) for energy, macro and above selected micro nutrients for Sri Lankan children were used to calculate the NQI using following equation.

$$\text{NQI} = \frac{\text{Amount of nutrient per 100 g of food} / \text{RDA for that nutrient}}{\text{Calories in 100 g of food} / \text{RDA for energy}}$$

If developing foods were not nutritious according to the NQI scores, ingredients amounts were adjusted until developing menus become nutritious for the school children. After developing those as nutritious menus, nutrients contents in 100 g of developed menus were obtained from Foodbase 2000 soft ware (TABLE I, II and III). The weight of the one portion of developed menu was determined when developed menu was been given 200 kcal of energy (TABLE IV). Macro and micro nutrients contents in one portion of developed menus were calculated manually (TABLE V, VI and VII). Percentage energy from macronutrients (carbohydrate, protein, fat) was calculated per portion of developed menus (TABLE VIII).

#### 2.5.2. Sensory evaluation

Acceptance of developed menus by school children with different grades was checked by using food quality measuring scale (Fig. 6-11). They were asked to rank (with the guidelines) different attributes regarding food quality for given slips for each developed menus.

#### 2.5.3. Evaluation of cost for one portion of developed menus

Total Cost for ingredients in one portion of each developed menus was calculated manually according to the weight of the ingredients.

## 3. RESULTS

### 3.1. Results for energy and nutrients composition in five developed foods

**Table I: MAJOR NUTRIENT CONTENTS OF 100gOF DEVELOPED MENUS**

Food type	Energy (Kcal)	CHO (g)	Protein (g)	Fat (g)	Cholesterol (g)	Fiber (g)
Bread Pizza	225.56	32.71	7.77	10.43	50.17	1.92
Grain mixed kiribath	125.34	21.21	2.81	5.05	0.01	0.61
Nutritious Koththu	164.89	20.94	5.62	7.67	9.49	0.77
Nutritious kiribath	118.39	16.84	3.34	5.29	0.01	0.73
Nutritious pittu	374.54	46.82	8.51	18.39	68.53	4.59

**TABLE II: MINERAL CONTENTS IN 100g OF DEVELOPED MENUS**

Food type	Ca (mg)	Fe (mg)	Cu (mg)	Zn (mg)	Iodine (µg)	P (mg)	S (mg)
Bread Pizza	82.09	1.89	0.19	0.68	11.22	93.35	65.23
Grain mixed kiribath	35.08	1.15	0.21	0.78	02.67	89.12	45.55
Nutritious Koththu	60.96	1.64	0.15	0.70	19.41	87.47	57.76
Nutritious kiribath	41.29	1.01	0.38	0.64	00.43	48.85	34.36
Nutritious pittu	33.04	2.33	0.29	1.06	07.36	122.47	41.58

**TABLE III: VITAMIN CONTENTS IN 100g OF DEVELOPED MENUS**

Food type	Vit.B12 (µg)	Folic acid (µg)	Vita C (mg)	Vit. A (µg)	Thiamin (mg)	Riboflavin (mg)	Niacin (mg)
Bread Pizza	0.29	32.09	2.04	201.69	0.11	0.09	1.07
Grain mixed kiribath	0.00	31.55	1.76	100.06	0.07	0.05	0.54
Nutritious Koththu	0.42	24.63	3.19	219.58	0.07	0.10	0.39
Nutritious kiribath	0.32	12.96	2.82	66.22	0.05	0.04	0.51
Nutritious pittu	1.43	15.76	0.41	93.49	0.04	0.04	0.91

**TABLE IV: WEIGHT OF THE ONE PORTION OF DEVELOPED MENUS**

Food type	Energy (Kcal)	Weight (g)
Bread pizza	200	87
Nutritious kiribath	200	169
Nutritious koththu	200	121
Grain mixed kiribath	200	160
Nutritious pittu	200	53

