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Nutritional Evaluation of Some Prepared Baby's Complementary Food Mixtures for Weaning Period

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Abstract: Pomegranate molasses and orange juice are very good source of vitamins and minerals which needed for healthy growth, and widely available in the Egyptian market. They were used to enrich different formulated baby food mixtures with vitamins and minerals. Nine baby food mixtures were prepared using carrots, oats, apples and sweet potatoes as basic components and enriched with, pomegranate and orange juice. Organoleptic, chemical composition, minerals and vitamins were evaluated for all the prepared mixtures. Mixture numbers 6 and 5 had the highest overall acceptance which enriched with orange juice and pomegranate molasses and orange juice only respectively with the basic components. Highest protein and fibers (2.39 and 8.3%) were observed in mixture numbers 8 and 7 respectively while mixture number 6 contained the highest value of fat and carbohydrate (0.56 and 95.8%). Mixture number 3 which consists of carrot, oat,orange juice and pomegranate molasses contained the highest level of iron, calcium, sodium and magnesium while mixture number 9 which consists of sweet potato, orange juice and pomegranate molasses contained the highest level of zinc and potassium. The highest level of contents of beta carotene, vitamins E and C were 0.1218, 0.1022 and 3.7308 mg/100gm in mixture numbers 9, 8 and 3 respectively. While the lowest levels of vitamin contents were 0.0474 and 0.0032 mg/100gm for beta carotene, vitamin E in mixture number 1 and 1.8493 mg/100gm for vitamin C in mixture number 7. The addition of orange juice and pomegranate molasses led to improvement in the contents of beta carotene, vitamins E and C in all the baby foodmixtures. The highest levels of vitamin B group contents were 1.6184, 1.267, 4.615, 2.571 and 1.633 mg/100gm for vitamins B1, B2, B3, B6 and B9 respectively. The baby mixture number 8 which consists of sweet potato and orange juice had the highest level of vitamin B group. The formulated baby food mixtures have good nutrition value and good source of vitamins and minerals and can be prepared easily at home with low cost. Diversity of baby mixture ingredients will help to get the benefits (minerals and vitamins) of each component and prepare a nutritious complementary baby food mixture.

Key words: Pomegranate Molasses · Orange Juice · Complementary Baby Food Mixtures · Carrot · Sweet Potato · Apple · Oat

INTRODUCTION

Under nutrition is one of the major problems confronting infants and young children in the developing countries. However, at the age of six months and above when the child's birth weight is expected to have doubled, breast milk is no longer sufficient to meet the nutritional needs of the growing infant. Most children between the age 4 months and 2 to 3 years suffer from malnutrition [1, 2]. Weaning of a child is a gradual process by which an infant is introduced to adult diet. Weaning food is a special formulation, which is a supplement to the breast milk. The composition will be as close as possible to breast milk except for high calories and protein values. Breast milk from a well-nourished mother is inadequate to meet nutritional needs of an infant for the first three months of life; therefore, there is need for supplement or weaning food [3].Vegetable based foods are easy to digest and offer high nutrient density [4]. Therefore baby puree made out of carrots, parsnips or potatoes plays a major role in early nutrition. Carrots are considered to have high nutritional value and are mostly the first vegetable the babies receive after breast feeding. Therefore, carrots were chosen as the model vegetable for

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this study. The nutritional quality, sensory and food safety of baby puree, e.g. from carrots, is influenced by many factors within the production steps. They are, for example, the quality of raw material, the pre-processing as well as the processing conditions. Vitamin E is relatively safe compared to other fat-soluble vitamins. Peeled baby carrots are high in nutrients, such as carotene, vitamin C and dietary fiber, but a poor source of calcium and vitamin E according to USDA [5].

Oats are a major component of infant's foods due to their high nutritional profile, lack of allergenicity, palatable favour, good shelf-life, stability and low cost. Food used for oats include oat bran, oat meal, oat flour and oat flakes which are mainly used for breakfast cereals. Porridge, hot cereals, bread, biscuits, infant food, muesli and granola bars are a few examples of food products produced from oats. Oat flour is also used as a thickener in many infants' foods [6].

Sweet potato, a tuber widely across the World (Africa, Asia, America, Caribbean and Europe) and very affordable, supplies the body with major and vital nutrients (Carbohydrates, fat, proteins, vitamins) needed for good body development. Therefore, sweet potato can be used as an ingredient in weaning food for babies. For this purpose it needs to be boiled and mashed into a paste before being served to babies [7].

