

Original Paper

Acceptability and Satiety Evaluation of a Developed Nutritionally Balanced School Meal

Manal Abdeen Ali^{1*}, Ibtihag Awad Mahmoud¹, Sawsan Ahmed Balla¹, Rekha Lecomte², Laura
Dehondt², Eman Ahmed Abdekareem³ & AbdelHalim Rahma Gubara¹

¹ Nutrition & Health Center for Training and Research, School of Health Sciences, Ahfad University
for Women, Sudan

² Tweed Research Center of Nutriset Group, France

³ Samil Industrial Co., Khartoum, Sudan

* Manal Abdeen, Ahfad University for Women, Al Arda Street, Omdurman, Sudan

Received: January 19, 2020

Accepted: January 30, 2020

Online Published: March 9, 2020

doi:10.22158/fsns.v4n1p1

URL: <http://dx.doi.org/10.22158/fsns.v4n1p1>

Abstract

Five nutritionally designed school meals were developed in a form of pastes based on leguminous seeds (lentil, chick pea, and soya) mixed with dairy ingredients. All formulas contain groundnut, and few contained crushed nuts providing inclusions inside the prototypes to test acceptance. The products were fortified with essential minerals and vitamins following the DRI guideline for children. Developed meals were served as a breakfast meal to ~200 students (6-9 years juniors; 10-14 years seniors) of one of the Sudanese basic schools (Omdurman City) for 21 days to substitute a traditional breakfast meal boiled Pigeon pea colloquially called “Balila” served routinely to the students. This paper covers acceptability of favorable products behavioral responses of senior and junior students to four meal/subject interactions coverings temptation to finishing the whole meal, reason(s) for not finishing the whole meal, time needed to finish the meal, and degree of satiety the students feel during teaching hours.

Almost 95% of the senior students interacted positively with pastes based on lentil or chick pea finish the product as evidenced by the short time (<10 min) to finishing or stop taking the meal in ≤ 10 minutes. All past products provide satiety; senior students judged that lentil based paste(s) as the meal that secures full satiety during school hours. Unlike seniors, more than 95% of junior students finished more of the soy-based meal, one third of them took more time to finish lentil-based meal indicate that the results reflected satisfaction by taking less quantities from all products offered. Degree of satiety feeling among junior students fluctuated where >90% of them confirmed satisfactory degree of satiety

compared to all products offered.

Keywords

acceptability, satiety, school meal, nutrition

1. Introduction

Nutritional readers need no reminding of the consequences of the spread of malnutrition among population of most developing countries. Black et al. (2008) summarized such consequences; whereas FAO (2006) highlighted root causes of food insecurity leading to such consequences, and when it comes at the door of vulnerable groups such as children, FAO (2009) itself indicated kind of strategies that prevent or reduce under-nutrition and combat child mortality.

Almost, a decade back, Sudan Ministry of General Education (SMGE, 2008) launched a school feeding program that reached about 1.2 million children throughout the country with the objective of increasing school attendance, particularly of girls, and relieving short-term hunger while transforming resources to vulnerable households. Lack of food in the households is reportedly one of the main reasons for school dropout, according to baseline survey carried out by SMGE (2008).

The child performance in morning schooling is very much related to taking right nutritious food that is rich in energy, protein, carbohydrates and calorific sources, e.g., breakfast items, to help in focus and concentration, a pre-requisite behavior for better learning and hence more opportunities in life.

The market for children's foods is continuously growing, and children have an increasing influence on food purchase decisions. This has led to the use of children in product development programs by food manufacturers, to the development of twin target markets for adults and children in many food categories (Jean-Xavier, 2001), and to requirements for palatable, healthy and nutritious food for children amidst trends towards convenience foods and demands for responsible nutrition. The sensory properties of any food item are important determinants of its acceptance among consumers, and as a result, the need for sound methodology for sensory testing with children has increased (ASTM, 1992; Guinard, 2001; ASTM, 2003). The principal objective of this effort was to test the acceptability of nutritionally balanced school meals developed to substitute existing conventional breakfast meal served to needy students at most of the Sudanese primary (Basic) schools. The test also embraced satiety profile of meals to answer their level of stomach fulfillment during the school hours.

