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CHEMICAL, TECHNOLOGICAL AND BIOLOGICAL STUDIES ON CERTAIN MIXTURES OF NEW INFANT FOODS

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ABSTRACT

The objects of the present study is to formulate and prepare protein-rich food mixtures in powder forms using local available plant sources, for infants and young children. the raw materials used in preparing the three infant foods were corn flour, rice flour, skim milk powder, textured soy protein (T.S.P) mung bean, pumpkin and parsley. The protein content of the formulas ranged from 21.4 to 22.84%, and Lipids content ranged from 3.07 to 4.43%, as well as, carbohydrates ranged from 67.0 to 69.7%. Data revealed that the new prepared formulas had high content of minerals and contain high amount of essential amino acids, but they were deficient in some vitamins. The biological assay on white rats fed with the tested formulas had high weight gain, food conversion efficiency and protein efficiency ratio. Microbiological examination revealed that all the formulas were free from pathogenic micro organisms.

INTRODUCTION

Most of malnutrition problems of infants and young children in developing countries are mainly due to shortage in available varieties of weaning foods that will meet the ever increasing demand for such foods at low cost. Nutritionally, breast mother milk or other animals milk provides infants with sufficient amount of dietary requirements until the age of three or four months (Davidson et al., 1975). During the first year of infancy, the baby growths and develops more rapidly than any other time of his life. He would double his birth weight in first five months and triple by the time of 10–12 months of age. (Jelliffe and Jelliffe, E.F. 1979). Additional food must be introduced so that infant can gradually and progressively adapts to an adult diet (Mousa 1990 and Ruth 2006).

The development of weaning food is based on the nutritional requirements of children aged 6–12 months . The total food intake must supply 100–120 kcal./kg of body weight of energy and 14 g protein daily in the first year (FAO/WHO 1989). As well as, a variety of micro nutrients (Renner, 1989).

The Natural feeding is considered the best nutritional way for infants, as well as, for protection against comply lobacter associated diarrhea (Megroud et al 1990, Alberta,2005 and Arnig and Claudia, 2007).

Committee on nutrition of the American Academy of pediatrics (1985) recommended that some cereals and stained vegetables and fruits have to be introduced at about 6 months of age to supply energy, iron, vitamins and possibly other factors.

In addition, weaning foods should be easy to swallow, semi liquid consistency and microbiologically safe when consumed. Some efforts had been carried out in Egypt to produce cereal-based protein rich food mixtures suitable for infants and preschool age children from vegetable protein

sources alone or mixed with skim milk powder. (Selee 1990 and Morcos et al 1993 and Mendez et. al., 2002) .

Therefore, the object of the present study is to prepare low-cost and high nutritive value food formulas for infants and young children. Corn, rice, textured soy protein, (T.S.P.), mung bean, pumpkin and parsley were used here in because of their high available energy, protein, minerals and vitamins.

MATERIAL AND METHODS

1. Materials:

The raw materials used in these studies for preparation the different infant food mixtures were as follows:

1.1 Cereals:

(a) Rice: (*Oryza sative*, L., Giza 171).

(b) Corn (yellow corn *Zea mays*, L., Dahab).

Rice and corn were purchased from the Field Crops Research Institute, Agriculture Research Center, Giza, Egypt.

1.2 Legumes:

(a) Textured soy bean protein (T.S.P.) was purchased from Food Technology Research Institute, Agriculture Research Center, Giza, Egypt.

(b) Mung Bean: Mung Bean (*Phaseolus aurens*, L, Vc 1000) was purchased from Department of Legumes Production, Field Crops Research Institute, Agriculture Research Center, Giza, Egypt.

1.3 Fresh Vegetables:

(a) Pumpkin: Pumpkin (*Cucurbita moschata* c.v., Balady).

(b) Parsley: Parsley (*Petroselinum crispum* c.v. Balady).

Pumpkin and parsley were purchased from the market in Kafr El-Sheikh.

1.4 Skim Milk Powder:

Skim milk powder was purchased from Misr Dairy and Food Company in Kafr El-Sheikh. Exporter: Laktopol – Poland. Product of Poland.

2. Methods:

The following procedures were carried out as preliminary step towards the preparation of infants formulas:-

Preparation of raw materials:

2.1 **Cereals**:

The yellow corn grains and rice were cleaned, washed and blanched in a boiling water for 30 min., then dried in an oven at 60° C for 12 hours and then ground by using ordinary electrical mill to pass through 60 mesh sieve.

