PREPARATION AND NUTRITIONAL EVALUATION OF BABY FOOD MIXTURES BASED ON VEGETABLE PROTEIN

Yonis, A.A.M*., Hafez, M.Y.. And Atwa , M.A.****

*** Faculty Of Specific Education, Mansoura, Univ.**

****Food Tech. Res. Inst., Agric. Res. Center, Giza.**

ABSTRACT

Nine baby food blends were prepared from cereals; wheat, rice, sorghum, legumes; faba beans, chickpeas, cowpeas and dried skim milk for preschool children. Legumes were subjected to different treatments including germination and cooking to remove the antinaturitional factors (ANF) . Germination caused an apparent increase in protein, whereas fat, fiber, ash and carbohydrate content decreased. While in cooking process carbohydrate was increased but fat, fiber, ash and protein were decreased. Treatments minimized ANF in raw materials; e.g. phytic acid decreased to 55.8 – 86.2% and trypsin inhibitor decreased to 61.9- 96.2% in faba beans.

Protein, fat, ash, fiber and carbohydrate content of the blends (calculated on dry weight basis) ranged from 19.0 to 22.0%, 1.12 to 2.36% , 3.99 to 5.30%, 1.39 to 1.90% and 69.68 to 73.68% respectively.

The mixtures were rich in amino acids improved except tryptophan which was detected as a limiting amino acid.

Nutritional evaluation of baby food indicated high nutritive value for all prepared mixtures. The superior blends No. (5), (6), (3) and (4) for their high values of protein digestibility (ranged to 76.10 – 82.90 and 71.38 - 73.52 by pepsin and trypsin enzymes respectively), biological value (ranged to 75.91- 81.91) and protein efficiency ratio (ranged to 2.47 – 3.04). Organoleptic evaluations were acceptable.

INTRODUCTION

The most common baby foods used to feed preschool children in developing countries are starchy gruels produced from traditionally refined cereal grains (Delgado and Saldivor., 2000).

However, vegetable protein are characterized by their low nutritional value due to presence of antinutritional factors such as inhibitors, phytic acid, unbalanced amino acids composition and low digestibility. Therefore blending or mixing two or more different materials together will help to solve and overcome the deficiency proplem of cereals and legumes if used as food protein source (Pipes and Trahms., 1993).

Also, germination is considered a suitable procedure to improve the nutritional value of legumes seeds by reducing levels of antinutritional factors (Donangelo et al., 1995), and the bulk of its gruels (Marero et al., 1988). While protein content increased (King and Puwastein., 1987).

Cooking process after germination of legumes caused reduction of phytic acid and trypsin inhibitor, and improved the digestibility of protein (Ismail et al., 2000 and Zahran, 2000).

Faba bean is an abundant and economical source of food protein and some mineral elements (Finney et al., 1988 and Youssef et al., 1987).

Chickpea and cowpea are important cheap source of vegetable protein which contained adequate amounts of most essential amino acids for preschool children (Paredes –Lopez et al., 1991, Clement et al., 1998 and Abd El Akher et al., 1995).

The aim of this investigation is to produce nutritionally balanced baby foods from locally available raw materials at low cost.

MATERIALS AND METHODS

1 – **Materials**:

a) Cereals: Wheat (*Triticum species*), sorghum variety Giza 15 and rice (*Oryza sativa*).

b) Legumes: Faba bean (*vicia faba*), chickpea (*Cicer arietinum)* and cowpea (*Vigna unguiculato*) cereals and legumes were obtained from Agriculture Research Center, Giza, Egypt.

D) Dried skim milk was obtained from the National Research Center, Dokki- Giza, Egypt.

2 – **Methods**:

a) Preparation of the different materials:

Dry cereals and dry legumes were cleaned from impurities and then washed thorough with tap water. The washed cereals seeds were separately soaked in tap water overnight and the legumes were separately germinated according to the method of Marero et al., (1988).Germinated seeds were husked by hands under running water.

Germinated legumes seeds (faba bean, chickpea and cowpea), and cereals seeds (wheat, sorghum and rice) were cooked in a pressure cooker also separately for 10 and 8 minutes respectively.

Thereafter , the cooked materials were dried in an air dryer at 65-70^{o}C and milled in an electrical mill, then sieved through a 35 mesh seiver (425 microns).

b) Preparation of baby food mixtures:

The baby food mixtures were prepared to be as preschool children. The quantity of each ingredient of these mixtures were chosen according to essential amino acid contents of each material and the Pattern of amino acid requirements for preschool children, (Table 4).

c) Preparation of baby food diets:

To produce 100 g of the prepared baby food diet, 75 ml water was added to 25 g of the mixture, then mixed directly to produce a thick gruel.

d) Chemical analyses:

* Moisture, crude protein , fat, fiber, total ash and minerals were determined according to the AOAC (1990). Total carbohydrates were calculated by difference.
* Amino acids were identified through the acid hydrolyzate with 6 N. HCl at 110^{o}C for 24 hr. according to the procedure of Moore, et al., (1958).
* Phytic acid was determined according to the methods of Wheeler and Ferrel (1971).
* Trypsin inhibitor was determined according to the method of Roy and Reo, (1971).

