

Sensorial Evaluation of Egyptian School Meals

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Abstract: The actual recipes used to prepare school meals are important to provide the children in some Egyptian school with adequate daily balanced diet to enhance the nutrient content of easily available and accessible plan as participated in the Egyptian school program focusing on food quality and assessing healthy eating behaviors. Also, these diets should allow children to achieve optimal physical and conjunctive development, attain a healthy weight, enjoy food and reduce the risk of chronic disease. The aim of this study is to sensorial evaluate five suggested school pies (A, B, C, D and E), which contained different ratios of yellow butter and margarine (8:0, 6:2, 4:4, 2:6 and 0:8, respectively). This sensory evaluation was tested by 150 primary stage students (25 students from each grade), their ages ranged from 6 to 12 years old. Results showed that all the prepared formulas were healthy and good sources of protein and energy. However, the prepared formulas covered the daily requirements of energy for students aged from 6 to 12 years in the range from 15.31 to 22.52%. Also, the baked pies made from formula C (1 : 1, yellow butter : margarine) was the most preference meal which received statistically the highest scores in all the judged quality attributes (color, odor, chewing, taste and overall acceptability) compared to all other tested formulas. Therefore, the nutrition education for children may promote better health for children's in various locations.

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1. Introduction

Protein-calorie malnutrition is a major syndrome affecting more than 170 million pre-school children and nursing mothers in developing Afro-Asian countries. The present trend in population growth indicates that the protein gap may continue to increase in the future unless-plane measures are taken to tackle the situation (Iqbal et al., 2006). On the other hand, malnutrition is currently widespread in many areas of the world. The most serious nutrition problem is protein calorie malnutrition, especially among children in the developing countries.

USDA/ARS children's, Nutrition Research Center (Addison et al., 2006) recommended that the daily, nutrient intake for school children by grade level were 16g protein, 22g total fat and 825 calories. Whereas, poor diet and physical inactivity, which may lead to an energy imbalance, are major contributors to the alarming increases in childhood obesity (Institute of Medicine, 2007).

The children consume energy from foods that are low in nutrients and high in energy (including salty snacks and baked goods and other snacks that are high in fat) at home (Briefel et al., 2009).

The American Dietetic Association, adopting appropriate eating habits should allow children to achieve optimal physical and cognitive development, attain a healthy weight, enjoy food, and reduce the risk of chronic disease. An increased number of childhood overweight conditions has driven

dietitians to address children's over consumption of foods and beverages that are lacking in proper nutrients (Kennedy and Goldberg, 1995) and to highlight the need to improve their nutritional intake (Kleinman et al., 1998; Pollit, 1995) because children's food choices very often result in poor nutrient intake (Byers, 1993; US Department of Agriculture, 1998)

Afridi, (2009) suggested that for as low a cost as 3 cents per child preschool day the scheme reduced the daily protein deficiency of a primary school students by 100%, the calorie deficiency by almost 30% and the daily iron deficiency by nearly 10%. At least in the short-run, therefore the school meal program had a substantial effect on reducing hunger at school and protein-energy malnutrition.

However, according to the Food and Agriculture Organization of the United Nations (FAO/WHO/UNU, 1985) the average daily intake of 0.34g/kg of fully utilized (perfect) protein per kg of lean body weight as the minimum needed to maintain body's protein level for adults. When individual deviations are taken into account (doubling the 15% standard deviation), nearly 98% of healthy adults should be safe with 0.45g/kg daily intake of fully utilized protein. This study was, therefore, undertaken to prepare five school meals and analyzed for their essential nutrients, sensory properties and RDA of energy in order to highlight their nutritional significance.

The aim of this study is to sensorial evaluate

five suggested school pies (A, B, C, D and E), which contained different ratios of yellow butter and margarine (8:0, 6:2, 4:4, 2:6 and 0:8, respectively).

2. Materials and Methods

Materials

The school pies include different ingredients in **Table (1)**. Flour was purchased from Egyptian millers company 6 October city, eggs from production sector Agricultural Research Center Giza, margarine from Efcostar company, skim milk from the International commerce group, vanillin and sugar from Sugar company and complementary industries, butter from El-Eman form Commerce and supplying, salt in El-Nasr Company Alexandria, sesame from El-Reda & El-Nour company, minced date (Agwa) from Central Administration for Food Industries

(Food Technology Research Institute-Agricultural Research Center) and the yeast from Al-Zahraa company Giza.

Methods

Technological processing

Five school Pies were prepared from five formulas (A, B, C, D and E) using the recipes summarized in **Table (1)**, expressing the different ratios of yellow butter and margarine as fat blends used in this study. Formula A contained 100% yellow butter (as a fat content). While, formulas B, C and D contained (80:20, 50:50 and 20:80) butter to margarine, respectively, where formula E contained 100% margarine. All the other ingredients were added at the same ratio percentages.