2.2 **Legumes**:

Mung bean was cleaned, washed, broken and blanched in a boiling water for 15 min. Then seeds were washed by a running tap water to remove the hulls then dried in an oven at 60° C for 12 hours.

Textured soy protein and dried mung bean were ground using ordinary electrical mill to pass through 60 mesh sieve.

2.3 **Fresh vegetables:**

2.3.1 Pumpkin:

Pumpkin washed, cut into big slices, then peeled with 2 cm. thickness and cut into small pieces then blanched in boiled water for 10 min., in an open pan and dried in an oven at 60° C for 16 hours.

2.3.2 Parsley:

Parsley leaves were washed, cleaned, then dried in an oven at 60° C for 10 hours. The dried pumpkin and parsley were ground using ordinary electrical mill to pass through 60 mesh sieve.

The dried raw materials were preserved in a sealed polyethylene bag and stored in the refrigerator at 5-8° C until use.

2.4 **Preparation of Formulas:**

The three experimental formulas were prepared using different percentage of cereals, legumes, vegetables and skim milk powder as follows:

- Formula No.(1) composed of :
  27.5% rice + 27.5% corn + 15% skim milk powder + 25% T.S.P. + 5% pumpkin.
- Formula No.(2) composed of :
  27.5% rice + 27.5% corn + 15% skim milk powder + 15% T.S.P. + 10% mung bean + 5% pumpkin.
- Formula No.(3) composed of :
  27.5% rice + 27.5% corn + 15% skim milk powder + 15% T.S.P. + 10% mung bean + 5% parsley.

The powder samples of these three mixtures were packaged in clean polyethylene bags under good hygienic conditions and stored in freezer at -20° C until analysis.

3. Chemical Analysis:

Moisture, crude protein, fat and ash contents of the tested samples were determined according to the method described in the A.O.A.C (1990). Carbohydrates were calculated by difference (dry weight base). The results were calculated on dry weight bases.

Calcium, zinc, iron, magnesium, copper, manganese, sodium and potassium were estimated by using atomic absorption apparatus (Thermo of Arrell, Ash, Smith Hieftje 100) according to the method described by the A.O.A.C.(1990). Total phosphorus were determined according to the method of Perkins (1975).

B-Carotene examined by column chromatography according to the method recommended by Association of Vitamin Chemists (1951).

Ascorbic acid, thiamin (B_1), Riboflavin (B_2), pyridoxal (B_6) were analyzed according to A.O.A.C. (1990).

4. Determination of amino acids:

Amino acids determination were performed at the Central Laboratory of College of Agriculture, University of Alexandria. Samples were performed in the sealed ampoules for the determination of all amino acids according to the method described by Block et. al (1958) other than tryptophan.

The filtered hydrolyzed was used for the amino acid analysis. Beckman amino acid analyzer Model 119 CL was used in which a sample of 0.5ml volume was injected.

5. Biological evaluation of Baby food mixtures:

The Biological evaluation of the experimental baby formulas was carried out using method described by Miller and Bender (1955). Twenty four Weaning Albion rats (23 days) of weight average 45 ± 2gm were obtained from laboratory of the Ministry of Health, Cairo. The animals were fed normal diet for one week before the beginning of experiment. Then they were divided into 4 groups. Each one consisted of six rats (3 males + 3 females) were housed in separate cages at 25° C with 12 hours light /12 hours dark and had free access of food and water. The examined diets were given daily for 8 weeks during the course of study.

Three groups were fed on tested prepared diets as infants food and the fourth group was fed on standard diet using casein and served as control group..

The ratio of cellulose to glucose in the basal diet recommended by Miller and Bender (1955), was modified in order to increase the protein to reach 13%. This diet contained 4% cellulose and 6% glucose. One hundred grams contained:-

65gm. Dried powdered diet under test.
15gm. Edible fat. 4 gm. Cellulose.
6gm. Glucose 5 gm. Salt mixture.
5gm. Vitaminized carbohydrate.

Body weight gain, food consumption (g), protein intake (g), and food conversion efficiency (FCE) were determined according to Rady (1992). Protein efficiency ration (PER) was determined according to Wilson et. al (1974).