2. Methodology

Based on an earlier preliminary study by Ahfad University for Women (AUW) team, (NHCTR, 2017) concerning acceptability and quality of several school meals, only five meals were then selected and developed by Samil Industrial Co., Onyx, and Tweed Research Center of Nutriset Group, based on plant foods (e.g., soybean, chickpea, lentil, peanuts, etc.), and dairy ingredients, in a form of pastes. The meals were additionally fortified with recommended gaps in Iron, Iodine, Zinc, Vitamins of A, B9, B12, and C.

A total of ~200 school children (6-9 year juniors; 10-14 year seniors) studying at one of Omdurman City (Sudan) primary schools were selected to assure minimum classes attendance of 180 children throughout the study. Recruited students were served ethically (DIUS, 2007) developed meals in a form of paste-in sachets (100 g each) for 15 school days plus 5 days given to the reference conventional school meal prepared traditionally from boiled salted or sweetened pigeon pea colloquially called “Balila” and served routinely to the children as a school meal.

Using a concise questionnaire consisted of elements relevant to sensorial issues (Brace, 2004), the students with the help of the study group, were asked to judge on the five products (meals) guided by multi- descriptive sensory evaluation techniques (Gordin, 1987; ISO, 1988; Poste et al., 1991; Lawless & Heymann, 1998; Schutz & Cardello, 2001; Meilgaard et al., 2007), and facial drawing procedures to express level of satisfaction by one of three choices (Happy face that reflects acceptance of product; no- expression face that expresses neither/nor decision; and sad face that expresses rejection of the product) simplified to suit their level of perception (Goldstein, 2006).

3. Results and Discussion

Table 1 shows distribution and number of school students served school meals by class and age group. The initial week started with serving the conventional school meal (Balila) for 5 days as a control, followed by the newly developed products (5 of them; A: Soy based product “Vitamamba”; B: Lentil based product; C: Lentil based product + inclusion product; D: Chick pea based product; E: Chick pea based product + inclusion product) served for consecutive 15 school study days giving 3 alternating days for each product. The number of students receiving breakfast meal daily for 5 days ranged between 38-54 for males and 39-55 for females from the junior class; 6-9 years (3rd grade) giving a total range of 81-109 students of this category. Similarly, the number of students from the senior class; 10-14 years (7th grade) receiving the same meal for the same period of time ranged between 35-55 for males, and 41-53 for females giving a total range of 79 to 105 students of this category. Table 1 itself shows a total of 1854 meals offered to students from the juniors and 1844 meals offered to students from the seniors by the end of the study.

Table 1. Distribution and Number of Meals for School Students Served by Class and Age Group

Junior students -Class 3 (age 6-9)							Senior students -Class 7 (age 10-14)							Total of meals/gendre				
		Total	M	%	F	%			Total	M	%	F	%	Total	M	%	F	%
Week 1 (Balila meal)	Sunday	86	44	51.2	42	48.8	week 1 Balila meal	Sunday	100	55	55	45	45	186	99	53.2	87	46.8
	Monday	83	44	53.0	39	47.0		Monday	105	52	49.5	53	50.5	188	96	51.1	92	48.9
	Tuesday	82	38	46.3	44	53.7		Tuesday	85	40	47.1	45	52.9	167	78	46.7	89	53.3
	Wednesday	106	51	48.1	55	51.9		Wednesday	92	45	48.9	47	51.1	198	96	48.5	102	51.5
	Thursday	109	54	49.5	55	50.5		Thursday	79	35	44.3	44	55.7	188	89	47.3	99	52.7
Week 2	A	88	42	47.7	46	52.3	Week2	A	91	47	51.6	44	48.4	179	89	49.7	90	50.3
Paste Products	B	81	40	49.4	41	50.6		B	92	47	51.1	45	48.9	173	87	50.3	86	49.7