**TABLE V: ENERGY AND MAJOR NUTRIENT COMPOSITION IN ONE PORTION**

Food type	Energy (Kcal)	CHO (g)	Protein (g)	Fat (g)	Cholesterol (g)	Fiber (g)
Bread Pizza	200	29.11	6.91	9.28	44.65	1.71
Grain mixed kiribath	200	31.68	4.22	7.58	0.00	0.91
Nutritious Koththu	200	25.34	6.80	9.23	11.49	0.93
Nutritious kiribath	200	28.63	5.68	8.99	0.00	1.24
Nutritious pittu	200	79.59	18.67	26.46	116.51	7.81

**TABLE VI: MINERAL COMPOSITION IN ONE PORTION OF FIVE DEVELOPED MENUS**

Food type	Ca (mg)	Fe (mg)	Cu (mg)	Zn (mg)	Iodine (µg)	P (mg)	S (mg)
Bread Pizza	71.42	1.64	0.17	0.59	9.76	81.22	56.75
Grain mixed kiribath	59.29	1.95	0.35	1.32	4.51	150.61	76.99
Nutritious Koththu	73.76	1.98	0.19	0.85	23.49	105.84	69.89
Nutritious kiribath	66.08	1.61	0.60	1.02	0.69	78.15	54.97
Nutritious pittu	18.01	1.14	0.16	0.51	3.58	67.16	39.35

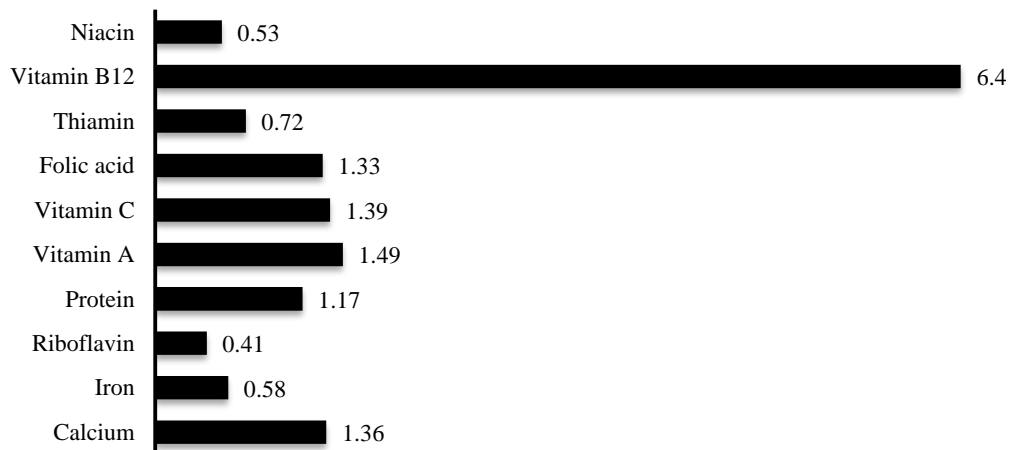
**TABLE VII: VITAMIN COMPOSITION IN ONE PORTION OF FIVE DEVELOPED MENUS**

Food type	Vit B12 (µg)	Folic acid (µg)	Vit C (mg)	Vit A (µg)	Thiamin (mg)	Riboflavin (mg)	Niacin (mg)
Bread Pizza	0.25	27.92	1.78	175.47	0.09	0.078	0.93
Grain mixed kiribath	0.00	53.33	2.98	1.79	0.13	0.08	0.91
Nutritious Koththu	0.51	29.79	3.86	265.69	0.08	0.12	0.47
Nutritious kiribath	0.52	20.74	4.52	105.95	0.08	0.06	0.82
Nutritious pittu	0.76	8.35	0.22	49.55	0.02	0.02	0.48