Strict guidelines: However, being an important supplement to children diet and/or for their progressive adaptation to ordinary food, the nutritional quality of commercial fruit baby food is very important [4].

Nutritive value of baby food deeply depends on the composition, what raw materials are used and what are the proportions of fruit or vegetable content. A part as the supply of energy the fruit baby food are perceived as the fiber, ascorbic acid, polyphenols and other antioxidants sources based on the fruit (Vegetable) content and composition [8, 9]. Minerals are inorganic substances required by the body in small amounts for a variety of functions. These include the formation of bones and teeth; as essential constituents of body fluids and tissues; as components of enzyme systems and for normal nerve function. Some minerals are needed in larger amounts than others, e.g. calcium, phosphorus, magnesium, sodium, potassium and chloride. Others are required in smaller quantities and are sometimes called trace minerals, e.g. iron, zinc, iodine, fluoride, selenium and copper. Despite being required in smaller amounts, trace minerals are no less important than other minerals. Minerals are often absorbed more efficiently by the body if supplied in foods rather than as supplements. Also, a diet that is short in one mineral may well be low in others and so the first step in dealing with this is to review and improve the diet as a whole. Eating a varied diet will help ensure an adequate supply of most minerals for healthy people. As reported by British Nutrition Foundation [10].

Vitamins are molecules required by the body in small amounts for a variety of essential processes in the body. They are classified as micronutrients because they are normally required in small amounts: usually a few milligrams (mg) or micrograms (μg) per day. Most vitamins cannot be synthesized by the body so must be obtained by the diet. If insufficient amounts of vitamins are available to the body because of a poor diet or some medical condition, such as mal-absorption disorders or inborn errors of metabolism, a deficiency disease can develop as reported by British Nutrition Foundation [11] Early weaning practices are one of the most important reasons of malnutrition of weaning children which ultimately increase the chance of infant morbidity and mortality. The weaning period is the most critical phase of infant's life. During this period mother's milk is not generally adequate to cover the nutritional requirements and support body growth. Weaning foods are generally introduced between the ages of six months to one year old as breastfeeding is discontinued [12]. In most developing countries commercial weaning foods of excellent quality either imported or locally produced are presently available, but due to sophisticate processing, expensive packing, extensive promotion and solid profit margins, the price of these commercial products are generally in the order of 10-15 times the cost of the common staple foods. While these products are generally highly appreciated and their use and value are well understood, they are priced beyond the purchasing power of the majority of population in the lower income groups, who spent already about 50-75% of their income in common foods [13].

The aim of this study is to prepare some complementary baby food mixtures rich in minerals and vitamins for weaning period (6-12 months) using available and cheap ingredients.

MATERIALS AND METHODS

Sweet potato, Apple, Carrot, Oat, Pomegranate and Orange were purchased from local market in Dokki, Giza Governorate, Egypt.

Methods: Formulation and processing were done under ambient laboratory conditions. Sweet potato, apple, oat and carrot were blanched by steam until become soft. All ingredients were mixed using multi Moulintt Mixer

Table 1: Ingredients of Baby Food Mixtures.

Basic Ingredients	Mixture No.	Mixture Ingredients
Carrot Group	1	Carrot 90% +Oat 10%
	2	Carrot 80 % +Oat 10% + Orange juice 10%
	3	Carrot 70% + Oat 10%+Orange juice 10 %+ Pomegranate molasses 10 %
Apple Group Pomegranate molasses 10 %	4	Apple 90% + Oat 10%
	5	Apple 80 % + Oat 10% + Orange juice 10%
	6	Apple 70% + Oat 10%+Orange juice 10%+ Pomegranate molasses 10 %
Sweet Potato Group Pomegranate molasses 10 %	7	Sweet Potato 100%
	8	Sweet Potato 90% + Orange juice 10%
	9	Sweet Potato 80 % + Orange juice 10% + Pomegranate molasses 10 %

(Moulinex, France). Twelve baby food mixtures were prepared using the basic ingredients (Carrots, apples and sweet potatoes) and supplemented with orange juice and pomegranate molasses. Three mixtures (Which included pomegranate only with the basic ingredients) of twelve were excluded based on the panel testing (Refused taste and color). The ingredients of each mixture are shown in Table (1).

Preparation of Orange Juice and Pomegranate Molasses: Orange juice was prepared according to Zein *et al.* [14] and pomegranate molasses was prepared according to Arafa [15].