Table 1. Recipes of different formulas (%) contained different percentage of margarine and/or yellow butter

Ingredients	Formulas				
	A	B	C	D	E
Wheat flour	50.00	50.00	50.00	50.00	50.00
Sugar	5.00	5.00	5.00	5.00	5.00
Yellow butter	8.00	6.00	4.00	2.00	0.00
Margarine	0.00	2.00	4.00	6.00	8.00
Sesame	1.00	1.00	1.00	1.00	1.00
Yeast	0.25	0.25	0.25	0.25	0.25
Salt	0.30	0.30	0.30	0.30	0.30
Eggs	4.50	4.50	4.50	4.50	4.50
Skimmed milk	2.00	2.00	2.00	2.00	2.00
Vanillin	0.05	0.05	0.05	0.05	0.05
Minced date paste (agwa)	20.00	20.00	20.00	20.00	20.00
Water	8.90	8.90	8.90	8.90	8.90

A: contained 100% yellow butter.

B: contained 80:20 butter to margarine.

C: contained 50:50 butter to margarine.

D: contained 20:80 butter to margarine.

E: contained 100% margarine.

Pies were prepared according to the method described in **AACC (2002)**. The procedure was applied at Abo-Sultan factory. Dry raw materials (wheat flour, sugar, salt, yeast, sesame, skimmed milk and vanillin) were added in dough mixer and mixed at the slow speed (60 rpm) for homogeneity of these ingredients. Then, water was added, mixed at slow speed to form the gluten network. The fat materials (margarine, yellow butter or their blends) and eggs were added, then blended at slow speed. Therefore, water was added and beaten for three minutes at the slow speed, then for twelve minutes at the fast speed (120 rpm) until the development of the dough.

The dough was transferred to the shaping machine, and the minced date was added to feeder. After the shaping of the Pies, they automatically transferred to the trays. Then the trays were transferred to the fermentation room for one hour

until the Pies were fermented. The trays were transferred to rotating ovens at 210°C for eleven to thirteen min., then ventilated and packaged into packaging machine.

Analytical methods

Moisture, crude fat, crude protein, ash and crude fiber were determined according to **AOAC (2000)**. Formulas energy was calculated as Kcal/100g using the following equation:
Energy value of food = Fat energy + protein energy + carbohydrate energy.

Sensory evaluation

Sensory evaluation was carried out by 150 primary stage students. Twenty five students from each grade (from first to six) ages from 6 to 12 years old were asked for the acceptability of the quality attributes i.e., color, odor, chewing, taste and overall

acceptability of the baked meals prepared from the studied formulas.

Statistical analysis

A one-way analysis of variance (ANOVA) was used to evaluate the means of sensory properties. The significant difference between treatments was compared by Duncan's Multiple Range Test (DMRT) (Watts et al., 1989).

3. Results and Discussions

Data in table (2) show the proximate composition of the meals prepared from different formulas. Results showed that, carbohydrate contents ranged from 51.20 to 53.77%. Formula A and C were slightly higher in fibers (3.67 and 3.49%) than those of other tested formulas. Fat and protein contents ranged from 9.40 to 11.6 and 9.60 to 9.90, respectively. In general; the composition of the prepared meals was practically the same. These data revealed that the prepared formulas of Egyptian school meals has a good source of protein which could be safe for adults compared with the healthy diet of adult 0.45g/kg daily intake; **FAO/WHO/UNU, 1985**. Also, the results indicated that the level of nutrients were higher in prepared school formulas compared to USDA/ARS Children.

Data in table (3) show that, the total energy ranged from 348 to 365 kcal for tested meal formulas. Formula B showed the highest energy value compared to other formulas. The data in table (4) indicated that all formulas covered a percentage ranged between 15.31 and 22.52% from the daily energy requirements for children aged from 7 to 12 years. The data showed a gradual decrease in the energy requirements parallel to progressive of age or grades.

Results in Table (5) show that, the color of school meal of formula C and D received the highest scores from students aged between 9 and 12 years (grade 4, 5 and 5) compared to other tested formulas followed by formulas E, B than A. It was observed that the best formula was C which contained 50:50 butter and margarine, while formula A which contained 100% yellow butter was not preference from all school grades.

The same observation was noticed for odor characteristic which was similar to that of color as shown in Table (6). The meal prepared from formula C had the best odor characteristic recorded the highest score values (10.67±1.09), while formula B was the least one (2.00±1.10) compared to those of all prepared school meals from other formulas.

