RESULTS AND DISCUSSION

I. Chemical composition of raw materials and formulated children food mixtures:

The chemical analysis were carried out on the original raw materials and also on the formulated ten mixtures. It was decided to estimate moisture, protein, fat, carbohydrate, crude fiber, ash and minerals which were thought to be of great importance in infant feeding.

It might be noticed here that the vitamin contents of both raw materials and formulas were not under consideration due to the fact that the original food commodities were exposed to processes of preparation and cooking which might destroy the vitamins, particularly the water soluble ones. However, the main interest of the present study was devoted to the protein and mineral contents in order to face and overcome the protein calorie malnutrition and anemia which are prevailing problem in the lower scio-enonmic class infants and toddlers of Egypt.

1. Chemical composition of the raw materials:

The raw materials under investigation, i.e. cereals (wheat, corn and rice); legumes (hulled chickpea, hulled broad beans, dried peas and lentil); oil seeds (sesame and peanut); vegetables (carrot and potato) and dried skim milk were analyzed for protein, fat, ash, available carbohydrates and fibers. Results are presented in Table (5).

From the results in (Table, 5) it could be noted that potato and carrot had the lowest protein content being 1.55 and 1.25%, respectively. Meanwhile, dried skim milk had the highest protein content being 36.29%. But, rice, corn and wheat had almost the protein content ranged from 8.23 to 14.00. Lentil, hulled broad beans, hulled chickpea and dried peas had also high protein content : 28.55, 23.84, 21.88 and 20.13%, respectively. Moreover, peanut and sesame had also high protein content: 28.88 and 26.25%, respectively.

High fat levels were observed in sesame (55.92%) and peanut (52.62%) as compared with the low levels in dried peas (1.84%), dried skim milk (0.75%), rice (0.56%); carrot (0.23%) and potato (0.11). While, in, lentil, wheat, hulled broad beans, corn and cickpea ranged from 2.25 to 6.13%. Also, available carbohydrate was low in sesame (7.94%), carrot (9.64%), peanut (9.93%), potato (18.25%) and dried skim milk (47.79%). However, rice had the highest available carbohydrate, 83.42%. While, corn and wheat had high content (77.05 and 72.00%, respectively). Available carbohydrate in the other legumes ranged from 56.40 to 62.90%.

Table (5): Chemical composition of the raw materials used for the preparation of children food formulas (g per 100 g on wet weight basis).

Raw materials	Moisture	Protein	Fat	Ash	Total carbohydrate	Fibre	Available carbohydrate
Hulled chickpea	5.04	21.88	6.13	2.55	64.40	1.50	62.90
Dried peas	10.86	20.13	1.84	2.94	64.23	3.35	60.88
Lentil	8.75	28.55	2.25	2.28	58.17	1.77	56.40
Hulled broad beans	5.74	23.84	3.02	3.16	64.24	3.20	61.04
Peanut	2.32	28.88	52.62	2.70	13.48	3.55	9.93
Sesame	3.20	26.25	55.92	2.46	12.17	4.23	7.94
Wheat	8.33	14.00	2.62	1.55	73.50	1.50	72.00
Corn	6.33	12.69	5.47	1.46	74.05	2.00	72.05
Rice	6.57	8.23	0.56	0.52	84.12	0.70	83.42
Dried skim milk	7.12	36.29	0.75	8.05	47.79	--	47.79
Carrot	86.50	1.25	0.23	1.25	10.77	1.13	9.64
Potato	78.50	1.55	0.11	1.15	18.69	0.44	18.25

Sesame had the highest level of fiber content (4.23%), followed by peanut (3.55%); dried peas (3.35%), broad beans (3.20%) and corn (2.0%), While, dried skim milk had no fiber content.

Dried skim milk had the highest level of ash (8.05%) followed by hulled broad beans (3.16%), while, rice was (0.52%), but, chickpea, peas, lentil, hulled broad beans, peanut, sesame, wheat, corn, carrot and potato contained 2.55, 2.94, 2.28, 3.16,2.70, 2.46, 1.55, 1.46, 1.25 and 1.15% ash, respectively.