6. Microbiological assay:

Microbiological tests of infant food mixtures were run for total plate count, coliform group, molds and yeasts according to the methods of A.P.A.A. (1971).

7. Organoleptic evaluation:

The final formulated mixtures were sensory evaluated by panel testes (panelist) according to Notter et. al (1959), where tested samples were prepared in puree like forms. The formulated mixtures were prepared by mixing 100gm of raw material of each for formula with 20gm sugar and 240ml water. The organoleptic characteristics of all mixtures were carried out by (10) selected volunteer mothers as it was difficult to obtain the data from the infants.

RESULTS AND DISCUSSION

1. Chemical composition of the infants food mixtures:

The prepared infants food mixtures were chemically analyzed in order to determine their main features of chemical composition and bearing in mined evaluation of their nutritive value. The data shown in Table (1), and the results indicate that formula No.(1) had the highest protein ratio (22.84%)

followed by formula No.(3) and (2) (21.67 and 21.40, respectively). The high percentage of protein was due to high content of protein rich ingredients i.e. textured soy protein, skim milk powder and mung bean. These values of protein content were within the rang reviewed by ESO (1992) which refers that the protein content of cereal-based food must be not less than 15% from all contents. Results in Table (1) indicate also all formulas had relatively high lipids content (3.07 – 4.43%), food formula No.(1) had he highest percentage of lipids (4.43%) which may be due to its high content of T.S.P. and corn. The data of ash present in all prepared formulas were ranged from 4.10% for No.(2) to 4.21% for No.(3). These values of menials indicate that the prepared formulas could be considered mineral rich foods, especially in developing countries. The results of crude fiber content were approximately the same for No. (1) and (2) (1.58% and 1.55%, respectively) but it was less for No.(3) (1.35%), this is due to high fiber content of pumpkin . Results in table (1) show that formula No.(3) had the highest content of carbohydrate (69.70%) followed by No.(2) 69.43% while the formula No.(1) had the lowest value (67.00% which may be due to high starch content of mung bean presented in fomulas No. (2) and (3).

Table (1): Gross chemical composition of the three prepared infants food formulas (on dry weight basis).

Formulas / Components	1	2	3	Daily requirements for infants
Moisture	8.10 ± 1.05	8.43 ± 0.85	8.09 ± 1.01	
Protein	22.84 ± 1.07	21. 4 ± 1.32	21.67 ± 0.75	
Fat	4.43 ± 0.22	3.52 ± 0.14	3.07 ± 0.19	
Ash	4.15 ± 0.16	4.10 ± 0.23	4.21 ± 0.14	
Carbohydrates	67.00 ± 2.05	69.43 ± 1.85	69.70 ± 1.92	
Crude fiber	1.58 ± 0.07	1.55 ± 0.04	1.35 ± 0.09	
Food energy: k.cal	399.23 ± 2.43	395.00 ± 3.11	393.11 ± 2.05	
Minerals mg/100 gm				
Ca	204.60	194.60	213.00	
P	156.68	159.89	178.54	
Fe	3.40	2.40	4.15	
Mg	325.80	267.30	244.20	
Zn	3.70	3.45	5.20	
Cu	1.75	1.45	5.80	
Mn	2.65	2.95	6.00	
Na	330.40	315.50	273.20	
K	608	482	725	
Vitamins mg/100 gm				
Absorbic acid	13.27±0.85	13.65±1.03	19.03±1.44	35.00
Thiamin	0.26±0.01	0.25±0.04	0.29±0.01	0.50
Riboflavin	0.07±0.01	0.07±0.02	0.09±0.02	0.60
Pyridoxal	0.14±0.02	0.15±0.01	0.13±0.02	0.40
B-carotene	0.39±0.06	0.40±0.01	0.70±0.01	0.90

2. Mineral contents of the infant food mixtures:

All materials used in preparation the formulas contain varying amounts of minerals. The data in Table (1) revealed that highest mineral content except magnesium and sodium was found in formula No.(3), which was supplemented with parsley.

Results revealed that supplying infant with 50g from these formulas in feeding might be quite sufficient to provide them with about 19 -30% of the daily calcium requirements during the first year of age according to the recommendations of (FAO / WHO ,1989).

Supplying infant with 240–417gm from various formulas, provide them with the daily requirements of iron. Giving infants 145gm formulas cover their requirements of Zinc, but 50gm from all formulas provide them with daily magnesium requirements, and 160-190gm from all formulas to fulfill infants requirement from phosphorus (FAO WHO 1989).