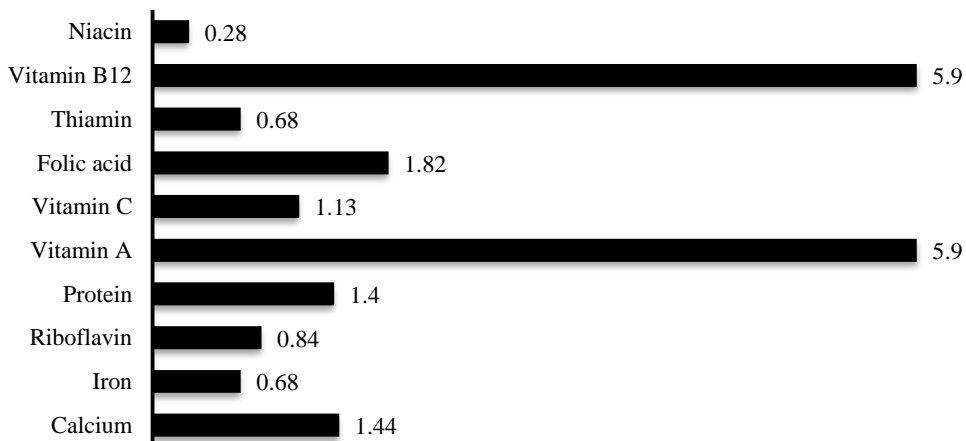
**TABLE VIII: PERCENTAGE OF ENERGY IN MAJOR THREE MACRO NUTRIENTS PER PORTION**

Food type	CHO %	Protein %	Fat %
Bread Pizza	53	16	31
Grain mixed kiribath	64	16	20
Nutritious Koththu	52	18	30
Nutritious kiribath	58	17	25
Nutritious pittu	54	15	31