Week 3 Paste Products	C	92	49	53.3	43	46.7	Week3	C	95	47	49.5	48	50.5	187	96	51.3	91	48.7
	D	88	43	48.9	45	51.1		D	93	44	47.3	49	52.7	181	87	48.1	94	51.9
	E	94	45	47.9	49	52.1		E	94	45	47.9	49	52.1	188	90	47.9	98	52.1
	A	90	45	50.0	45	50.0		A	90	42	46.7	48	53.3	180	87	48.3	93	51.7
	B	95	45	47.4	50	52.6		B	89	45	50.6	44	49.4	184	90	48.9	94	51.1
	C	98	49	50.0	49	50.0		C	89	48	53.9	41	46.1	187	97	51.9	90	48.1
	D	97	49	50.5	48	49.5		D	92	45	48.9	47	51.1	189	94	49.7	95	50.3
	E	98	50	51.0	48	49.0		E	99	51	51.5	48	48.5	197	101	51.3	96	48.7
	A	88	49	55.7	39	44.3		A	93	44	47.3	49	52.7	181	93	51.4	88	48.6
	B	91	47	51.6	44	48.4		B	92	48	52.2	44	47.8	183	95	51.9	88	48.1
Week 4 Paste Products	C	92	45	48.9	47	51.1	Week4	C	88	45	51.1	43	48.9	180	90	50.0	90	50.0
	D	97	49	50.5	48	49.5		D	89	44	49.4	45	50.6	186	93	50.0	93	50.0
	E	99	50	50.5	49	49.5		E	97	47	48.5	50	51.5	196	97	49.5	99	50.5
	Total intervention		1854	928	50.1	926		49.9	Total		1844	916	49.7	928	50.3	3698	1844	1854
Average per day (20 school days)														185	92	93		

M: Male; F: Female.

A: Soy based product Vitamamba; B: Lentil based product; C: Lentil based product + inclusion product; D: Chick pea base product; E: Chick pea based + inclusion product.

Figures 1 and 2 (Tables 2a and 2b, respectively) show percent contribution by junior female and male students, and senior ones, respectively, receiving Balila in first week calculated from total. It was obvious that senior females were more punctual to attending school classes (Table 2b; Figure 2), the observation that concerned us for the following three weeks assigned for serving the newly developed meals. The negative fluctuation in percent number of junior female and male students (Table 3) receiving new meals was tolerable and seems normal with respect to students' daily attendance. Surprisingly, unlike the junior students, the week following the initial Balila week witnessed positive fluctuation in number of senior participants (Table 4) which would suggest more or less consistency in number of juniors and seniors male and female students who participated to the four week testing program.

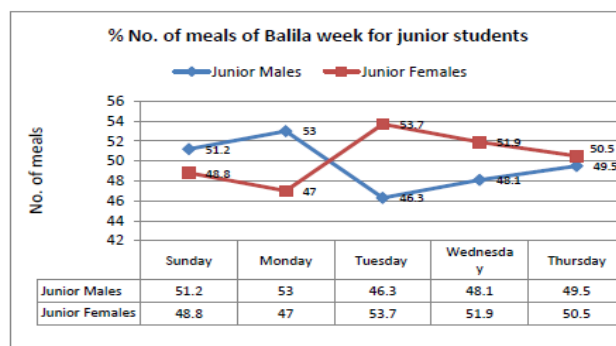


Figure 1 (Table 2a). Percent Contribution by Junior Male and Female Students to the Feeding Test during Balila Week

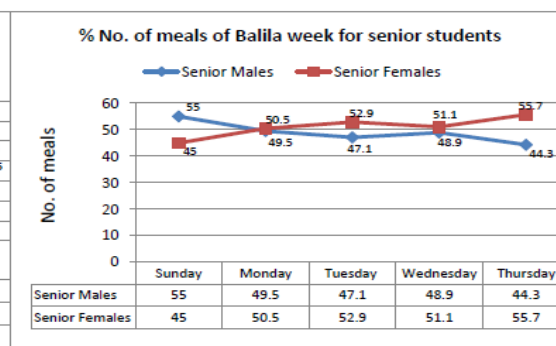


Figure 2 (Table 2b). Percent Contribution by Senior Male and Female Students to the Feeding Test during Balila Week

The increase or decrease in number of students taking the meals during the course of the study did not reflect improvement or decline in school attendance, since the latter phenomenon is associated with certain factors such as in-door or out-door school activities. The second week of serving newly developed products (Tables 3 and 4) started to partially reflect actual response of participant's contribution to taking the new meals. The same second week of feeding the new meals witnessed highest number of meals served (478 meals) with a slight decrease in the final week (467 meals) mainly coming from female students due to certain domestic school reasons beyond acceptability factors.