Physical Properties of Prepared Baby Food Mixtures: pH of each fresh mixture samples were determined by using Digital pH- meter (Wen way, model 3020 Dunnou, Essey, UK) at room temperature. Viscosity (CP) measurement was carried out by the Brookfield Digital Viscometer Model DV-II+ A., temperature-controlled water bath was used to regulate the temperature of the samples according to Pastor *et al*. [16]. Total soluble solids were quantified by using Abbe Mat Refractometer (Milton Roy Co., USA) at 21°C [17].

Chemical Analysis

Chemical Analysis of Prepared Baby Food Mixtures: Moisture, protein, crude fiber, fat, ash contents and minerals (Fe, Ca, P and Zn) of the prepared mixture were determined according to the method described in AOAC [18]. Total carbohydrate were calculated by difference. Total calories were calculated as mentioned by Kerolles [19] according to the following equation: Total calories = 4 (protein + Carbohydrates) + 9 (fat).

Mineral Contents: The prepared mixtures were analyzed for mineral profile following the protocols described in AOAC [20]. Mineral were determined by Perkin-Elemer 3300 atomic absorption spectro-photometer-Analytical Jena.

Sensory Evaluation: Nine fresh baby food mixtures were sensory evaluated at zero time according to Metwalli *et al*. [21] by ten panelists from the staff members of Food Technology Research Institute at Agricultural Research Center "ARC". The scoring scheme was established for odor, taste, color, texture and overall acceptance.

Determination ß-carotene and Á -Tocopheral Acetate Analysis: The analyses of ß -carotene and á-tocopheral acetate were conducted using a modified method from Howard and Dewi [22].

Determination of Vitamin C (L-Ascorbic Acid): L-Ascorbic acid of different baby food mixtures were determined according to the method described in the AOAC [23] using High Performance Liquid Chromatography (HPLC) Beckman model.

Determination of vitamin B1, B2, B3, B6 and B9 Contents: Vitamins B1 (Thiamin), B2 (Riboflavin), B3 (niacin), B6 (Pyroxidine) and B9 (Folic acid) of different meals were determined according to the method described in the AOAC [23] using High Performance Liquid Chromatography (HPLC) Beckman model.

Microbiological Evaluation: The following examinations were done for all prepared mixtures: Total bacterial count, (On standard plate count agar), Yeast and Mold were enumerated according to American Public Health Association Methods APHA [24].

Statistical Analysis: The obtained data from sensory evaluation and compositions were statistically analyzed by the Least Significant Differences value (LSD) at 0.05 levels probability according to the procedure of Mohan *et al*. [25].

Table 2: Sensory Evaluation of Baby Food Mixtures

Mix. No.	Mixture Ingredients	Odor (10)	Taste (10)	Color (10)	Texture (10)	Acceptance (10)
1	Carrot + Oat	7.818 ^{A}	7.636 ^{B}	9.000 ^{A}	8.636 ^{AB}	8.091 ^{AB}
2	Carrot + Oat+ Fresh orange juice	8.000 ^{A}	7.918 ^{B}	9.000 ^{A}	8.545 ^{AB}	8.182 ^{AB}
3	Carrot + Oat+ Fresh orange juice + Pomegranate molasses	8.182 ^{A}	8.091 ^{AB}	8.773 ^{A}	8.136 ^{C}	8.364 ^{AB}
4	Apple + Oat	8.091 ^{A}	8. 091 ^{AB}	8.373 ^{CB}	7.909 ^{ABC}	7.727 ^{B}
5	Apple + Oat+ Fresh orange juice	8.128 ^{A}	8.718 ^{B}	8.727 ^{A}	8.364 ^{BC}	8.591 ^{AB}
6	Apple + Oat+ Fresh orange juice+ Pomegranate molasses	8.091 ^{A}	8.909 ^{A}	8.536 ^{A}	8.081 ^{ABC}	8.818 ^{A}
7	Sweet Potato	7.818 ^{A}	8.000 ^{AB}	8.182 ^{AB}	8.182 ^{ABC}	7.636 ^{B}
8	Sweet Potato + Fresh orange juice	8.091 ^{A}	8.545 ^{AB}	8.545 ^{A}	8.636 ^{AB}	8.182 ^{AB}
9	Sweet Potato + Fresh orange juice + Pomegranate molasses	8.273 ^{A}	8.380 ^{AB}	7.964 ^{BC}	8.727 ^{A}	8.364 ^{AB}
LSD		0.7393	0.9353	0.8413	0.7542	0.8148

Means carrying same letters in a column do not differ significantly.