* The in-vitro-protein digestibility index by pepsin and trypsin enzymes in a single system was assessed according to the method of Saunder, et al., (1973).

* Total energy in the resultant products was expressed in calories, and was calculated according to Tamime, et al., (1987).

e) Organoleptic evaluations.

Organoleptic tests of baby food mixtures were scored according to Notter et al., (1959).

RESULTS AND DISCUSSION

* Chemical composition of raw, germinated and cooked materials.

The raw, germinated and cooked materials under investigation, i.e., cereals (rice flour, wheat flour and sorghum flour) ; legumes (faba bean flour, chickpea flour and cowpea flour) and dried skim milk were analyzed for protein, fat, ash, moisture, carbohydrate and fibers. The results are presented in Table (1), it could be noted that rice flour, wheat flour and sorghum flour had the highest carbohydrates content being 89.7, 81.9 and 80.4% respectively. But chickpea flour, cowpea flour and faba bean flour had almost the carbohydrate content ranged from 58.0 to 62.6.

High protein levels were observed in dried skim milk (36.0%), faba bean (33.4%), cowpea (29.0%) and chickpea (24.3%). While in wheat, rice and sorghum ranged from 8.0 to 13.5.

Dried skim milk had the highest level of ash (8.4%), followed by faba beans (3.6%), cowpea (3.4%) chickpea (2.8%) sorghum (1.6%), wheat (1.4%) and rice (0.7%).

The highest level of fiber content was in cowpea (3.7%), followed by faba bean (3.5%), but chickpea, sorghum, wheat and rice contained 2.8, 1.6, 1.3 and 0.8% respectively, while dried skim milk had no fiber content.

The germinated legumes possess a higher amount of the protein than the ungerminated ones, as that found by Finey et al., (1980) . These increment may due to the effect of germination process which lead to a slight increase in curde protein as compare to the raw samples (Khalil and Mansour, 1995). On contrary , fat, ash, carbohydrate and fiber content are decreased slightly.

Cooking process, which is followed the germiantion process, lead to decrease in protein by about 5.03% , 5.98% and 6.98 % for faba bean, cowpea and chickpea respectively. Also , moisture, fat, fiber and ash content showed a decrement of all tested materials.

Morever, carbohydrates content of tested materials was increased due to cooking process. This trend seeamed to be the same as reported by Cardoso-Santiago and Areas (2001) in chickpea.

Table (1): The chemical composition of raw, germinated and cooked materials (Calculated on dry weight).

Materials	Moisture	Protein	Fat	Ash	Carbohydrates	Fiber
Wheat	8.5	13.5	1.9	1.4	81.9	1.3
Rice	5.8	8.0	0.8	0.7	89.7	0.8
Sorghum	9.7	13.5	2.9	1.6	80.4	1.6
Chickpea raw	9.8	24.3	7.5	2.8	62.6	2.8
Germinated	7.1	25.8	7.0	2.4	62.4	2.4
Cooked	4.3	24.0	5.5	2.6	65.7	2.2
Faba bean raw	10.3	33.4	1.5	3.6	58.0	3.5
Germinated	6.7	33.8	1.1	3.4	58.6	3.1
Cooked	4.2	32.1	1.0	3.1	60.9	2.9
Cowpea raw	9.9	29.0	1.9	3.4	62.0	3.7
Germinated	6.3	30.1	1.8	3.2	61.9	3.0
Cooked	4.0	28.3	1.6	3.1	63.8	2.9
Dried skim milk	4.2	36.0	1.1	8.4	54.5	-

Essential amino acids content of the materials

The nutritive value of protein mostly would depend on its amino acids profile, in general and the quantities of the essential amino acids in particular. Protein requirements can be satisfied by providing the total essential amino acids rather than increasing the intake of protein.

Table (2) showed the ten amino acids content in cooked legumes (chickpea, faba bean and cowpea) and skim milk powder compared with FAO/WHO (1985) pattern.

The data revealed that the essential amino acids content of the materials

exceeded their corresponding quantities in FAO pattern except for methionine, cystine and tryptophane in cooked faba bean flour and threonine in cooked chickpea flour.

Table (2): Essential amino acids content of the tested materials compared with FAO pattern of preschool children.