In conclusion , it could be suggested that the formulas are good source of Ca , Mg , and Zn for the first vital period of childhood age as a supplementary food beside the mother milk.

3. Vitamins content of the infant food mixtures :

Data presented in Table (1) show that formula No.(3) contained the highest amounts of ascorbic acid, thiamin and B–carotene (19.0,0.29 and 0.7mg / 100 gm respectively) compared with formula No.(1) and (2). Formula No.(1) and No.(2) have 0.07mg/100gm riboflavin for each and 14mg/100gm pyridoxine for No.(1) and 15mg/100gm for No.(2). FAO and WHO (1987) reported the daily requirement of vitamins for infants, which were higher than found in tested formula, so these formulas should be enriched with these vitamins (c, B, B2, B6, and with b-carotene).

4. Amino acid content of food formulas:

The problem of satisfying protein requirements might be solved by providing the essential amino acids in adequate amount.

Table(2) shows the amino acid distribution in the three tested formed food mixtures. Data in table (2) indicate that formula No.(3) had the highest concentrations of essential amino acids followed by formulas (1) and (2). Leucine, phenylalanine and valine were present in high levels in all formulas. The total essential amino acids contents detected in tested formulas were higher than those of human milk. This may be due to variable protein content of these formulas. Chemical scores of essential amino acids in different used formulas are shown in Table (3). These results indicate that the first limiting amino acid for all formulas was methionine, while cystine, and threonine were the second limiting amino acid for formula No. (1) and (2) and lysine for formula No. (3). Consequently, methianine + cystine must add to the formulated infants foods in order to compensate the deficiency of this amino acid.

5. Biological evaluation for tested formulated infant food:

Data present in Table (3) show the biological parameters for rats fed on casein diet and formulated infant foods diets. It was noticed that the weight gain of rats fed on diet No.(3) was the highest , as while as, the lowest weight gain was recorded for rats fed on control diet. Food conversion efficiency data of rats fed on diets prepared for infants food seem to be similar. The lowest value (4.29) of protein efficiency ratio was recorded for rats fed on diet No.(1) followed by rats fed on casain diet. The obtained data are in accordance with these reported by Badawy et. al (1993) Hussein et al (1993) , Bessar et. al (1997) and Mendez et. al., (2002).

Table (2): Amino acid composition of the three prepared infants food formulas (g/100g protein).

Formulas / Essential amino acids	1	2	3	Human milk reference**
Isoleucine	6.52	6.71	6.75	4.00
Leucine	10.30	10.11	10.44	8.60
Lysine	5.43	5.22	5.55	6.70
Methionine	1.45	1.40	1.50	1.58
Phenylalanine	5.43	6.10	6.21	1.40
Threonine	2.76	2.80	3.85	4.416
Valine	6.19	6.31	6.92	4.50
Histidine	3.5	3.55	3.09	2.50
Total essential amino acids	41.58	42.20	44.31	39.58
Non-essential amino acids				
Cystine	0.033	0.15	0.07	1.33
Tyrosine	3.73	3.81	4.97	3.25
Arginine	7.13	7.32	7.5	3.83
Alanine	4.70	4.86	4.93	3.91
Aspartic acid	7.64	7.85	7.94	8.41
Glutamic acid	13.62	13.71	13.94	15.08
Glycine	4.57	[illegible]	4.91	2.50
Proline	7.90	[illegible]	7.63	7.08
Serine	3.30	[illegible]	3.95	4.5
Total non-essential a.a.	53.22	[illegible]	53.94	47.92
Total amino acid	94.80	[illegible]	98.25	87.50
E/T	43.86	[illegible]	45.10	45.23
NE/T	56.14	[illegible]	54.90	54.76

6. Microbiological examination of the formulated infant food:

The prepared formulas were examined for the total bacterial , yeast and molds counts and coliform group . The obtained results are shown in Table (4) indicate that the total bacterial count (TBC) of formulas No.(1), (2) and (3) were 100 ,110 and 140, respectively. These results are within the ranges reported by Egyptian Standard Organization (ESO, 1992). Data of the same table revealed that all formulas were free from coliform group, and yeast and molds colonies. So that all formulas microbiologically safe when consumed in feeding infants.