RESULTS AND DISCUSSION

The Sensory Evaluation of Different Baby Food Mixtures: Data presented in Table (2) showed the sensory evaluation of different baby food mixtures. Evaluation process was carried out for color, taste, odor, texture and acceptance directly after preparation of mixtures. The results revealed that there were insignificant differences between mixtures in odor. However, the sensory evaluation reflected the acceptability of apple mixture more than other mixtures. Otherwise addition of orange juice and pomegranate molasses to the mixtures enhance the score of color, odor and taste. Whereas, high acceptance was observed for sweet potato, carrot, apple and oat mixtures enriched with orange juice and pomegranate molasses compared to the same mixtures prepared without orange juice and pomegranate molasses.

Chemical Composition of the Basic Ingredients: The chemical composition of the basic ingredients of the formulated baby food mixtures (Sweet potato, carrot, oat and apple) is summarized in Table (3).

Moisture contents were ranged from 1.84 to 86.56%, protein from 0.36 to 13.14 %, fat from 0.1 to 5.79 %, fiber from 2.4 to 12.19, ash from 0.94 to 1.57% and carbohydrate from 6.5 to 66.1 % for sweet potato, carrot, oat and apple respectively. Oat contained the highest level of protein, oil, fiber, ash and carbohydrate compared with sweet potato, carrot and apple, which is attributed to the high dry matter of oats and low moisture content. The obtained results are close to that of Mixture number 3 which consists of carrot, oat, orange juice and pomegranate molasses contained the highest level of iron, sodium and manganese. While, mixture number 2 had the highest calcium content. On the other hand, the highest zinc and potassium contents were found in mixture number 9 which consists of sweet potato, orange juice and pomegranate molasses. Based on the previous data, diversity of food ingredients will help to get the benefits of each component and prepare a nutritious mixture. In this respect, Vita Sterna *et al*. [26] revealed that protein and fat contents of oat ranged from 9.70 to 13.30% and from 5.20 to 12.40% respectively. While results are lower to that reported by Youssef *et al.* [27] in moisture (9.96%-10.47%), crude fat (7.23% -8.92%), ash (2%-2.15%) and carbohydrates (69.435%-75.625%) but similar in crude protein (11.61% -13.62%) and higher in Crude fiber (3.535%-5.875%) of oats.

Protein, moisture and ash content of carrot of the present study were lower than that reported by Haq Raees-ul and Prasad [28] while, fat and crude fiber contents were higher but, the carbohydrate content was in the same range. The results are also lower in moisture, protein and ash of fresh carrots compared to that of Barroca *et al*. [29]**.** Protein and carbohydrate contents of sweet potato in the present study is typical to that reported by Figueira *et al.* [7] who revealed that the protein and carbohydrate contents were 1.6 and 20.1 g/100g respectively. Moisture content of apple was similar to that reported by Campeunu *et al.* [30] and Sharoba [31]. While**,** while protein and ash contents were less of that of Campeunu *et al.* [30] while, they were higher of that of Sharoba [31].

The differences in the chemical composition of the tested component maybe attributed to the difference in cultivars, planting program, weather and/or type of soil.

Chemical Composition of Different Baby Food Mixture: The chemical compositions of the prepared mixtures are shown in Table (4). Moisture content ranged from 85.4 to 92.1, protein from 1.15 to 2.39 %, fat from 0.25 to 0.56, fiber from 2.49 to 8.3% and carbohydrate from89.22 to 95.80 %.

The highest values in contents were observed for protein and fiber in mixture numbers 8 and 7 respectively while, for fat and carbohydrate in mixture number 6. The formulated mixtures provided calories ranged from 368.6 to 392.84. Meanwhile, the physicochemical properties such as pH, viscosity and total soluble solids (TSS) of mixtures were determined.

Table 3: Chemical composition of sweet potato, carrot, oat and apple (%)

Ingredient	Moisture %	Protein%	Fat %	Fiber %	Ash%	*Carbohydrate %
Sweet potato	75±1	1.6±0.1	0.1±0.02	3.15±0.02	1.21±0.01	20± 1
Carrot	72±2.65	0.67±0.04	0.83±0.04	7.6±0.26	0.94±0.03	6.5± 0.1
Oat	1.84±0.12	13.14±0.06	5.79±0.09	12.19±0.02	1.57±0.04	66.1± 1.11
Apple	86.56±2.94	0.36±0.03	0.27±0.02	2.4±0.1	0.97±0.04	13.61± 0.12

*Carbohydrates were calculated by difference

Table 4: Chemical composition of different baby food mixture (%)