**3.2. NQI scores for different nutrients in each five developed menus**



**Fig. 1: NQIs for different nutrients in Nutritious kiribath**



**Fig. 2: NQIs for different nutrients in Nutritious koththu**

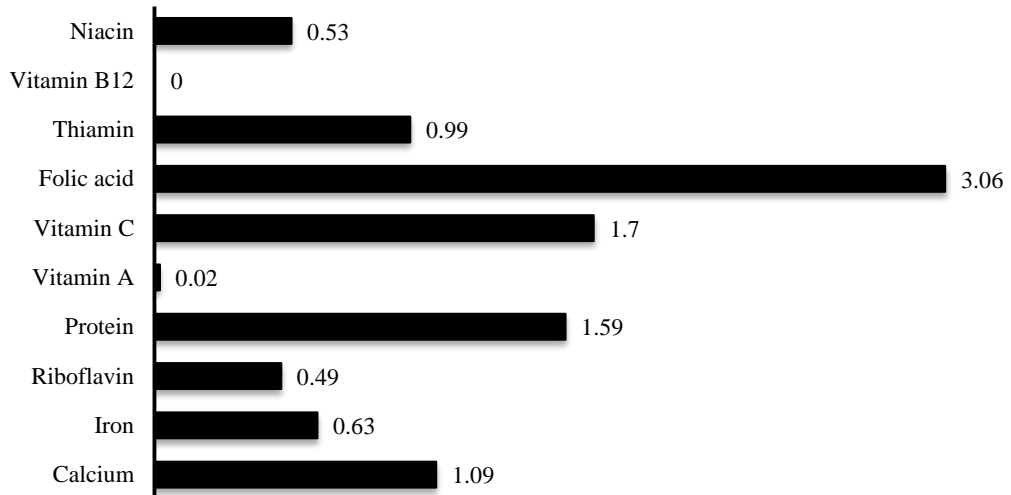


Fig. 3: NQIs for different nutrients in Grain mixed kiribath

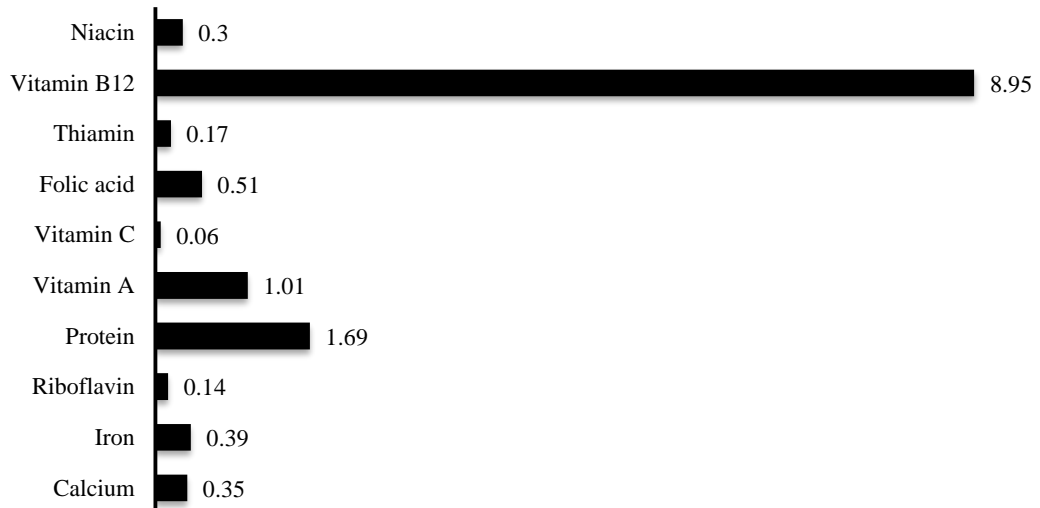


Fig. 4: NQIs for different nutrients in Nutritious pittu

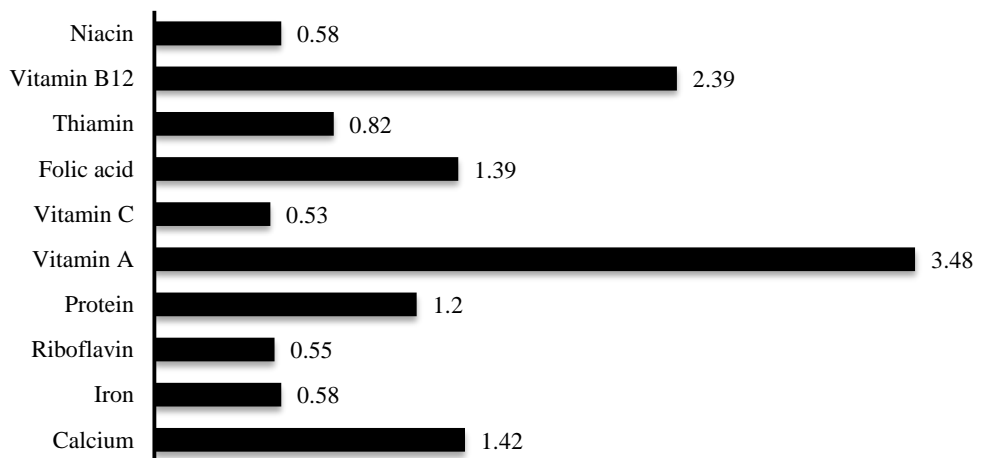