Table 3. Percent Contribution by Junior Male and Female Students to Taking New Products for 3 Weeks

Serving week	Product A				Product B				Product C				Product D				Product E			
	Male		Female		Male		Female		Male		Female		Male		Female		Male		Female	
	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%
Week 1	42	47.7	46	52.3	40	49.4	41	50.6	49	53.3	43	46.7	43	48.9	45	51.1	45	47.9	49	52.1
Week 2	45	50	45	50	45	47.4	50	52.6	49	50	49	50	49	50.5	48	49.5	50	51.5	48	49
Week 3	49	55.7	39	44.3	47	51.6	44	48.4	45	48.9	47	51.1	49	50.5	48	49.5	50	50.5	49	49.5

F= frequency

A: Soy based product Vitamamba; B: Lentil based product; C: Lentil based product + inclusion product; D: Chick pea base product; E: Chick pea based + inclusion product.

Table 4. Percent Contribution by Senior Male and Female Students to Taking New Products for 3 Weeks

Serving week	Product A				Product B				Product C				Product D				Product E			
	Male		Female		Male		Female		Male		Female		Male		Female		Male		Female	
	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%
Week 1	47	51.6	44	48.4	47	51.1	45	48.9	47	49.5	48	50.5	44	47.3	49	52.7	45	47.9	49	52.1
Week 2	42	46.7	48	53.3	45	50.6	44	49.4	48	53.9	41	46.1	45	48.9	47	51.1	51	51.5	48	48.5
Week 3	44	47.3	49	52.7	48	52.2	44	47.8	45	51.1	43	48.9	44	49.4	45	50.6	47	48.5	50	51.5

F= frequency

A: Soy based product Vitamamba; B: Lentil based product; C: Lentil based product + inclusion product; D: Chick pea base product; E: Chick pea based + inclusion product.

Tables 5 and 6 show response of senior and junior students, respectively; to finishing the whole new meal, in other words finishing the whole sachet content (100 g) of 5 products (A, B, C, D, and E) presented to the students for 3 successive weeks (15 school days). Balila meal was taken as in-memory

control against all products presented to the students. The number of the senior students (10-14 years) finishing the whole sachet content (Table 5) increased by serving days (weeks 2 and 3) with all products presented, although products B (lentil- based) and D (Chick pea- based) showed better consumption (> 95% of participants) compared to the rest of the products. Soya based product (A) seemed to be least acceptable to senior students by the end of the test. The response of junior students (6-9 years) to finishing the whole sachet content is shown in Table 6. Surprisingly, juniors seemed to have different opinion on the products by giving product A (Soy-based) the lead in finishing whole sachet content by the end of the feeding test period of time (> 95% of participants), followed by products C (Lentil/Inclusion-based), and B(Lentil-based) which registered 93.5% and 93.4% number of participants, respectively, finishing the whole sachet contents. With juniors, product E (Chick pea/Inclusion-based) was the least tempting to finish it all.

Table 5. %Response of Senior Students to Finishing the Whole Meal

Serving week		Product A		Product B		Product C		Product D		Product E	
		Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%
week 1	Yes	67	73.6	72	78.3	67	70.5	79	84.9	70	74.5
	No	24	26.4	20	21.7	28	29.5	14	15.1	24	25.5
	Total	91	100	92	100	95	100	93	100	94	100
week 2	Yes	74	82.2	84	94.4	78	87.6	85	92.4	93	93.9
	No	16	17.8	5	5.6	11	12.4	7	7.6	6	6.1
	Total	90	100	89	100	89	100	92	100	99	100
week 3	Yes	84	90.3	88	95.7	81	92.0	85	95.5	90	92.8
	No	9	9.7	4	4.3	7	8.0	4	4.5	7	7.2
	Total	93	100	92	100	88	100	89	100	97	100

A: Soy based product Vitamamba; B: Lentil based product; C: Lentil based product + inclusion product;

D: Chick pea base product; E: Chick pea based + inclusion product.