Amino acids (gm/100gm protein)	Cooked chickpea flour	Cooked faba bean flour	Cooked cowpea flour	Dried skim milk	FAO/WHO (1985)
Isoleucine	**3.40**	**4.80**	**5.07**	**5.90**	**2.80**
Leucine	**7.85**	**6.80**	**8.04**	**9.80**	**6.60**
Methionine	**1.60**	**0.89**	**2.05**	**1.50**	**2.50**
Cystine	**1.30**	**0.91**	**1.03**	**2.00**	
Phenylalanine	**4.00**	**3.56**	**5.29**	**4.00**	**6.30**
Tyrosine	**4.50**	**3.07**	**3.20**	**5.10**	
Threonine	**3.25**	**3.50**	**3.75**	**3.60**	**3.40**
Valine	**4.30**	**5.40**	**5.35**	**6.20**	**3.50**
Lysine	**6.90**	**6.70**	**7.92**	**7.30**	**5.80**
Tryptophane	**1.31**	**0.80**	**1.10**	**1.20**	**1.10**
Histedine	**3.10**	**2.01**	**3.82**	**4.00**	**1.90**
Total E.A.A.	**41.51**	**38.44**	**46.62**	**50.6**	**33.90**
Limiting A.A	**Tyr.**	**Cys.+ Meth.+ Try.**	-	-	-

Antinutritional factors affected by germination and cooking processes:

Nutritional value of legumes limited by the content of antinutrients such as phytic acid and trypsin inhibitors (Rincon et al., 1998). The effect of the pretreatment (germination and cooking) processes on phytic acid content for cowpea, chickpea and faba bean was studied. Data presented in Table (3) showed that there was dramatically reduction in phytic acid in all legumes due to the germination process. These results are agreed with that found by Shabib, (1999) and Ravindran et al., (1994).

It could be illustrated as Khan et al., (1988) reported that , during legumes germination, the phytase activity increased with concomitant decrease in phytate.

The present study showed, also that the germination process followed by cooking process lowered the phytic acid value in the chickpea, cowpea and faba bean to 1.4, 0.7 and 0.5 gm/100gm respectively. The effect of cooking process could be illustrated by the finding of Sandberg et al., (1987) who reported that during cooking, about 25% of hexaphosphate was hydrolyzed to pentatetra phosphate.

Results in Table (3) showed , also that the trypsin inhibitor value in the faba bean flour seemed to be higher in that found in chickpea and cowpea flour (39.9, 34.7 and 26.5 mg/g sample; respectively). Germination process leads to an extensive reduction in trypsin inhibitor in all of the tested samples.

The cooking process after germination process seemed to give a nearest reduction impact on trypsin inhibitor in tested materials, 96.2% in cowpea, 96.2% in faba bean and 92.5 in chickpea flour .

Table (3) : Effect of germination and cooked process on phytic acid content and trypsin inhibitor (on dry weight basis)

Materials	Phytic acid			Trypsin inhibitor		
	gm/100gm	Reduction %	Total Reduction %	gm/100gm	Reduction %	Total Reduction %
Chickpea flour						
Raw	7.4	-	-	34.7	-	-
Germinated	3.8	50.8	-	12.9	62.8	-
Cooked	1.4	63.2	81.3	2.6	79.8	92.5
Faba bean flour						
Raw	3.62	-	-	39.9	-	-
Germinated	1.6	55.8	-	15.8	60.4	-
Cooked	0.5	68.8	86.2	1.4	91.1	96.5
Cowpea flour						
Raw	3.77	-	-	26.5	-	-
Germinated	2.2	41.6	-	10.1	61.9	-
Cooked	0.7	68.2	81.4	1.0	90.1	96.2

Preparation of baby food mixtures:

Ingredients content (gm and percent %) and protein content (g and percent %) of each blend is found in Table (4), whole amount of all ingredients suggested to be 10g protein to be an adequate source to meet recommendation of protein as described by FAO/WHO (1985). Dried skim milk was predominantly used in all formulas to recover the shortage of protein. Moreover, Khalil and Mansour, (1995) reported that the nutritive value of many legumes was enhanced by heat processing and germination

Table (4): Ingredients of the prepared baby food mixtures.

Ingredients	Mixture (1)				Mixture (2)				Mixture (3)			
	Weight of materials		Protein content		Weight of materials		Protein content		Weight of materials		Protein content	
	gm	%	gm	%	gm	%	gm	%	gm	%	gm	%
Wheat	7.4	16.6	1	2.2	-	-	-	-	-	-	-	-
Rice	-	-	-	-	12.5	25	1	2.0	-	-	-	-
Sorghum	-	-	-	-	-	-	-	-	7.4	16.6	1	2.2
Cooked faba bean	9.3	2.0.9	3	6.6	9.3	18.6	3	6.0	9.3	20.9	3	6.6
Cooked Cowpea	10.6	23.8	3	6.6	7.1	14.2	2	4.0	10.6	23.8	3	6.6
Cooked Chickpea	-	-	-	-	-	-	-	-	-	-	-	-
Dried skim milk	8.3	18.7	3	6.6	11.1	22.2	4	8.0	8.3	18.7	3	6.6
Sucroce	8.9	20	-	-	10	20	-	-	8.9	20	-	-
Total	44.5	100	10	22	50.0	100	10	20	44.5	100	10	22