7. Sensory evaluation of the formulated infant food mixtures:

Table (5) shows the mean values of the characteristic scores of the formulated mixtures Results indicate that formula No.(1) had the highest score for taste followed by No.(2) and formula No.(3) had the highest value for odour only.

Table (3): Chemical scores estimated for proteins of infant food formulas.

Amino acids	FAO / WHO (1989) pattern Mg/g protein	Formulated infant mixtures			
		(1)	(2)	(3)	**Casein
Isoleucine	46	141.74	145.87	145.73	143.47
Leucine	93	110,75	108.71	122.26	108.60
Lysine	66	82.27	79.19	84.09	124.24
Methionine+Cystine	42	35.24*	36.80*	37.38*	88.09
Phenylalanine+tyrosine	72	127.22	137.64	100.28	168.05
Threonine	43	64.19	65.12	89.53	104.65
Valine	55	112.55	114.73	125.82	134.54
Histidine	26	134.62	136.54	118.85	115.38

*limiting amino acids *Lampert (1987) Tryptophan is not determined

Table (4): Some Biological parameters of rats fed on the prepared infant food Formulas).

Parameters / Diets	Initial weight (g)	Final weight (g)	Weight gain (g)	Food intake (g)	Protein intake (g)	F.C.E.	P.E.R
Diet (1)	46.31±2.07	97.00±2.21	50.69±1.65	233.30±2.3	53.28±1.15	4.60±0.09	0.96±0.07
Diet (2)	47.00±2.11	98.00±2.43	51.00±1.33	230.00±3.21	49.22±1.82	4.50±0.11	1.04±0.09
Diet (3)	46.10±3.02	100.00±2.87	52.9±2.07	238.30±3.11	51.64±1.65	4.50±0.08	1.02±0.13
Control (Casein diet)	50.00±2.06	95.60±2.05	45.6±1.43	195.60±2.18	46.55±1.33	4.29±0.07	0.97±0.04

F.C.E. = Food Conversion Efficiency (gm of food intake/gm body weight gain).
P.E.R. = Protein efficiency Ratio (gm of weight gain/gm of protein intake).

Table (5): Microbiological examination of the dried formulated infant food mixtures.

Mixture / Level	Total bacterial count	Yeast / molds	Coliform group
Maximum	10.0000 cfu/gm	100 cfu/gm	Zero
Mixture (1)	100.00 ± 2.11	ND	ND
Mixture (2)	110.00 ± 2.07	ND	ND
Mixture (3)	140.00 ± 2.22	ND	ND

ND refers to not detected.
Maximum level of bacterial count (ESO, 1992).

Table (6): Organoleptic evaluation of prepared formula mixtures (M + SD).

Mixture	Organoleptic score					
	Taste	Odour	Colour	Texture	Appearance	Over all Acceptability
1	8.2±0.02 a	7.2±0.02 b	8.7±0.03 a	7.8±0.02	8.1±0.02 a	8.0±0.11 a
2	8.0±0.03 a	7.8±0.02 a	8.5±0.04 a	8.0±0.02	8.4±0.04 a	8.14±0.15 a
3	5.6±0.02 c	8.1±0.02 a	7.4±0.03 b	7.9±0.02	7.3±0.02 b	7.26±0.11 c

* Mean values obtained from 10 panelists scoring.

In general, results of sensory evaluation revealed that formula No.(1) and (2) had high score for organoleptic quality but formula No.(3) had the lowest score value in spite of its high nutritive value.

CONCLUSION

The present investigation indicates the possibility of preparing infant food formulas by using plant materials (corn flour, rice flour, skim milk powder, T.S.P., mung bean, pumpkin and parsley) with high hygienic and safety conditions and can be considered as a good source of nutrients enough to cover the nutritional needs of infants according to the level of Egyptian standard organization (ESO, 1992).