Table 6. %Response of Junior Students to Finishing the Whole Meal

Serving week		Product A		Product B		Product C		Product D		Product E	
		Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%
week 1	Yes	68	77.3	69	85	79	86	74	84	79	84
	No	20	22.7	12	15	13	14	14	16	15	16
	Total	88	100	81	100	92	100	88	100	94	100
week 2	Yes	80	88.9	82	86	88	90	88	91	90	92
	No	10	11.1	13	14	10	10	9	9	8	8
	Total	90	100	95	100	98	100	97	100	98	100

week 3	Yes	84	95.5	85	93	86	93	89	92	90	91
	No	4	4.5	6	7	6	7	8	8	9	9
	Total	88	100	91	100	92	100	97	100	99	100

A: Soy based product Vitamamba; B: Lentil based product; C: Lentil based product + inclusion product;
D: Chick pea base product; E: Chick pea based + inclusion product.

Tables 7 and 8 show responses of senior and junior students, respectively; to reasons for not finishing the whole contents of sachet (whole meal). None of the senior students (Table 7) expressed any dislike for finishing 3 products (C: Lentil+ Inclusion; D: Chick pea; & E: Chick pea+ Inclusion) during the entire 3 weeks testing. About fifth or even less (11-19%) of the senior students expressed dislike as a reason for not finishing Soy-based product (Product A). Palatability of any product decides most of the time length of tolerability and hence decision of continue taking any meal (Gregory & Kadri, 2015). The junior students' behaviour in finishing the whole meal is shown in Table 8. It seems that the 100g material offered in sachet was too much for most of them since more than two third of them felt they had enough (stomach full) before finishing the sachet content. The latter feeling is slightly different from that full satisfaction feeling expected to reflect lingering satiety during the school hours. Product D (Chick pea based) seemed to be the favourite for juniors, followed by product B (Lentil based).

Table 7. %Response of Senior Students to Reasons for not Finishing the Whole Meal

Serving week	Response	Product A		Product B		Product C		Product D		Product E	
		Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%
week 1	Dislike	3	12.5	1	5.0	0	0.0	0	0.0	0	0.0
	Had enough	15	62.5	11	55.0	20	71.4	9	64.3	1	4.2
	Fully satisfied	6	25.0	8	40.0	8	28.6	5	35.7	23	95.8
	Total	24	100	20	100	28	100	14	100	24	100
week 2	Dislike	3	18.8	0	0.0	0	0.0	0	0.0	0	0.0
	Had enough	12	75.0	5	100.0	1	9.1	7	100.0	6	100.0
	Fully satisfied	1	6.3	0	0.0	10	90.9	0	0.0	0	0.0
	Total	16	100	5	100	11	100	7	100	6	100
week 3	Dislike	1	11.1	0	0.0	0	0.0	0	0.0	0	0.0
	Had enough	6	66.7	3	75.0	7	100.0	4	100.0	7	100.0
	Fully satisfied	2	22.2	1	25.0	0	0.0	0	0.0	0	0.0
	Total	9	100	4	100	7	100	4	100	7	100

A: Soy based product Vitamamba; B: Lentil based product; C: Lentil based product + inclusion product;
D: Chick pea base product; E: Chick pea based + inclusion product.