Mix. No.	Mixture Ingredients	Moisture %	Protein %	Fat %	Fiber %	Carbohydrate %	Calories	pH	Viscosity	TSS %
1	Carrot + Oat	91.2±0.72	1.96±0.03	0.25±0.01	3.5±0.1	94.29±0.2	387.25±1.09	5.92±0.11	46400±100	9.5±0.17
2	Carrot + Oat+ Fresh orange juice	92.1±0.36	1.59±0.03	0.26±0.02	3.24±0.05	94.91±0.22	388.34±1.54	3.46±0.16	32800±264	8±1
3	Carrot + Oat+ Fresh orange juice +	91.8±0.17	1.58±0.01	0.29±0.01	3.12±0.02	95.01±0.24	388.97±1.96	4.31±0.34	16800±100	14±1.8
	Pomegranate molasses									
4	Apple + Oat	85.4±0.92	1.18±0.02	0.54±0.02	2.67±0.04	95.61±0.23	392.02±1.03	3.57±0.05	616 00±100	7±1
5	Apple + Oat+ Fresh orange juice	85.9±0.58	1.51±0.03	0.53±0.01	2.58±0.03	95.38±0.04	392.33±0.58	5.04±0.19	38400±100	10.5±0.1
6	Apple + Oat+ Fresh orange juice+	85.6±0.36	1.15±0.01	0.56±0.01	2.49±0.04	95.80±0.35	392.84±1.25	3.22±0.09	22400±265	13.5±0.1
	Pomegranate molasses									
7	Sweet Potato	90.5±0.46	1.94±0.02	0.36±0.01	8.3±0.02	89.40±0.17	368.6±0.53	5.14±0.10	66400±265	23.5±0.2
8	Sweet Potato + Fresh orange juice	91.1±0.2	2.39±0.01	0.37±0.01	8.02±0.18	89.22±0.11	369.77±1.25	4.81±0.08	51200±100	21.5±0.1
9	Sweet Potato + Fresh orange juice +	91.4±0.17	2.10±0.26	0.39±0.02	7.93±0.02	89.58±0.32	370.23±0.69	4.21±0.08	42400±265	26.5±0.2
	Pomegranate molasses									

Table 5: Mineral Contents of Baby Food Mixtures.

		Mineral Contents of Baby Food Mixtures mg/kg					
Mix. No.	Mixture Ingredients	Fe	Zn	Ca	Na	Mg	K
1	Carrot + Oat	108.57±0.1	20.15±0.23	174.17±0.29	173.79±0.36	19.46±0.50	425.23±0.68
2	Carrot + Oat+ Fresh orange juice	112.78±0.17	21.32±1.14	185.93±0.12	174.96±0.94	21.05±0.09	450.71±0.62
3	Carrot + Oat+ Fresh orange juice +	115.08±0.51	22.02±0.03	190.08±0.14	187.18±0.75	23.54±0.51	500.46±1.37
	Pomegranate molasses						
4	Apple + Oat	95. 73±1.07	14.57±0.74	66.01±0.99	87.54±0.51	19.48±0.50	251.46±0.94
5	Apple + Oat+ Fresh orange juice	98.24±0.88	16.39±0.53	40.54±1.74	97.76±0.67	20.05±0.93	282.38±1.07
6	Apple + Oat+ Fresh orange juice+	111.59±1.18	19.76±0.67	44.56±0.51	102.99±1.98	21.30±0.61	299.23±2.25
	Pomegranate molasses						
7	Sweet Potato	101.71±0.51	23.70±0.52	164.27±0.64	151.54±0.51	19.59±0.71	519.42±0.52
8	Sweet Potato + Fresh orange juice	107.80±0.72	24.92±1.12	169.21±0.71	159.93±0.89	21.14±0.24	525.12±1.2
9	Sweet Potato + Fresh orange juice +	112.79±1.06	25.47±0.81	174.12±0.21	165.33±0.58	22.92±0.88	534.52±4.3
	Pomegranate molasses						

The pH ranged from 3.22 to 5.92, the acidity of mixtures attributed to its ingredients which are acidic in nature. The viscosity ranged from 22400 to 66400 CP and total soluble solids "TSS"-ranged from 7 to 26.5.

Sharoba [31] revealed that some physicochemical properties and nutritional value of prepared spirulina, fruits and vegetables-based baby food formulas were ranged from 72.41-72.56, 4.64-4.51, 0.516-0.543, 1.637-1.796, 5.23-5.45 and 27.44-27.59 for moisture, protein, fat and fiber, pH and total solids respectively. The results are also in agreement with that of Bahlol *et al*. [32].