Ingredients	Mixture (4)				Mixture (5)				Mixture (6)			
	Weight of materials		Protein content		Weight of materials		Protein content		Weight of materials		Protein content	
	gm	%	gm	%	gm	%	gm	%	gm	%	gm	%
Wheat	7.4	15.6	1	2.1	-	-	-	-	-	-	-	-
Rice	-	-	-	-	12.5	23.5	1	1.9	-	-	-	-
Sorghum	-	-	-	-	-	-	-	-	7.4	15.6	1	2.1
Cooked faba bean	-	-	-	-	-	-	-	-	-	-	-	-
Cooked Cowpea	14.1	29.6	4	8.4	10.6	20.0	3	5.7	14.1	29.6	4	8.4
Cooked Chick pea	8.3	17.4	2	4.2	8.3	15.6	2	3.8	8.3	17.4	2	4.2
Dried skim milk	8.3	17.4	3	6.3	11.1	20.9	4	7.4	8.3	17.4	3	6.3
Sucroce	9.5	20	-	-	10.6	20	-	-	9.5	2	-	-
Total	47.6	100	10	21	53.1	100	10	19	47.6	100	10	21

Ingredients	Mixture (7)				Mixture (8)				Mixture (9)			
	Weight of materials		Protein content		Weight of materials		Protein content		Weight of materials		Protein content	
	gm	%	gm	%	gm	%	gm	%	gm	%	gm	%
Wheat	7.4	16.2	1	2.2	-	-	-	-	-	-	-	-
Rice	-	-	-	-	12.5	24.3	1	1.9	-	-	-	-
Sorghum	-	-	-	-	-	-	-	-	7.4	16.2	1	2.2
Cooked faba bean	12.5	27.4	4	8.8	9.3	18.1	3	5.7	12.5	27.4	4	8.8
Cooked Cowpea	-	-	-	-	-	-	-	-	-	-	-	-
Cooked Chickpea	8.3	18.2	2	4.4	8.3	16.1	2	3.8	8.3	18.2	2	4.4
Dried skim milk	8.3	18.2	3	6.6	11.1	12.5	4	7.6	8.3	18.2	3	6.6
Sucroce	9.1	20	-	-	10.3	20	-	-	9.1	20	-	-
Total	45.6	100	10	22	51.5	100	10	19	45.6	100	10	22

Chemical composition of baby food mixtures

The nine mixtures were chemically analysed in order to determine the main chemical composition. The data obtained are shown in Table (5). It could be noted that the moisture content ranged between 3.72 and 5.31% however, this low moisture content is of great importance for good keeping quality of reasonablie shelf life period for the final product. The protein content of the formulated mixtures was ranged between 19.0 and 22.0%.

Data presented in Table (5) showed also , that the tested mixtures could be categorized into two groups according to their fat content. The first group was included mixtures No. (1), (2), (3) and (8) which its fat was lower than 2%. On the other hand, the second groups, which its fat was higher than 2% was included mixtures No. (4), (5), (6) ,(7) and (9). These results are in agreement with those reported by Ismail et al., (2000).

Table (5): Chemical composition of the baby food mixtures (calculated an dry weight)

Baby food mixture	Moisture %	Protein %	Fat %	Ash %	Carbohy-drates%	Fiber %
1	**4.60**	**22.00**	**1.29**	**3.99**	**70.83**	**1.89**
2	**4.32**	**20.22**	**1.12**	**5.03**	**72.32**	**1.53**
3	**5.31**	**22.00**	**1.40**	**4.33**	**70.37**	**1.90**
4	**3.97**	**21.00**	**2.25**	**4.54**	**70.48**	**1.73**
5	**3.72**	**19.00**	**2.08**	**5.30**	**72.23**	**1.39**
6	**4.29**	**21.00**	**2.36**	**4.56**	**70.32**	**1.76**
7	**4.05**	**22.00**	**2.01**	**4.42**	**69.84**	**1.73**
8	**3.78**	**19.00**	**1.90**	**4.03**	**73.68**	**1.39**
9	**4.37**	**22.00**	**2.12**	**4.44**	**69.68**	**1.76**

It could be also, seen from Table (5) that the highest value for carbohydrates content was in mixture No.(8) (73.68%) , while mixture No. (2), (5), (1), (4),(3) and (6) had contained values 72.32, 72.23, 70.83, 70.48,

70.37 and 70.32% respectively. Mixtures No. (7) and (9) showed lower values of carbohydrates content (69.68 and 69.84%), respectively.