Fig. 5: NQIs for different nutrients in Bread pizza

3.3. Sensory evaluation results

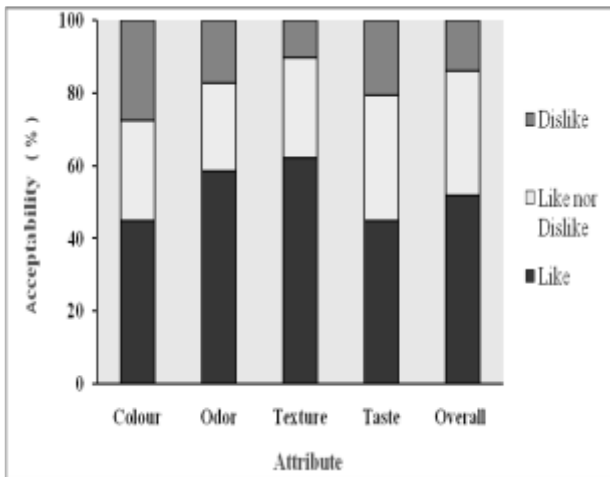


Fig. 6: Percentage acceptability for different attributes of Nutritious kiribath

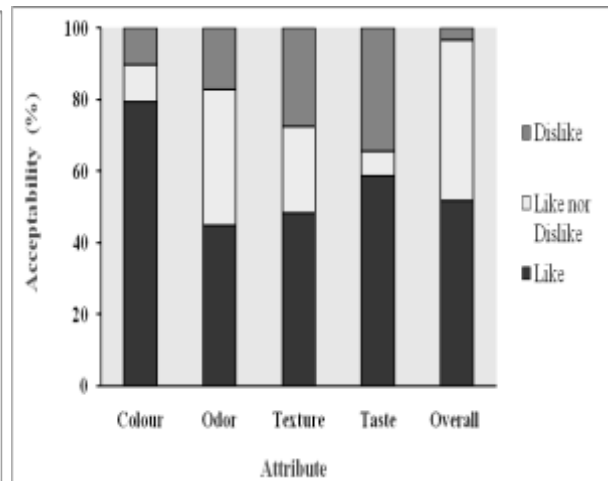


Fig. 7: Percentage acceptability for different attributes of Nutritious koththu

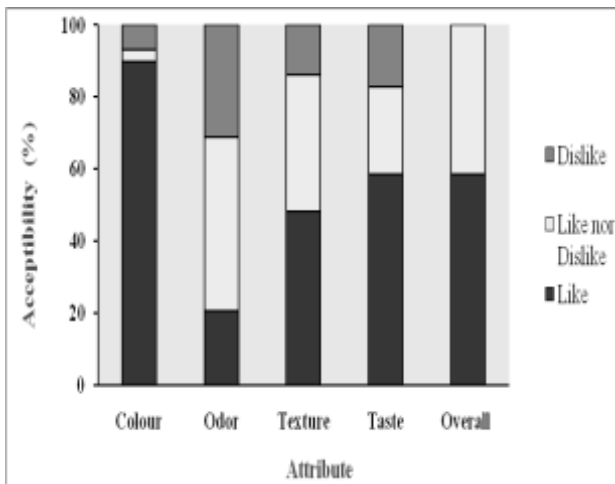


Fig. 8: Percentage acceptability for different attributes of Grain mixed kiribath