2. Chemical composition of the ten formulated children food mixtures:

The ten mixtures were chemically analysed in order to determine main chemical composition. The data which were obtained could be seen in Table (6). It could be noted that the moisture content did not almost vary between the formulated mixtures. This could be explained upon the basis that, the analysis was carried out on the dry mixtures. However, this low moisture content is of great importance for good keeping quality of reasonable shelf-life period for the final product. As for the protein content of the formulated mixtures, it was found that the highest values were obtained with mixtures No. 6, 1, 2, 5 and 9

Table (6): Chemical composition of the dried formulated children food mixtures (g/100 g on wet weight basis).

Formula No.	Moisture	Protein	Fat	Ash	Total charbohydrate	Fibre	Available carbohydrate
1	2.44	22.97	4.18	2.89	67.52	1.48	65.68
2	2.46	22.95	4.43	2.58	67.67	1.90	65.77
3	2.08	18.81	3.65	2.70	72.85	2.00	70.85
4	2.92	19.68	4.43	2.55	71.42	1.82	69.60
5	2.05	22.31	3.28	2.65	69.71	1.22	68.49
6	2.52	23.19	3.17	2.98	68.14	1.98	66.16
7	4.48	18.38	4.75	1.66	70.73	1.92	68.81
8	4.56	20.56	4.95	2.53	67.40	1.50	65.90
9	2.13	22.31	4.80	2.75	68.01	2.00	66.01
10	3.69	21.00	4.47	2.87	67.97	1.86	66.11

were (23.19, 22.97, 22.95, 22.31 and 22.31%, respectively). While the protein content in the other mixtures (7, 3, 4, 8 and 10) ranged between 18.38 and 21.00%. Some of the obtained data for protein content of these mixtures (6, 1, 2, 5 and 9) are nearly similar to those reported by the Protein Advisory Group (PAG, 1970), who pointed out that the protein content of Supramine produced in Algaria and Tunisia was 20.20%, while the baby food NSP produced in Chili was 22%. On the other hand, the product TRL of Turkey and Chili contained 25.3%. The same trademark produced in Iran and Ethiopia was 20.7%. Another baby food product in Ethiopia named Faffa had a protein content 26.6%.

With regard to fat contents of the formulated mixtures, it could be noted from Table (6) that the fat content was more or less the same for mixtures No. 3, 4, 5 and 6, while the values were higher in mixtures No. 1, 2, 10, 7, 9 and 8 (4.18, 4.43, 4.47, 4.75, 4.80 and 4.95%), respectively.

It could be also seen from Table (6) that the highest value for available carbohydrates was in mixture No. 3 (70.85%). While mixtures No. 4, 5, 7, 6, 10 and 9 had more or less the same values (60.60, 68.49, 68.81, 66.16, 66.11 and 66.01%, respectively). Mixtures No. 8, 2 and 1, showed lower values of available carbohydrates (65.90, 65.77 and 65.68%), respectively.

The ash content for the ten formulated mixtures ranged between 1.66 to 2.98%. The highest values were in mixtures No. 6, 1, 10, 9, 3 and 5 (2.98, 2.89, 2.87, 2.75, 2.70 and 2.65%, respectively).

The crude fiber content for the ten formulated mixtures ranged between 1.22 and 2.00. The highest values were in the mixtures No. 3, 9, 6, 7, 2, 10, 1 and 4 (2.0, 2.0, 1.98, 1.92, 1.90, 1.86, 1.84 and 1.82%, respectively), while the lowest values were in mixtures No. 8 and 5 (1.50 and 1.22%, respectively).

The advantage and disadvantage of the crude fiber presence in infant nutrition was discussed by several workers. Ohlson (1963) reported that the increase of fibers in baby foods might cause some irritation to the gastrointestinal tract. On the other hand, Mitchell et al. (1968) stated that the presence of fiber would be of some necessity for more efficient and normal peristaltic action in the stomach.