Mineral Contents of Mixtures: Data presented in Table (5) show the mineral contents of prepared baby food mixtures. The mineral contents ranged From 95.73 to 115.08, from 14.57 to 25.47, from 40.54to 190.08 from 87.54 to 187.18, from 19.46to 23.54 and from 251.46 to 534.52 mg/kg for Fe, Zn, Ca, Na, Mg and K respectively.

Mixture number 3 which consists of carrot, oat, orange juice and pomegranate molasses contained the highest level of iron, sodium, calcium and magnesium. On the other hand, the highest zinc and potassium contents were found in mixture number 9 which consists of sweet potato, orange juice and pomegranate molasses. Based on the previous data, diversity of food ingredients will help to get the benefits of each component and prepare a nutritious mixture.

Vitamin Contents of Mixtures: The obtained results of Beta Carotene, vitamins E and C contents are shown in Table (6). The highest level of contents of Beta Carotene, vitamins E and C were 0.1218, 0.1022 and 3.7308 mg/100 in meals number 9, 8 and 3 respectively. While the lowest level of vitamin contents were 0.0474 and 0.0032 for Beta carotene and E in mixture number 1 and 1.8393 mg/100 for vitamin C in mixture number 7. The addition of orange juice and pomegranate molasses led to improvement in the contents of Beta Carotene, vitamins E and C in all the formulated baby mixtures.

Table 6: Beta Carotene, Vitamins E and C Contents (mg/100g) of Different Baby Food Mixtures

Mixture No.	Mixture Ingredients	Beta Carotene	Vit. E	Vit. C
1	Carrot + Oat	0.0474	0.0032	2.54799
2	Carrot + Oat+ Fresh orange juice	0.0678	0.0056	3.41565
3	Carrot + Oat+ Fresh orange juice + Pomegranate molasses	0.0726	0.0165	3.7308
4	Apple + Oat	0.057	0.0150	2. 2868
5	Apple + Oat+ Fresh orange juice	0.075	0.0166	2. 6973
6	Apple + Oat+ Fresh orange juice+ Pomegranate molasses	0.1056	0.0175	2.9925
7	Sweet Potato	0.087	0.0058	1.8493
8	Sweet Potato + Fresh orange juice	0.1164	0.1022	2.0641
9	Sweet Potato + Fresh orange juice + Pomegranate molasses	0.1218	0.0136	2.1284

Table 7: Vitamin B Group Content (mg/100g) of Different Baby Food Mixtures

Mix. No.	Mixture Ingredients	Thiamine B1	Riboflavin B2	Niacin B3	Pyroxidine B6	Folic acid B9
1	Carrot + Oat	0.307	0.460	2.430	0.54	0.365
2	Carrot + Oat+ Fresh orange juice	0.609	1.093	4.615	1.313	0.559
3	Carrot + Oat+ Fresh orange juice + Pomegranate molasses	0.966	0.722	2.475	0.938	0.627
4	Apple + Oat	0.645	1.267	0.217	0.592	1.023
5	Apple + Oat+ Fresh orange juice	0.512	0.581	0.503	1.044	0.461
6	Apple + Oat+ Fresh orange juice+ Pomegranate molasses	1.090	0.534	2.171	0.645	1.398
7	Sweet Potato	1.208	0.245	1.580	1.434	1.633
8	Sweet Potato + Fresh orange juice	1.6184	0.476	3.520	2.571	1.0737
9	Sweet Potato + Fresh orange juice + Pomegranate molasses	0.879	0.5	1.453	1.061	1.259

Table 8: The Total Bacterial and Yeast & Mold Counts of Baby Food Mixtures (cfu/gm)

		Zero Time		48 hours		96 hours	
Mix. No.	Mixture Ingredients	T.C	Y&M	T.C	Y&M	T.C	Y&M
1	Carrot + Oat	ND	ND	$4 X10^1$	$1X10^1$	$6X10^2$	$2X10^2$
2	Carrot + Oat+ Fresh orange juice	ND	ND	$3 X10^1$	$2 X10^1$	$5 X10^2$	$9 X10^1$
3	Carrot + Oat+ Fresh orange juice + Pomegranate molasses	ND	ND	$1 X10^1$	ND	$3 X10^2$	$3 X10^1$
4	Apple + Oat	ND	ND	$2 X10^1$	$3 X10^1$	$9 X10^2$	$7 X10^1$
5	Apple + Oat+ Fresh orange juice	ND	ND	$4 X10^1$	$2 X10^1$	$7 X10^2$	$3 X10^2$
6	Apple + Oat+ Fresh orange juice+ Pomegranate molasses	ND	ND	$5 X10^1$	ND	$4 X10^2$	$4 X10^2$
7	Sweet Potato	ND	ND	$7 X10^1$	$2 X10^1$	$3 X10^2$	$8 X10^1$
8	Sweet Potato + Fresh orange juice	ND	ND	$4 X10^1$	$1 X10^1$	$2 X10^2$	$7 X10^1$
9	Sweet Potato + Fresh orange juice + Pomegranate molasses	ND	ND	$2 X10^1$	ND	$1 X10^2$	$2 X10^1$