Chewing characteristic scores of prepared meals from various formulas are shown in Table (7). No significant difference was observed for chewing

characteristic for school meals made from formulas A, B and D. While, a significant difference with higher score values for chewing characteristic of formula C than other tested formulas was noticed. Thereby, the formula C was the best one for chewing characteristic followed by formula E, then formulas A, B and D.

The taste score values of school meals made from different studied formulas are illustrated in (table 8). There was no significant difference in taste of both formulas B and A, also between formulas D and A was observed. On the other hand, the formula C had statistically the highest mean score value compared to all other prepared meals and was the most preference meal for all students.

As seen in table (9) students from all of the grade levels from first (6-7 years) to six (11-12 years) grade gave the highest score values for meal prepared from formula C for total acceptability with mean value of 11.76±1.37 compared to other prepared meals. Thus, there were great significant differences between the received scores of meal prepared from formula C and other tested meals. While, the lowest scores of total acceptability was noticed for the prepared formula E (2.66±1.37) followed by A (2.83±1.72), B (3.50±1.76) and D (4.33±1.75). These results may be due to the alteration of yellow butter and margarine in the formulas, however when the yellow and butter margarine were added in formula C at the ratio of 1:1, it obtained the highest score of total acceptability. In this respect, **Glatz et al., (1989)** pointed out, that there are many reasons to include fats and oils in food with different combinations of fatty acids may be desirable. Fats have important nutritional functions to supply a concentrated energy source. In addition, the fatty acid composition of dietary fat markedly influences the fatty acid composition of lipids in blood and adipose tissue.

Figure (1) showed the significant differences in color, odor, taste, chewing and total acceptability between meal prepared from formula C and all the other studied meals. Meal prepared from formula C containing yellow butter and margarine (1:1) recorded the highest score values for all the sensory properties followed by D (1:3), B (3:1), A (1:0) and E (0:1). The results given in this paper enable to ensure health-beneficial of daily constituents of the prepared Egyptian school meals for children. Where the actual recipes used in the preparation of the studied school meals provide the students with the most accurate children's in their diets and the confirmed relationship between school meal program participation and confirmed the nutritional quality of children diets.

Table (2): Proximate composition of school meals prepared from formulas (% on dry weight basis).

Constituents	Formulas				
	A	B	C	D	E
Moisture	24.00	22.50	24.50	22.80	21.60
Carbohydrate*	51.20	52.25	51.31	52.88	53.77
Fiber	3.67	2.72	3.49	2.80	2.73
Fat	10.17	11.60	9.80	10.40	9.40
Protein	9.80	9.65	9.70	9.90	9.60
Ash	1.16	1.28	1.20	1.22	1.20

* calculated by differences

Table (3): Calculated energy values of school meal formulas (K.Cal./100g)

Nutrients	Energy values of formulas (K.Cal./100g)				
	A	B	C	D	E
Fat	92.55	105.56	89.18	94.64	85.54
Protein	41.16	40.53	40.74	41.58	40.32
Carbohydrate	215.04	219.45	215.50	222.10	225.83
Total energy	348.75	365.54	345.42	358.32	351.69

Table (4): The covering percentage of recommended energy daily allowances according to FAO/WHO/UNU from prepared school meals.

Age/year	FAO/WHO/UNU (2001)		Percentage of formula energy covering RDA				
	Average	Means	A	B	C	D	E
			7-8	1554-1692	1623	21.41	22.52
8-9	1698-1830	1764	19.77	20.72	19.50	20.37	19.94
9-10	1854-1978	1916	18.20	19.10	18.03	18.70	18.35
10-11	2006-2150	2078	16.70	17.55	16.62	17.23	16.92
11-12	2149-2341	2245	15.53	16.20	15.31	15.90	15.61

Table (5): Color scores* of school meals prepared from different formulas

Grade Age/year	Formulas				
	A	B	C	D	E
First grade (6-7 years)	3	1	9	11	1
Second grade (7-8 years)	0	6	10	6	3
Third grade (8-9 years)	2	3	10	6	4
Fourth grade (9-10 years)	0	3	15	5	2
Fifth grade (10-11 years)	3	0	14	4	4
Six grade (11-12 years)	0	3	14	4	4
Total	8	16	72	36	18
Means \pm SD	2.67 \pm 0.58	3.20 \pm 1.79	12.00 \pm 2.61	6.00 \pm 2.61	3.00 \pm 1.26

* Number of students accepted meal color

A,B NS B,E NS C,D S D,E S

A,E NS B,D NS C,E S

A,D S B,C S

A,C S

(S: significant, NS: not significant P< 0.05)

Table (6): Odor scores* of school meals prepared from different formulas.