3. **Calculated calorific values of the formulated children food mixtures:**

The total calorific values were calculated as mentioned earlier in the methods section, using Atwater and Bryant factors as mentioned by Hawk *et al*. (1949). The calculated figures could be seen in Table (7). The highest values were obtained with mixtures 9 and 2, being 396.48 and 394.75 K cal. per 100 g of each mixture, respectively. While mixture 6 had the lowest value, being 385.93 K cal. Mixtures 1, 3, 4, 5, 7, 8 and 10 are inbetween (392.22; 390.68; 387.99; 392.72; 391.51; 390.39 and 388.67 K cal., respectively). These obtained results are higher than those reported by K.I.T. (1983), who mentioned that, the calorific values of the baby food (Faffa) produced in Ethiopia and the (AK-1000) in Haiti were 340 and 350 K cal. per 100 g dry matter, respectively.

According to the aforementioned values it could be said that, if an infant or a baby was given 50 g of any of the formulated mixture, it would provide him/her with at least 193 K cal. This value (193) K cal., would provide the baby with about 23.5% of the recommended daily calories which were stated by Filer and Martinez (1963) for infants at 6-8 months old (822 K cal.).

Table (7): Calculated calorific values of the formulated children food mixtures.

Mixtures No.	Source of calories (K cal.)			Total K cal./ 100 g sample
	Carbohydrate	Protein	Fat	
1	262.72	91.88	37.62	392.22
2	263.08	91.80	39.87	394.75
3	283.40	75.24	32.04	390.68
4	278.40	78.72	30.87	387.99
5	273.96	89.24	29.52	392.72
6	264.64	92.76	28.53	385.93
7	275.24	73.52	42.75	391.51
8	263.60	82.24	44.55	390.39
9	264.04	89.24	43.20	396.48
10	264.44	84.00	40.23	388.67

The same obtained average value might supply an older baby with his 19.5% of the total daily allowances according to Church and Church (1969), who reported that the daily requirements of calories for infant between 6-12 months was 990 K cal.

However, it could be suggested that 50 g of any of the studied formulas could be considered a good source for calories, if given to the child.

II. **Minerals content of the formulated children food mixtures:**

Minerals are proved to enter, to a great or less degree, into the structure of the body tissues The hard skeletal structure is largely composed of them. Nerve and muscle cells also contain minerals. Therefore, it was of interest to have an idea about the mineral contents of the formulated foods.

Table (8) illustrated most of minerals contents of the ten formulated children food mixtures. The surveyed minerals were calcium, phosphorus, magnesium, iron, sodium and potassium, beside some trace elements (copper, zinc and manganese).

The obtained data revealed that the highest calcium content was found in mixture 2 (675.29 mg/100 g) which was supplemented with broad bean . This high value was followed by mixture 1 content (669.94 mg/100 g). Calcium content of the other formulas ranged between 535.76 and 623.18 mg/100 g. These results agreed with those mentioned by Protein Advisory Group (PAG, 1970), who pointed out that, the calcium content of Superamine produced in Algeria was 800 mg/100 g. Similar values were also obtained by Sidky (1986) for her eight formulas. She reported that,

Table (8): Minerals content of the formulated children food mixtures (mg/100 g on Dry weight basis).

Minerals	Formula number									
content	1	2	3	4	5	6	7	8	9	10
Ca	669.94	675.29	623.18	628.66	535.76	557.14	553.76	557.30	614.38	564.37
P	606.94	617.14	350.99	394.90	324.50	351.19	303.87	320.22	381.25	551.72
Na	242.77	278.57	264.90	171.97	165.58	214.29	132.60	191.51	193.75	189.66
K	2554.91	2500.00	1589.90	1509.86	1490.07	1404.76	1955.80	1539.32	1443.75	1781.61
Mg	60.99	63.43	57.42	58.01	53.71	54.05	56.85	54.21	58.19	56.26
Cu	0.75	0.71	0.46	0.55	0.40	0.48	0.61	0.22	0.44	0.23
Zn	2.38	2.79	2.29	2.80	3.31	3.90	3.70	1.35	1.94	2.41
Mn	1.27	1.43	1.26	1.53	1.46	1.67	2.49	1.63	1.94	1.21

the calcium content of all formulas ranged between 250 to 850 mg/100 g. Meanwhile, Church and Church (1969) and the FAO/WHO Committee (1974), reported that the calcium daily dietary allowances for infant and young children varied from 500 to 600 mg daily during the first year and might be increased up to 700-900 mg daily during the second year. While the Food and Nutrition Broad (1980), recommended that the daily calcium allowances for infants aging 0-5 and 5-12 months would be 360 and 540 mg, respectively.