Results in Table (7) showed the vitamin B content of the different mixtures.

The highest levels of content were 1.6184, 1.267, 4.615, 2.571 and 1.633 mg/100gm for vitamins B1, B2, B3, B6 and B9 respectively. Meanwhile, the lowest levels of content were 0.307, 0.245, 0.217, 0.54 and 0.365 mg/100gm for vitamins B1, B2, B3, B6 and B9 respectively.

From the obtained results it could be noticed that the formulated baby food mixture number 8 which consists of sweet potato and orange juice had the highest level of vitamins however, the baby food mixture number 1 which consists of carrots and oats had the lowest level of vitamins.

Microbiological Testing of the Formulated Baby Food Mixtures: The total bacterial and Yeast & Mold counts of the prepared mixtures are shown in Table (8). The results revealed that total bacterial and Yeast & Mold counts were not detected at zero time of mixtures preparation. While, after 48 hours of storage at a temperature of 5°C the total bacterial and Yeast & Mold counts ranged from $1X10^1$ to $7X10^1$ and from ND to $3X10^1$ cfu/gm respectively. However, after 96 hours of storage at 5°C the total bacterial and Yeast & Mold counts ranged from 100 to $6X10^2$ and from $2X10^1$ to$7X10^2$ cfu/gm respectively. The formulated baby mixtures were prepared without any heat treatments to preserve the nutritional component

from being lost or reduced. Accordingly the results suggest that feeding of freshly prepared mixtures is the best way for getting the benefits and assuring the quality and safety of mixtures.

CONCLUSION

The present study aimed to formulate different homemade complementary baby food mixtures for weaning period fortified with orange juice and pomegranate molasses which are rich in vitamins and minerals which are needed for healthy growth in this important age period using available and cheap ingredients.