The ash content ranged between 5.30 and 3.99% . The highest values were for mixtures No. (5), (2), (6) and (4) (5.30, 5.03, 4.56 and 4.54% respectively). The lowest values were in mixtures No. (8) and (1) (4.03 and 3.99% respectively). The curde fiber content for the nine formulated mixtures ranged between 1.39 and 1.90%. The highest values were in mixture No,. (3), (1), (6), (9), (7) and 4 respectively. While the lowest values were in mixtures No.(8), (5), and (2) respectively.

Essential amino acids content of baby food mixtures:

It is clear from Table (6) that the different formulated mixtures contained high proportions of essential amino acids comparing with FAO provisional pattern except tryptophane was detected as a limiting amino acid. The same table showed, also that the mixture No. (5) contained the highest content of total essential amino acids (50.39 gm/100gm protein) followed by mixtures No. (6), (4), (2),(3) and (1) respectively.

Nutritional evaluation of baby food mixtures

a)Nutrientcontent From the results in Table (7) it could be noted that, 100gm from each tested mixture provides about one third of the energy daily requirement. The same amount of each of the tested mixtures provides about 1.3 fold nearly of the protein requirements. Data in Table (7) also, revealed that 100 gm of the individual mixture possessed by about 1.5 to 1.7 folds of daily requirement of the total essential amino acid as reported FAO/WHO (1985). The same table showed, also that magnesium content in 100gm of all mixtures was higher than that recommended by FAO/WHO (1985). All tested formulas covered one third of the daily requirement for zinc content from 100gm . Also, it gave from 50% of the daily requirement of calcium and iron content.

b) Nutritive value:

The protein digestibility (PD) of the tested mixtures was studied and compared with casein, as a standard protein (Table 8). It was found that the mixtures No (8), (7), (2), (9) and (6) possessed the highest PD values than casein by trypsin enzymes, respectively. All tested mixtures have higher PD values by pepsin enzymes than trypsin enzymes. While the PD index for casein was the highest by pepsin than that of each formulas. The variation in PD could be demonstrated to one or more of the following reasons: PD depends on the kind of protein and consequently its content of essential amino acids (EL-Akel. 1993).

The calculated protein efficiency ratio (PER) of the tested mixtures could be divided into two groups. The first one included mixtures No. (1), (2), (3), (4), (5), (6) and (9), such mixtures had PER more than 2.0. The second group included mixtures No. (7) and (8) which had PER was less than 2.0. However, mixture No. (5) had the highest PER value (3.04) . Harper and Jansen (1981) reported that blends which had PER of 2.0 – 2.3 would be expected to contain protein of high enough quality to be satisfactory for a weaning food.

According to the biological value (BV) it is clear from (Table 8) that the two mixtures (5) and (6) gave the highest BV (81.91 and 78.96 respectively), while mixtures (3), (4), (1), (2), (9) and (8) gave (76.75, 75.91, 74.33, 73.91 , 71.38 and 70.01 respectively). The lowest value was found in mixture (7) (68.33).

Table (8): protein digestibility, Protein efficiency ratio biological value of baby food mixtures.

Baby food Mixtures	Protein digestibility %		PER*	BV**
	Pepsin	Trypsin		
1	77.43	73.62	2.32	74.33
2	80.61	73.90	2.28	73.91
3	76.10	73.01	2.55	76.75
4	78.62	72.43	2.47	75.91
5	82.19	73.52	3.04	81.91
6	77.51	71.38	2.76	78.96
7	80.36	74.00	1.75	68.33
8	83.70	75.27	1.91	70.01
9	79.32	73.80	2.04	71.38
Casein	88.79	73.44	-	-

Protein efficiency ratio (PER)* = - 1.816 + 0.435 (Methionine) + 0.780 (leucine) + 0.211 (Histidine) – 0.944 (tyrosine), Alsmeyer et al., (1947).

Biological value (BV)** = 49.9 + 10.53 PER, Mitchell and Block, (1946).

Organoleptic evaluation:

One of limiting factor for consumer acceptability is the organoleptic properties. Table (9) illustrated the mean values of the sensory characteristic scores such as; color, odor, taste, texture and appearance. Also, the overall average scores of the formulated blends. The obtained results indicated that the best preferable mixture with respect to overall acceptability was mixture No., (2) , followed by mixtures No. (3), (1), (5), (4) and (8) and last blend No. (6). Such mixtures recorded lower value of overall acceptability when compared with mixture No. (6) and the differences between them (No. (3),

(1), (5), (4) and (8) were unsignificant. In general, it could be concluded that, all the tested food mixtures are met recommended requirements of all nutrients for such children. On the other hand, the highest preferable food mixture was noticed in case of blend No,(5) due to the highest degree of BV(81.91) followed by mixtures No(6) , (3) and (4) gave 787.69, 76.75 and 75.91 respectively. Also, each 100g of mixture No(5) provides about 118.8%, 176.5%, 67.5%, 48.0% and 29.1% of the protein, total E.A..A., calcium, iron and total energy of daily requirement respectively. While, 100g from each mixtures No (6), (3) and (4) covered 131.3, 174.5, 61.0,52.1, 29.4 and 137.5, 178.3, 51.6, 60.0, 29.1 and 131.3, 174.2, 52.1, 56.0, 29.4 of the protein, total E.A..A., calcium, iron and total energy of daily requirement respectively.