Table 8. %Response of Junior Students to Reasons for not Finishing the Whole Meal

Serving week	Response	Product A		Product B		Product C		Product D		Product E	
		Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%
week 1	Dislike	2	10	1	8.3	0.0	0.0	0.0	0.0	0.0	0.0
	Had enough	18	90	9	75.0	12.0	92.3	14.0	100	14.0	93.3
	Fully satisfied	0	0	2	16.7	1.0	7.7	0.0	0.0	1.0	6.7
	Total	20	100	12	100	13.0	100	14.0	100	15.0	100
week 2	Dislike	1	10	0	0	0.0	0	0.0	0	0.0	0
	Had enough	7	70	12	92.3	10.0	100.0	9.0	100	7.0	87.5
	Fully satisfied	2	20	1	7.7	0.0	0.0	0.0	0.0	1.0	12.5
	Total	10	100	13	100	10.0	100	9.0	100	8.0	100
week 3	Dislike	0	0	0	0.0	1.0	16.7	0.0	0.0	0.0	0.0
	Had enough	3	75	6	100	5.0	83.3	8.0	100	7.0	77.8
	Fully satisfied	1	25	0	0.0	0.0	0.0	0.0	0.0	2.0	22.2
	Total	4	100	6	100	6	100	8	100	9	100

A: Soy based product Vitamamba; B: Lentil based product; C: Lentil based product + inclusion product; D: Chick pea base product; E: Chick pea based + inclusion product.

Tables 9 and 10 show time needed for senior and junior students to finish and/or stop taking more of the meal. It was obvious that more than 90% of the senior students (Table 9) did not take much time (≤ 10 minutes) in finishing or stop taking the sachet content of all the 5 products offered to them successively on daily basis. The positive side of this test outcome is that the sachet content (the paste), was easily chewable, non-sticky, easily swallowed, and palatable enough to hasten the eating process. The latter characteristic usually encourages eaters to continue taking more or finishing any stuff offered (Barbara & Sandra, 2010). Table 10 also shows the time taken by junior students to finish or stop taking the sachet content. Although more than two third ($> 68\%$) of the junior participants needed 10 minutes only or even less to finish the meal, the other one third is of concern to us for reasons that made them took 15 minutes or more to finish lentil - based pastes (B&C). Lentil is a conventional legume to all Sudanese particularly to school meals planning and preparations (Federal Ministry of Health, 2006).

Table 9. Time Needed by Senior Students to Finish and/or Stop Taking more of the Meal

Serving	Finishing	Product A		Product B		Product C		Product D		Product E	
week	time	Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Week 1	≤10 minutes	82	90	86	93	92	97	91	98	90	96
	~15 minutes	7	8	6	7	3	3	2	2	4	4
	>15 minutes	2	2	0	0	0	0	0	0	0	0
	Total	91	100	92	100	95	100	93	100	94	100
Week 2	≤10 minutes	86	96	84	94	88	99	90	98	98	99
	~15 minutes	4	4	4	4	1	1	2	2	1	1
	>15 minutes	0	0	1	1	0	0	0	0	0	0
	Total	90	100	89	100	89	100	92	100	99	100
Week 3	≤10 minutes	89	96	90	98	88	100	85	96	93	96
	~15 minutes	4	4	2	2	0	0	4	4	4	4
	>15 minutes	0	0	0	0	0	0	0	0	0	0
	Total	93	100	92	100	88	100	89	100	97	100

A: Soy based product Vitamamba; B: Lentil based product; C: Lentil based product + inclusion product;

D: Chick pea base product; E: Chick pea based + inclusion product.

Table 10. Time Needed by Junior Students to Finish and/or Stop Taking more of the Meal

Serving	Finishing	Product A		Product B		Product C		Product D		Product E	
week	time	Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Week 1	≤10 minutes	71	80.7	56	93	67	97	60	98	77	96
	~15 minutes	16	18.2	17	7	19	3	23	2	15	4
	>15 minutes	1	1.1	8	0	6	0	5	0	2	0
	Total	88	100	81	100	92	100	88	100	94	100
Week 2	≤10 minutes	86	95.6	77	81.1	84	85.7	79	81.4	75	76.5
	~15 minutes	4	4.4	16	16.8	14	14.3	16	16.5	15	15.3
	>15 minutes	0	0.0	2	2.1	0	0.0	2	2.1	8	8.2
	Total	90	100	95	100	98	100	97	100	98	100
Week 3	≤10 minutes	65	73.9	65	71.4	67	72.8	82	84.5	86	86.9
	~15 minutes	22	25.0	25	27.5	25	27.2	15	15.5	13	13.1
	>15 minutes	1	1.1	1	1.1	0	0.0	0	0	0	0
	Total	88	100	91	100	92	100	97	100	99	100

A: Soy based product Vitamamba; B: Lentil based product; C: Lentil based product + inclusion product;

D: Chick pea base product; E: Chick pea based + inclusion product.