REFERENCES

1. BDHS, 2007. Bangladesh Demographic Health Survey 2007. Published: March, 2009.
2. General Economic Division, Planning Commission, GOB, 2007. MDG Midterm Bangladesh Progress Report.
3. UNICEF/WHO, 1998. Complementary Feeding of Young Children in Developing Countries: A Review of Current Scientific Knowledge. WHO/NUT/98.1. World Health Organization, Geneva. 1998. pp: 1-228.
4. Cizkova, H., R. Sevcik, A. Rajchl and M. Voldrich, 2009. Nutritional quality of commercial fruit baby food. Czech J. Food Sci., 27: 134-137.
5. U.S. Department of Agriculture, Nutrient Database for Standard Reference Release, 14 (2001).
6. Ranhotra, G.S. and J.A. Gelroth, 1995. Food uses of oats, in The Oat Crop: Production and Utilization" Welch, R. (ed.). London: Chapman and Hall.
7. Figueira, A.C., O. Makinde and M.C. Vieira, 2011. Process optimization of sweet potato (*Ipomoea batatas*) puree as an ingredient in a formulation of weaning food. Fruits, Vegetable and Cereal science and Biotechnology, 5(special issue 2): 25-34.
8. Behrens, W.A. and R. Madere, 1994. Ascorbic acid, is ascorbic acid, dehydro-ascorbic acid and dehydroisoascorbic acid in selected food products. Journal of Food Composition and Analysis, 7: 158-170.
9. Wu, X., G.R. Beecher, J.M. Holden, D.B. Haytowitz and S.E. Gebhard, 2004. Lipophilic and hydrophilic antioxidant capacities of common foods in the United States. Journal of Agricultural and Food Chemistry, 52: 4026-4037.
10. British Nutrition Foundation, 2019. Available on: https:// www.nutrition.org.uk /nutrition science/ nutrients-food-and-ingredients /minerals -and-trace-elements. html? limit=1&start=1
11. British Nutrition Foundation, 2019. Available on: https://www. Nutrition. org.uk/nutrition science/ nutrients-food-and- ingredients/ vitamins.html?limit=1&start=1
12. Parvin, R., M.A. Satter, S.A. Jabin, N. Abedin, F. Islam, M. Kamruzzaman and D.K. Paul, 2014. Studies on the development and evaluation of cereal based highly nutritive supplementary food for young. Int. J. Innov. Appl. Stud., 9(2): 974.
13. Wurdemann, W. and J.C.M. Van de Meerendok, 1994. Weaning food production and enterprise development in developing countries. The KIT approach to and marketing of cereal based porridge mixes from local raw materials. Amsterdam Royal Tropical Institute.
14. Zein, H., A.E.M.S. Hashish and G.H.H. Ismaiel, 2015. The antioxidant and anticancer activities of Swiss chard and red beetroot leaves. Curr. Sci. Int., 4: 491-498.
15. Arafa, S.A., 2013. Chemical and Biological Studies on some Pomegranate Products. The Bulletin, Faculty of Agriculture, Cairo University, 64(4): 396-405.
16. Pastor, M.V., E. Costell and L. Duran, 1996. Effect of hydrocolloids and aspartame on sensory viscosity and sweetness of low calorie peach nectars. J. Texture Stud., 27: 61-78.
17. Sogi, D.S., D.P.S. Oberoi and S. Malik, 2009. Effect of particle size, temperature and total soluble solids on the rheological properties of watermelon juice: A response surface approach. International Journal of Food Properties, 13: 1207-1214.
18. AOAC., 2012. Official Methods of Analysis of the Association of Official Analytical Chemists, 19th ed, Arligton, Virginia, USA.
19. Kerolles, S.Y., 1986. Studies on certain dairy food. Ph. D. Thesis, Fac. of Agric. Ain Shams Univ.
20. AOAC., 1995. Official Methods of Analysis of the Association of Official Analytical Chemists. 16th Edition. Volume II. Washington DC.
21. Metwalli, O.M., S.Y. Al-Okbi and T.E. Hamed, 2011. Chemical, biological and organoleptic evaluation of newly formulated therapeutic diets for protein calorie malnutrition. Med. J. Islamic World Acad. Sci., 19(2): 67-74.

22. Howard, L.R. and T. Dewi, 1996. Minimal processing and edible coating effects on composition and sensory quality of mini-peeled carrots. J Food Sci., 61: 643-645.
23. AOAC., 2000. Association of Official Ananlytical Chemists. Official Methods of Analysis of the AOAC International, 17th ed. Gaithersburg, Marylad, USA.
24. APHA, 1994. Standard methods for the examination of dairy products, 16 th Ed, American Public Health Association, Washington, USA.
25. Mohan, R., B. Kathleen and Z. Marc, 1985. PC-STAT, Version1 A (One Way Analysis of Variance), University of Georgia, USA.
26. Vita Sternaa, S. Zuteb and L. Brunavaa, 2016. Oat grain composition and its nutrition benefice. Agriculture and Agricultural Science Procedia, 8: 252-256.
27. Youssef, M.K.E., A.G. Nassar, F.A. EL-Fishawy and M.A. Mostafa, 2016. Assessment of Proximate Chemical Composition and Nutritional Status of Wheat Biscuits Fortified with Oat Powder. Assiut J. Agric. Sci., 47(5):83-94.Website: http:// www.aun.edu.eg/ faculty_agriculture E-mail: ajas@aun.edu.eg
28. Haq Raees-ul and K. Prasad, 2015. Nutritional and processing aspects of carrot (*Daucus carota*) - A review. South Asian J. Food Technol. Environ, 1(1): 1-14.
29. Barroca, M.J., R.P.F. Guiné, A.R.P. Calado, P.M.R. Correia and M. Mendes, 2017. Artificial neural network modelling of the chemical composition of carrots submitted to different pre-drying treatments. Food Measure, 11: 1815-1826.
30. Campeanu, G., G. Neata and G. Darjanschi, 2009. Chemical composition of the fruits of several apple cultivars growth as biological crop. Notulae Botanicae Horti Agro Botanici Cluj-Napoca, 37: 161-164.
31. Sharoba, A.M., 2014. Nutritional Value of Spirullna and Its Use In The Preparation of Some Complementary Baby Food Formulas. J. Food and Dairy Sci., Mansoura Univ., 5(8): 517-538.
32. Bahlol, H.E.M., A.M. Sharoba and A.I. El-Desouky, 2007. Production and evaluation of some food formulas as complementary food for babies using some fruits and vegetables. Ann. of Agric. Sc., Moshtohor, 45(1): 147-168.