The supply of 100 g from the various formulas will be quite sufficient to supply an infant of the daily calcium requirements during the first year of age. Therefore, all formulas under investigation may be considered as a good source of calcium for infant feeding.

Phosphorus content next to calcium in the total amount of minerals present in the body. Table (8), shows the phosphorus contents, of the studied formulas, which ranged between 303.87 to 617.14 mg/100 g. The highest values were for mixture 2 and 1 (617.14 and 606.94 mg/100 g, respectively). The lowest values were 303.87 and 320.22 mg/100 g for mixtures 7 and 8, respectively.

Handred grams of any of the formulated mixtures would be sufficient to cover all the daily requirements, of infant during the first year, on the basis of the recommendations reported by Church and Church (1969) and FAO/WHO Committee (1974), who stated that, the phosphorus daily allowances for infants and young children ranged from 200 to 500 mg during the first year.

The magnesium content of the different formulated baby food mixtures ranged between 53.71 and 63.43 mg/100 g. The highest content was found in mixture No. 2, while the lowest content was in mixture No. 5. However, the daily allowance of magnesium for infant was reported to be 50-70 mg/day by the FNB (1980). Consequently, all the studied formulas children food mixtures are good sources of magnesium.

With regard to the sodium content of the studied mixtures it could be noted that, the sodium contents in the different prepared baby food mixtures ranged between 132.60 and 278.57 mg/100 g. However, these amounts could be considered within the reasonable margins. Concerning this point the British Nutrition Foundation (1981), recommended that the use of salt in infant feeds should not be increased and the manufactures should be decreasing it, if it would be compatible with safety and acceptability. Therefore, it was advised that the salt should not be added to commercial or home made baby foods.

The potassium content of the formulated mixtures is also included in Table (8). It ranged from 1404.76 to 2554.91 mg/100 g. In this respect, Meneely (1973) mentioned that potassium may have a protective effect against excess sodium, if it would occur.

As for iron content of the formulated children food mixtures under investigation, it could be seen from Table (8), that it ranged between 7.87 and 11.50 mg/100 g. The highest content (11.50 mg/100 g) was found in mixture No. 2. While the lowest content (7.87 mg/100 g) was observed in mixture No. 8.

The recommended daily requirements of iron for infants during the first year, was reported to be from 10 to 15 mg by the FAO/WHO Committee (1974). All the studied formulas could be considered as a good sources of iron and also seemed to cover about 80-100% of the iron need of infants during their first year of age, if it would be assumed that an infant would consume about 100 g of any mixture, per day.

The trace elements (copper, zinc and manganese), were determined in the different formulated mixtures and the obtained results showed that the zinc contents ranged between 1.35 and 3.90 mg/100 g. While the copper contents ranged between 0.22 and 0.75 mg/100 g. Also, the manganese contents ranged from 1.21 to 2.49 mg/100 g in the formulated mixtures.

However, it could be concluded that, the variation in the minerals content in all formulas, may reflect the pattern composition of these elements in the original raw commodities.

It could be observed that all the formulated mixtures could be considered good sources of minerals which the infants need in this vital period of age.

III- Amino acids content and protein score:

1) Amino acids composition of the formulated children food mixtures:

It had been proved that for man and other species the nutritive value of protein or mixture of proteins depended largely on the quality and proportion in which these provided certain essential amino acids. Different protein and protein combinations contained the essential amino acids in varying proportions. This might mean that, the problem of satisfying protein requirements might be solved by providing the essential amino acids in adequate amount rather than increasing the total intake of protein. Therefore, it was of great importance to investigate the amino acids pattern of the formulated mixtures, particularly the essential amino acids.

From Table (9 and 10), it could be observed that, the different supplemented mixtures contained higher contents of essential amino acids.