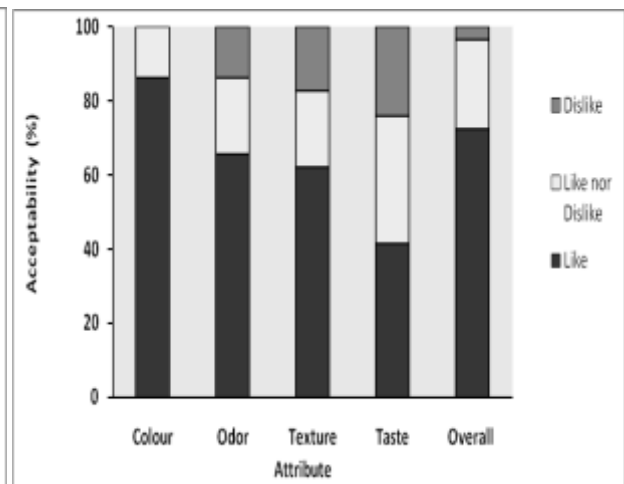


Fig. 9: Percentage acceptability for different attributes of Nutritious pittu

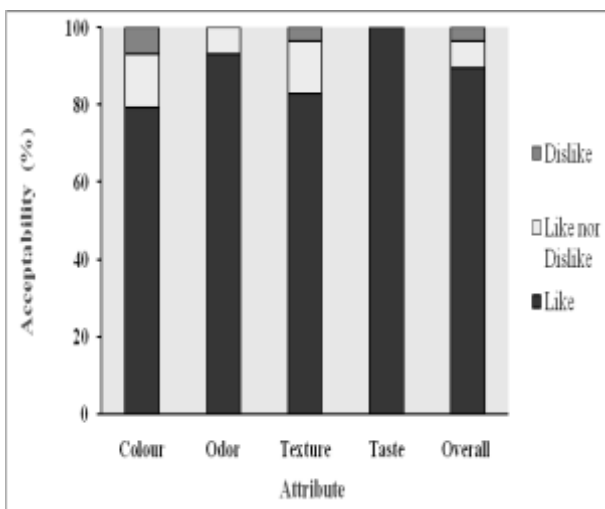


Fig. 10: Percentage acceptability for different attributes of Bread pizza

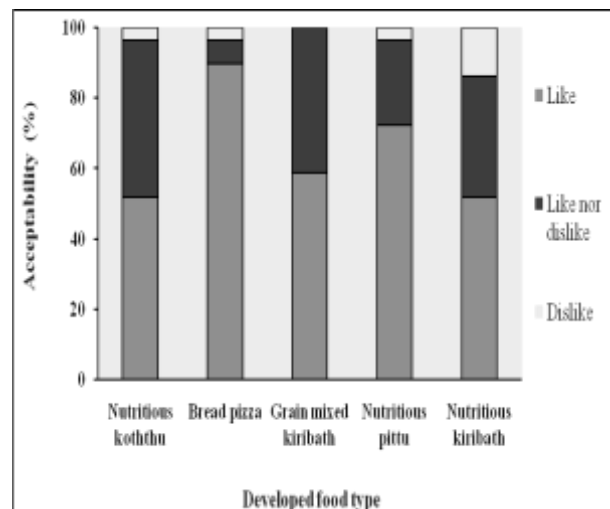


Fig. 11: Overall acceptability for five developed foods by school children

#### 4. DISCUSSION

MRI recommendation for energy and micronutrients were considered to develop those menus as nutritious for school children. However, those recommendations were based on normal healthy children. Therefore it is obvious that those menus were nutritious for normal healthy children. But sometimes those menus might be not adequately nutritious for some children who are having under nourished or over nourished conditions.

According to the definition of NQI; if NQI score of 1 for 4 or more nutrients or above 2 for at least 2 nutrients in foods, these can be considered as nutritious foods. Since it consider only several nutrients to put into that margin to decide as nutritious; it is not determined whether the food adequately supplies all critical nutrients by the developed menus for school children. That was one limitation here.

Some of the critical nutrients for school age children did not included in Sri Lanka MRI recommendation ( As an example Zn which is critical mineral especially during the adolescent period). Therefore those critical nutrients couldn't consider determining the nutrients density of the foods by following NQI score. That was one of the limitations in this study.

Average RDAs values of energy and micro nutrients considering sex and age difference among children were used to calculate the NQI for micro nutrients in developed menus. Since average value was considered, some time that might be both over and under estimation for the nutrients requirements. But it was practically impossible to introduce several options for same food menu considering different requirements.

For developing these five menus several trials were done through back calculation Using Foodbase 2000 and NQI concept following RDA values.

Sensory evaluation for all five developed menus was done at same day within about ½ hour. Therefore that could be affected for ranking of each attributes of foods, since children could compare each menus. So it was difficulty to take their accurate acceptance for five developed menus.

When introducing new food menus for school age children, presenting attractively also should be considered with the nutritious value. Since they are children they very much concern on appearance of the food as well. Though foods are nutritious enough, if they do not accept it is not useful to produce new food. Because of that, sensory evaluation test should be done properly to determine whether children accept the food or whether it is needed further modification.

Developed food menus should have an affordable price to the children or their parents. Otherwise they tend to move again for low cost foods which are having poor nutrition value. Then study objective will be difficult to achieve by addressing nutritional problem among school children in Sri Lanka.

NQI concept generally uses micro nutrients content in foods to evaluate the nutrient density. But NQI is not determined the macro nutrient distribution of the developed menus. That is important to consider the percentage of macronutrients in 100 g of developed foods, since if it is not in acceptable range palatability goes down. For a n example, if fat content is too low, menu is not palatable and therefore menu might be rejected by the children. As the same time if fat content is too high it makes health problems like obesity, cardiovascular diseases later in life.

#### 5. CONCLUSION

Five types of developed menus were nutritious according to the NQI score. All five developed menus are having acceptable macro nutrient percentages. Nutritious pittu had the lowest cost among these five developed menus while Nutritious koththu and Nutritious kiribath had highest price. Due to this variation of cost, children can buy the foods according to their affordability. According to the sensory evaluation results, Bread pizza was the most acceptable menu among these menus by the children.

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