Tables 11 and 12 show responses of senior and junior students, respectively; to degree of satiety feeling during class room hours following meal intake. Feeling full satiety by senior students (Table 11) during the school hours was improved towards the third week of testing the new products. By the end of the feeding test, product B (Lentil based) proved to fulfil that degree of satiety (100%) intended to quench hunger until the students finish their lessons and go back home. The other products were by no means less than B in giving that feeling (97.6-98.9% degree of satiety) of full satiety although sachet content of some of them were not fully consumed by seniors (Table 5) compared to B product. Table 12 shows fluctuation in degree of satiety feeling among junior students during the school hours following meal taking in the first and second weeks of the serving process, with more or less satisfactory degree of satiety offered by all the products by the end of the third week (94.1-98.9%). It then becomes hard to judge on poorness of any of them.

Table 11. Response of Senior Students to Degree of Satiety during Class Room Hours following Meal Taking

Serving week	Satiety response	Product A		Product B		Product C		Product D		Product E	
		Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%
week 1	No Satiety	1	1.5	1	1.4	0	0.0	1	1.3	0	0.0
	Not Sure	11	16.4	7	9.7	9	13.4	11	13.9	5	7.1
	Full Satiety	55	82.1	64	88.9	58	86.6	67	84.8	65	92.9
	Total	67	100	72	100	67	100	79	100	70	100
week 2	No Satiety	0	0.0	1	1.2	2	2.6	1	1.2	0	0.0
	Not Sure	1	1.4	4	4.8	7	9.0	4	4.7	3	3.2
	Full Satiety	73	98.6	79	94.0	69	88.5	80	94.1	90	96.8
	Total	74	100	84	100	78	100	85	100	93	100
week 3	No Satiety	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Not Sure	2	2.4	0	0.0	1	1.2	1	1.2	1	1.1
	Full Satiety	82	97.6	88	100.0	80	98.8	84	98.8	89	98.9
	Total	84	100	88	100	81	100	85	100	90	100

A: Soy based product Vitamamba; B: Lentil based product; C: Lentil based product + inclusion product; D: Chick pea base product; E: Chick pea based + inclusion product.

Table 12. Response of Senior Students to Degree of Satiety during Class Room Hours following Meal Taking

Serving	Satiety	Product A		Product B		Product C		Product D		Product E	
week	response	Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%
week 1	No Satiety	0	0	0	0.0	1	1.3	0	0.0	1	1.3
	Not Sure	0	0	5	7.2	2	2.5	10	13.5	10	12.7
	Full Satiety	68	100	64	92.8	76	96.2	64	86.5	68	86.1
	Total	68	100	69	100	79	100	74	100	79	100
week 2	No Satiety	0	0.0	3	3.7	2	2.3	0	0.0	0	0.0
	Not Sure	1	1.3	7	8.5	5	5.7	3	3.4	1	1.1
	Full Satiety	79	98.8	72	87.8	81	92.0	85	96.6	89	98.9
	Total	80	100	82	100	88	100	88	100	90	100
week 3	No Satiety	2	2.4	2	2.4	0	0.0	1	1.1	1	1.1
	Not Sure	2	2.4	3	3.5	2	2.3	0	0.0	1	1.1
	Full Satiety	80	95.2	80	94.1	84	97.7	88	98.9	88	97.8
	Total	84	100	85	100	86	100	89	100	90	100

A: Soy based product Vitamamba; B: Lentil based product; C: Lentil based product + inclusion product; D: Chick pea base product; E: Chick pea based + inclusion product.

In conclusion, senior students (10-14 years) seemed to have appreciated paste meal based on lentil or chick pea as reflected in finishing all the meals in less than 10 minutes and also showed full- satiety feeling during the daily school hours. One fifth of the seniors expressed dislike for soy based paste as a reason for not finishing the paste. With respect to junior students (6-9 years), they seemed to have different opinions by showing more appreciation to the soy-based paste and taking less time to finish the product, although they expressed full- satiety feeling with all the products during the daily school hours.