REFERENCE

A.O.A.C. (1990): Official Method of analysis of The Association official analytical chemists, 15 th Ed., Published by A.O.A.C., 2200 Wilson Boulevard Arlington Virginia 22201 U.S.A.

Abd El-Akher, M.A. Khalaf Allah, A.M. and Maatuk. H.I. (1995): Chemical evaluation of mung beans in respect of other indigenous Legume seeds. Egypt. J. Appl. Sei., 10 (2) : 98.

Alsmeyer, R.H., Cunningham, A.E. and Happich, M.L. (1974) : Equations predict PER from Amino acid analysis .Food Tech., 28 (1) : 34.

Cardoso-Santiago , R.A. and Areas, J.A.G (2001): Nutritional evaluation of snacks obtained from chickpea and bovine lung blends. Food Chem, 74 (1) : 35.

Clement, A.; Sancher, V.R; Vio que. J.B.; Bautista, J. and Millan, F. (1998) : Effect of cooking on Protein Quality of chickpea (Cicer arietrinum) seeds. Food Chem. 62 (1): 1

Delgado and Saldvior, S.O.S. (2000): Production and nutritional evaluation of liquefied weaning foods from malted sorghum, quality maize and other cereals . Food chem.., 77 (5) ; 652.

Donangelo, C.M., Trugo, L.C., Trugo , N.M.F. and Eggum, B.O. (1995): Effect of germination of legume seeds on chemical composition and on protein and energy utilization in rats. Food Chem, 53: 23 .

El-Akel, A.T. (1993): Production and evaluation of some ford mixture by extrusion-cooking J. Appl., Sci., 8. (3): 62.

FAO/WHO (1985): Food and Agriculture organization of united Naitons/World Health organization Energy and Protein requirements. Report of Joint FAO/WHO/UNU Expert consulation technical Report Series No. 724.

Finey, P.L.: Morad, M.M.; Smithard, R.R. and Liu, K.L. (1980): Effect of germiantion on physico chemical and bread-backing properties of yellow peal, Lentil and faba bean flour and starches. Cereal Chem, 57 (6) : 390.

Finney, P.L., Morad M. M, and Hubbard .J. D. (1980): Germinated and ungerminanted faba bean conventional U.S. Breads. Cereals Chem, 57 (4): 267.

Harper,J.M.and Jansen, G.R.(1981): Nutritious foods production by low cosst technology summary report of cooperative activities,between colorado state universty and affice of international cooperation and development,USDA,1974.

Ismail, F.A., Galal, F.S.; El-Atawy, Y.S. and Bakey, A.A. (2000): Chemical and physical characteristics of weaning foods prepared from cereals and legumes. Egypt. J. Agric. Res., 78 (1): 293.

Khalil,A.H. and Mansour,E.H. (1995): The effect of cooking ,autoclaving and germination on the nutrition quality of faba bean.Food Chem.,54(2):177.

Khan, N., Zatan, R. and Elahi, M. (1988): Effect of processing on the phytic acid content of Bengal grams (Cicer arietinum) Products. J. Agric . Food Chem. , 36 (3) : 274.

King, R.D. and Puwastein (1987): Effect of germination on the proximate composition and nutritional quality of winged bean seeds. J. Food Sci. 52 (1): 106.

Mavero, L.M. ; Payumo , E.M.M.: Librando, e.C.; Lainez, W.H.; Copez, M.D. and Homma, S. (1988): Technology of weaning foods formulations prepared from germinated cereals and legumes. J. Food Sci., 53 (5): 1391.

Mitchell, H.H. and Slock, d. (1946): The correlation of the amino acid composition of Protein with their nutritive value Nutrition Abstracts and Reviews, 16: 249.

Moore, S., Spachman, D.H., and stein, W.(1958): Chromotography of amino acid on sulphonated polystyrene resins. Anal . Chem., 30 : 1185.

Notter, G.k.; Taylor, P.H. and Downens, N.J. (1959): Orange duice powder Factors affecting storage stability. Food Tehc, 13-113.

Paredes-Löpes, O. ; Ordorica-Falomir, C and Olivares-Vezquez, M. R. (1991): Chickpea Protein isolates; physicochemical functional and Nutritional choracterization. J. Food Sci., 56 (3) : 726.

Pipes,P.L.and Trahms,C.M.(1993): Nutrient needs of infants and children

.In nutrition in ifancy and child hood .Published by Mosby,St.Leoui,Missouri,U.S.A..

Ravindran, V.; Ravindran, G. and Sivalogan, S. (1994): Total and feed stuffs of plant origin. Food Chem. 50 (2) : 133.