Grade Age/year	Formulas				
	A	B	C	D	E
First grade (6-7 years)	4	1	10	8	2
Second grade (7-8 years)	2	2	10	3	8
Third grade (8-9 years)	3	2	10	3	7
Fourth grade (9-10 years)	3	4	15	1	2
Fifth grade (10-11 years)	4	1	12	2	6
Six grade (11-12 years)	5	2	7	7	4
Total	21	12	64	24	29
Means±SD	3.50±1.05	2.00±1.10	10.67±1.09	3.50±2.83	4.83±2.56

* Number of students accepted meal odor

A,B NS B,C S C,D S D,E NS

A,E NS B,D NS C,E S

A,D NS B,E S

A,C S

(S: significant, NS: not significant P<0.05).

Table (7): Chewing scores* of school meals prepared from different formulas.

Grade Age/year	Formulas				
	A	B	C	D	E
First grade (6-7 years)	1	8	10	2	4
Second grade (7-8 years)	6	4	8	3	4
Third grade (8-9 years)	5	1	13	4	2
Fourth grade (9-10 years)	4	2	8	4	7
Fifth grade (10-11 years)	4	4	12	3	2
Six grade (11-12 years)	3	2	9	4	7
Total	23	21	60	20	26
Means±SD	3.83±1.72	3.50±2.51	10.00±2.10	3.33±0.82	4.33±2.25

* Number of students accepted meal chewing

A, B NS B,C S C,D S D,E NS

A,C S B,D NS C,E S

A,D NS B,E NS

A,E NS

(S: significant, NS: not significant P<0.05).

Table (8): Taste scores* of school meals prepared from different formulas

Grade Age/year	Formulas				
	A	B	C	D	E
First grade (6-7 years)	1	3	12	4	5
Second grade (7-8 years)	4	3	13	2	3
Third grade (8-9 years)	4	3	14	3	1
Fourth grade (9-10 years)	3	2	12	1	7
Fifth grade (10-11 years)	1	7	11	3	3
Six grade (11-12 years)	1	4	12	2	6
Total	14	22	74	15	25
Means±SD	2.33±1.51	3.67±1.75	12.33±1.03	2.50±1.05	4.17±2.23

* Number of students accepted meal taste

A,B NS B,C S C,D S D,E NS

A,C S B,D NS C,E S

A,D NS B,E NS

A,E NS

(S: significant, NS: not significant $P < 0.05$).

Table (9): Mean scores* of total acceptability of meals prepared from different formulas.

Grade Age/year	Formulas				
	A	B	C	D	E
First grade (6-7 years)	4	3	12	5	1
Second grade (7-8 years)	5	6	11	2	1
Third grade (8-9 years)	4	1	12	4	4
Fourth grade (9-10 years)	1	3	11	7	3
Fifth grade (10-11 years)	1	5	10	5	4
Six grade (11-12 years)	2	3	14	3	3
Total	17	21	70	26	16
Means±SD	2.83±1.72	3.50±1.76	11.67±1.37	4.33±1.75	2.66±1.37

* Number of students like meal attributes

A,B NS B,E NS C,D S D,E NS

A,E NS B,D NS C,E S

A,D NS B,C S

A,C S

(S: significant, NS: not significant $P < 0.05$).

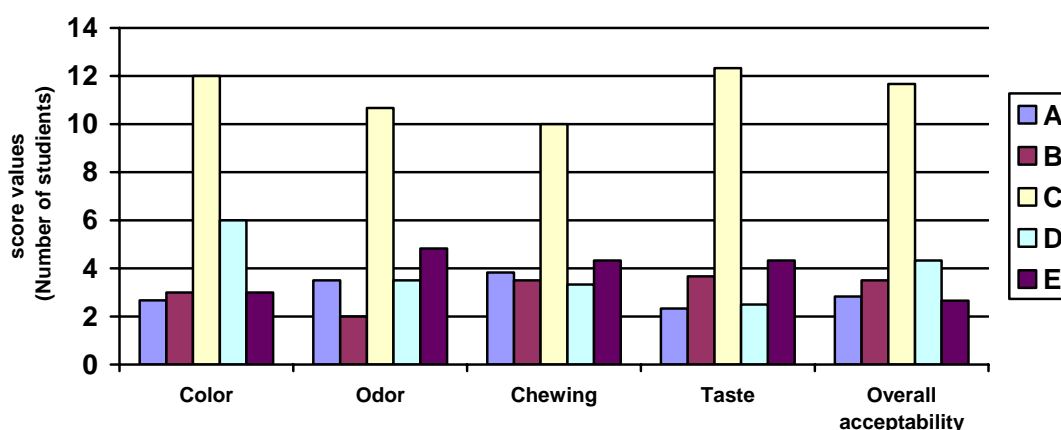


Figure (1): Sensorial evaluation of meals prepared from different formulas.

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