References

- ASTM. (1992). *American Society for Testing and Materials; Committee E-18. Manual on Descriptive Analysis for Sensory Evaluation* (R. C. Hootman, Ed.). Philadelphia, PA, MNL.
- ASTM. (2003). *American Society for Testing and Materials; E2299-03. Standard Guide for Sensory Evaluation of Products by Children*. Philadelphia, PA.
- Barbara, B., & Sandro, D. (2010). Nutrition and Consumer Protection Division, FAO. *Proceedings of the International Scientific Symposium Biodiversity and Sustainable Diets*. United Against Hunger. FAO Headquarters, Rome.
- Black, R. E., Allen, H. L., & Bhutta, Z. A. (2008). Maternal and child under nutrition: Global and

- regional exposures and health consequences. *Lancet*, 371, 243-260.
- Brace, I. (2004). *Questionnaire Design: How to Plan, Structure and Write Survey Material for Effective Market Research*. Kogan Page, Philadelphia, PA.
- Jean-Xavier G. (2001). Sensory and consumer testing with children, *Trends in Food Science and Technology*, 11 (8) 273-283
- DIUS. (2007). *Department for Innovation, Universities and Skills Rigour, respect and responsibility: A universal ethical code for scientists*.
- FAO, (2009). *Declaration of the World Summit on Food Security*, WSFS 2009/2, 16 November 2009.
- FAO, (2006). *Policy Brief, Issue 2: Food Security*. Rome.
- Federal Ministry of Health. (2006). *Policy - Nutrition Policy for Sudan and Strategy for Implementation Comprehensive national nutrition policy, strategy or plan*.
- Goldstein, E. B. (2006). *Sensation and Perception*. Wadsworth Publishing, Florence, KY.
- Gordin, H. H. (1987). Intensity variation descriptive methodology: Development and application of a new sensory evaluation technique. *Journal of Sensory Studies*, 2, 187-198. <https://doi.org/10.1111/j.1745-459X.1987.tb00416.x>
- Gregory, C. A., & Kadri, K. (2015). *Pet Food Palatability Evaluation: A Review of Standard Assay Techniques and Interpretation of Results with a Primary Focus on Limitations, Animals (Basel)* (Vol. 5, No. 1, pp. 43-55).
- Guinard, J. X. (2001). Sensory and Consumer Testing with Children. *Trends in Food Science and Technology*, 11, 273-283. [https://doi.org/10.1016/S0924-2244\(01\)00015-2](https://doi.org/10.1016/S0924-2244(01)00015-2)
- ISO. (1988). International Organization of Standards. *ISO 8587: Methods for sensory analysis of food*.
- Lawless, H. T., & Heymann, H. (1998). *Sensory Evaluation of Food: Principles and Practices*. Springer, N.Y.
- Meilgaard, M., Civille, C. V., & Carr, B. T. (2007). *Sensory Evaluation Techniques* (4th ed.). CRC, Boca Raton, FL.
- NHCTR, Nutrition & Health Center for Training & Research. (2017). *Technical Report on "The Acceptability of School Meals Developed Based on Plant Sources Test No. I"*. NHCTR, AUW, Sudan.
- NHCTR, Nutrition & Health Center for Training & Research. (2018). *Technical Report on "The Acceptability of School Meals Test No. II"*. NHCTR, AUW, Sudan.
- Poste, L. M., MacKie, D. A., Butler, G., & Larmond, E. (1991). *Laboratory Methods for Sensory Analysis of Food*. Canadian Group; Publishing Centre, Ottawa, Canada.
- Schutz, H. G., & Cardello, A. V. (2001). A labeled affective magnitude (LAM) scale for assessing food liking / disliking. *Journal of Sensory Studies*, 16, 117-159. <https://doi.org/10.1111/j.1745-459X.2001.tb00293.x>
- Sudan Ministry of General Education, (2008). *Baseline Survey on Basic Education on the Northern States of Sudan*. Directorate General of Educational Planning, Khartoum, Sudan.