Rincon, F.; Martinez, B. and Ibanez, M.V. (1998): Proximate composition and antinutritive substances in chickpea (Cicer arvetinum) as affected byh the biotype factor.J.Sci., Food Agric., 78: 382.

Roy, D.N. and Reo. P.S. (1971): Evidence . Isolaiton, Purification and some properties of trypsin inhibitor in lathyrus sativus. J. Agric. Food chem.. 19: 257.

Sandberg, A.S.; Andersson , H.; Corlsson, N.G. and Sandstrom, B. (1987): Degradation product of bran phytate formed during digestion in the human small intestine: effect of extrusion cooking on digestibility J. Nutr., 117: 2061 .

Saunder, R. M. , canner, M. A. Booth, A. N. , Brekoff, E. M. and Kohler, G.O. (1973): Measurement of digestibility of alfalfa protein Concentrates by in vivo and in vitro methods. J. Nutr. , 103: 530.

Shabib, Zeinab. A.K.(1999): Evaluation of saybean products as affected by extrusion-expelling and utilization in balady bread making. M. Sc. Thesis, Dept Sci. and Techn., Fac. Of Agric. Cairo. Univ.

Tamime, A.Y. Davies, G. and Ham Hamilton, M. P. (1983): The quality

of yoghurt on retail salein. Arshire: 1- Chemical and Microbiological evaluation. Dairy Industries Inter., 52 (6) : 21.

Wheeler, E.I.; and Ferrel, R.E. (1971): A method for phytic acid determination in wheat and wheat fractions. Cereal chem.., 48; 312.

Youssef, M.M.; Abd El-Aal, M.H.; She kib, Laila , A.E. and Ziena, H.M. (1987): Effects of dehulling, Soaking and germination on chemical composition mineral elements and protein Pattern of faba bean civicia Faba & L. Food Chem., 23 (1) 129.

Zahran, G.A. H. (2000): Effect of extrusion processing on properties of snack food manufactured from some cereals and legumes blends. Ph. D. Thesis Dept. Food Sci. and Tech., Fac. Of Agric. Cairo. Univ.

تحضير وتقدير القيمة الغذائية لخلطات أغذية الأطفال المعتمدة على البروتينات النباتية

علاء الدين أحمد مرسى *، محمد يوسف حافظ ** ، محمد عبد الرحمن عطوه**

*** كلية التربية النوعية – جامعة المنصورة**

****معهد بحوث تكنولوجيا الأغذية – مركز البحوث الزراعية – الجيزة**

يهدف هذا البحث إلى إعداد مخاليط غذائية لأطفال ما قبل سن المدرسة من بعض الحبوب (القمح – الأرز – الذرة الرفيعة) والبقول (الفول البلدى – الحمص- اللوبيا) واللبن الجاف منزوع الدسم وكان عدد المخاليط تسعة . وللتخلص من مضادات التغذية ثم إنبات كل من الفول والحمص واللوبيا ثم معاملتها حرارياً. أدت عملية الإنبات إلى زيادة فى محتوى البروتين فى حين أدت إلى نقص فى نسبة الدهن والألياف والرماد والكربوهيدرات . بينما أدت المعاملة الحرارية إلى زيادة فى الكربوهيدرات ونقص فى كل من الدهن والألياف والرماد والبروتين. كما أدت كل من عملية الإنبات والطبخ إلى حدوث نقص ملحوظ فى حمض الفيتيك وبلغ هذا النقص ٥٥,٨ % و ٨٦,٢ % فى الفول البلدى، وكان مثبط التربيسين أكثر تأثراً بالمعاملة الحرارية عن عملية الإنبات حيث كانت ٦١,٩ % و ٩٦,٥ % فى الفول البلدى أيضاً. ودل التحليل الكيميائى لأغذية الأطفال انها تحتوى على بروتين بنسبة تتراوح بين ١٩ – ٢٢ % والدهون كانت ١,١٢ – ٢,٣٦ % والرماد بلغت نسبته ٣,٩٩ – ٥,٣٠ % والألياف كانت ١,٣٩ – ١,٩٠ % واما الكربوهيدرات فكانت ٦٩,٦٨ – ٧٣,٦٨ % . كذلك تحتوى على نسبة عالية من أملاح المغنسيوم والكالسيوم والحديد.

وأحتوت أغذية الأطفال المحضره أيضا على الأحماض الأمينية الأساسية فيما عدا الحمض الأمينى تربتوفان الذى يعتبر الحامض الأمينى المحدد فى كل الخلطات. تميزت مخاليط الأطفال المقترحة بارتفاع قابلية البروتين للهضم حيث تراوحت بين ٧٦,١٠ – ٨٢,٩٠ بواسطة أنزيم الببسين ، ٧١,٣٨- ٧٣,٥٢ بواسطة أنزيم التربيسين .