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دراسات كيماوية وتكنولوجية وبيولوجية على بعض خلطات أغذيـــة الأطفـــال و الرضع

بديعـــة عبد الرحمن بيـــصـــار
قسم علوم وتكنولوجيا الأغذية – كلية الزراعة – جامعة كفر الشيخ

يعتبر لبن الأم أفضل غذاء للطفل الرضيع حيث أنه يوفر جميع العناصر الغذائية التـــي يحتاجها الرضيع في الستة أشهر الأولى، وبالرغم من أن لبن الأم هو الغذاء الأمثل إلا أنه لا يعتبر وحدة كافيا لتغطية كل الاحتياجات الغذائية المتزايدة بعد الشهر السادس، ولذلك يجب أعطاء الطفل تغذية تكميلية غنية بالطاقة والبروتين والفيتامينات والمعادن. ونظراً لانتشار أمراض سوء التغذية بين هذه الفئة العمرية في مصر باعتبارها دولة نامية. فكان الهدف الرئيسي من هذه الدراسة هـــو محاولة تجهيز بعض الخلطات الغذائية المنتجة محلياً من مصادر نباتية تفـــي باحتياجـــات الطفـــل الغذائية من ستة شهور إلى سنة أو أكثر.

وقد استخدم في تحضير هذه الخلطات الغذائية فول الصويا المنزوع الـــدهن والمعامـــل حراريا بجهاز البثق الحراري واللبن الفرز المجفف المنزوع الدهن وكذلك فول المانج كمـــصـــادر غذائية غنية بالبروتين وأيضاً استخدم القرع العسلي المجفف والبقدونس كمـــصـــادر غذائيـــة غنيـــة بالمعادن وبعض الفيتامينات وقد تم عمل ثلاث خلطات غذائية و تـــم اســـتبدال القـــرع العـــسلي بالبقدونس في إحداها وقد تم تحليل واختيار هذه المخاليط موضوع الدراســـة بـــالطرق الكيماويـــة والحيوية والميكروبية. وأظهرت النتائج المتحصل عليها الآتي:-

١) نسبة الرطوبة في العينات المختبرة تراوحت بـــين ٨,١% إلـــى ٨,٤٣% وهـــو يتمـــشى مـــع المواصفات القياسية المصرية رقم ٢٢٢٤٠ لسنة ١٩٩٢م. وقد احتوت الخلطة رقم (١) علـــى أعلى نسبة بروتين ٢٢,٨٤% بينما احتوت الخلطة رقـــم (٣) ٢١,٦٧% والخلطـــة رقـــم (٢) ٢١,٤% بروتين واحتوت الخلطة رقم (١) أيضاً على أعلى نسبة من الدهن يليها الخلطة رقـــم (٢). أما الألياف فكانت متشابها تقريباً في الخلطات الثلاث وبحساب قيمة الطاقة مترجمة إلـــى سعرات حرارية فقد وجد أن القيمة الحرارية تراوحت بـــين ٣٩٣,١١ إلـــى ٣٩٩,٢٣ ســـعر حراري / ١٠٠ جم مخلوط.

٢) احتوت الخلطة رقم (٣) أعلى نسبة من الكالسيوم (٢١٣ مجم / ١٠٠ جم) وكذلك أعلى نسبة من الفسفور (١٧٨,٥٤ مجم / ١٠٠ جم) والحديد ٤,١٥ جم / ١٠٠ جم) بينما احتوت الخلطة رقـــم (٢) أعلى نسبة من الماغنسيوم ٢٦٧,٣٠.

٣) عند تقدير الفيتامينات وجد أن الخلطة رقم (١) احتوت على أعلى نسبة من فيتامين C وكـــذلك الثيامين والريبوفلافين والبيتاكاروتين والخلطة رقم (٢) أعلى نسبة من الثيامين B6.

٤) أوضحت الاختيارات البيولوجية أن الخلطات المجهزة سجلت قيم عالية لكل من القيمة الحيويـــة للبروتين وذلك معدل كفاءة البروتين.

٥) عند إجراء الاختيارات الميكروبية لتقدير العد الكلي والخميرة والفطر ومجموعة القولون دلـــت النتائج على خلو المخاليط من مجموعة القولون والخميرة والفطر بينما تراوح العد الكلي للبكتريا ١ – ١,٤٥ × ١٠ ^{٢} / جرام.

وبناءاً على النتائج السابقة فإنه يمكن تحضير خلطات غذائيـــة للأطفـــال الرضـــع مـــن المصادر النباتية السابقة الذكر ذات خواص غذائية وصحية عالية يمكن الاستفادة بها في تعـــويض النقص في تغذية الأطفال من سن ٦ أشهر إلى ١٢ شهر خاصة أن لبن الأم يكـــون غيـــر كـــافي لاحتياجات الطفل في هذا العمر.