وكانت القيمة البيولوجية (BV) للخلطات بين ٧٥,٩١ و ٨١,٩١ بينما تراوحت الكفاءة النسبية للبروتين (PER) ما بين ٢,٤٧ – ٣,٠٤ . وأظهر التقييم الحسى للمخاليط التسعة المحضرة أنها ذات درجة قبول عالية . ويستنتج من ذلك أن المخاليط المقترحة تفى بالاحتياجات الغذائية لمرحلة ما قبل الدراسة وأن أكثر المخاليط قبولاً هى الخلطة رقم (٥) تليها الخلطات أرقام (٦) و (٣) ثم (٤) .

:

Table (7): Nutrient in 100 gm of baby food mixtures compared with daily recommended requirements for preschool children.

	Daily requirement FAO/WHO	Baby food mixtures								
		1	2	3	4	5	6	7	8	9
Energy (Kcal)	1300	379.4	375.1	378.6	382.2	378.9	382.6	381.9	382.9	382.2
Protein (gm)	16	22	20	22	21	19	21	22	19	22
Total essential amino acid (mg)	5424	9633.8	8838.0	9669.0	9447.9	9574.1	9464.7	9220.2	8227.0	9244.4
Calcium (mg)	800	413.1	530.1	412.8	417.0	540.3	416.5	415.1	538.9	414.9
Magnesiume (mg)	80	106.7	112.8	98.2	105.3	104.1	97.1	107.5	105.6	99.5
Iron (mg)	10	5.2	5.3	5.6	5.6	4.8	6.1	5.1	4.9	5.6
Zinc (mg)	10	3.4	3.8	3.5	3.4	3.5	3.5	3.2	3.3	3.6

*** FAO/WHO (1985).**

Table (9) : Organoleptic characteristics of baby food mixtures.

Parameters / Baby food mixture	Color (10)	Odor (10)	Taste (10)	Texture (10)	Appearance (10)	Overall acceptability (50)
1	8.25^{b}	7.65^{abc}	8.03^{b}	8.14^{ab}	8.13^{ab}	40.20^{b}
2	9.31^{a}	8.33^{a}	9.00^{a}	8.01^{ab}	8.60^{a}	43.25^{a}
3	8.34^{b}	8.13^{ab}	8.02^{b}	8.23^{a}	8.16^{ab}	40.88^{b}
4	7.61^{bc}	7.13^{bc}	7.57^{abc}	7.866^{b}	8.16^{ab}	37.70^{bcd}
5	7.57^{bc}	8.12^{ab}	8.55^{ab}	7.58^{b}	7.18^{cd}	39.01^{abc}
6	6.95^{c}	7.48^{abc}	7.11^{bc}	7.02^{b}	6.91^{d}	35.47^{d}
7	7.98^{b}	7.00^{c}	6.73^{c}	7.01^{b}	7.03^{cd}	35.75^{d}
8	7.93^{b}	7.17^{bc}	7.62^{abc}	7.10^{b}	7.64^{bc}	37.46^{bcd}
9	7.63^{bc}	7.04^{bc}	7.01^{bc}	7.03^{b}	7.55^{bc}	37.26^{cd}

.

Table (6) : Essential amino acids (EAA) content , of baby food mixtures compared with FAO pattern of preschool children

Amino acids (g/100g protein)	Baby food mixtures									FAO/WHO (1985)
	1	2	3	4	5	6	7	8	9	
Isoleucine	5.92	5.70	5.69	5.06	5.46	4.77	5.66	4.86	5.26	**2.8**
Leucine	7.99	8.30	8.45	8.24	9.41	8.75	7.74	8.20	8.25	**6.6**
Methionine	1.49	1.45	1.44	1.72	1.92	1.66	1.29	1.36	1.24	**2.5**
Cystine	1.35	1.36	1.32	1.44	1.56	1.39	1.40	1.42	1.38	
Phenylalanine	4.27	4.16	4.31	4.57	5.06	4.60	3.87	3.96	3.90	**6.3**
Tyrosine	3.60	3.90	3.71	3.86	4.40	3.93	3.86	4.16	3.93	
Threonine	3.49	3.54	3.56	3.46	3.94	3.53	3.36	3.44	3.43	**3.4**
Valine	5.47	5.45	5.35	5.15	5.75	5.03	5.20	5.10	5.09	**3.5**
Lysine	6.68	6.76	6.63	6.78	7.66	6.75	6.28	6.56	6.23	**5.8**
Tryptophane	1.03	1.03	1.03	1.16	1.27	1.10	1.03	1.12	1.04	**1.1**
Histedine	3.13	3.17	3.09	3.55	3.94	3.51	2.85	3.12	2.81	**1.9**
Total E.A.A.	43.79	44.19	43.95	44.99	50.39	45.07	41.91	43.30	42.02	**33.9**