Comparing the essential amino acids pattern of the formulated mixtures with that of hen's eggs protein as a standard, it was found that the essential amino acids content of the mixtures exceeded their corresponding quantities in egg's protein except for methionine.

Table (9): Essential amino acid contents (mg/100 g) of the formulated children food mixtures compared with hen's egg protein as standard.

Amino acids	Food mixtures 1	2	3	4	5	6	7	8	9	10	Hen's egg standard *
Histidine	667	669	556	554	571	569	545	518	573	579	273
Isoleucine	1035	1042	992	991	1010	1017	864	963	1280	1076	670
Leucine	1918	1923	1730	1728	1917	1918	1467	1594	1809	1829	1066
Lysine	1995	2003	1622	1624	1954	1956	1281	1107	1082	1721	868
Methionine	259	265	292	291	267	268	272	216	253	321	707
Phenylalanin + Tyrosin	2011	2016	2026	2025	1901	2002	1843	1920	1984	1936	1668
Therionine	958	959	839	843	943	947	718	781	811	891	583
Valin	1250	1251	1320	1323	1339	1343	807	920	899	1446	818
Tryptophan	--	--	--	--	--	--	--	--	--	--	211
Total	10093	10128	9397	9379	9886	10020	7797	8019	8655	9799	6864
Protein (%)	22.97	22.95	18.81	19.68	22.31	23.19	18.38	20.56	22.31	21.00	12.40

* FAO (1970).

Table (10): Non-essential amino acid contents (mg/100 g) of the formulated children food mixtures compared with hen's egg protein as standard.

Amino acid	Food mixtures 1	2	3	4	5	6	7	8	9	10	Hen's egg stand.
Arginine	1503	1505	1130	1133	1464	1663	868	1457	1430	1447	454
Asparatic acid	2276	2280	1502	1506	1914	2181	1694	2069	2074	1711	1190
Serin	1050	1055	897	895	1129	1202	964	853	875	862	946
Glutamic acid	4518	4523	3250	3253	4518	4820	3878	3863	3904	3506	1576
Proline	1386	1395	1005	998	1218	1309	1038	1276	1415	1461	515
Glycine	807	812	565	568	668	759	798	653	732	602	410
Alanine	1082	1082	985	989	953	1215	989	1123	1169	951	733
Cystine	--	--	--	--	--	--	--	--	--	--	--
Total	12622	12622	9334	9342	11864	13109	10229	11294	11599	10540	5824

This amino acid (methionine) would be considered the most different and limiting amino acid in all formulated mixtures. It may be noted that the total essential amino acids of the formulated mixtures also surpassed the total indespensible amino acids in egg protein. This could be explained that although egg protein was proved to have better quality, but the percentage of protein content in the formulated mixtures was much higher than its percentage in egg due to the low moisture content resulted by dehydration. The protein content of the formulated mixtures ranged between 18.81 and 23.19%, while it was in egg 12.4% (FAO, 1970). On the other hand, the figures of methionine reflected the better quality of egg protein (Table, 9). This essential amino acid proved to be the most limiting and deficient in all pulses (Aykroyed and Doughty, 1969).

The data in Table (11) indicate that if a baby of 6-12 months of age consumed 50 g of any of the formulated mixtures his/her recommended daily allowances would be met as follow: For mixture No. 1, the daily allowances of the essential amino acids will be covered by more than 100% of (histidine, isoleucine, lysine and phenylalanine), and by (31.90, 77.76, 85.63 and 94.98% of methionine, therionine, leucine and valine respectively.

Table (11): The percentage of the daily requirements for infants of essential amino acids covered by 50 g consumption of each formulated mixture proportional to the daily requirements.

Amino acids	Daily requirements* (mg)	Children food mixtures									
		1 %	2 %	3 %	4 %	5 %	6 %	7 %	8 %	9 %	10 %
Histidine	196	170.15	170.66	141.84	141.33	145.66	145.15	139.03	132.14	146.17	147.70
Isoleucine	490	105.61	106.33	101.22	101.12	103.06	103.78	88.16	95.51	130.61	109.80
Leucine	1120	85.63	85.85	77.23	77.14	85.58	85.63	65.49	71.16	80.76	81.65
Lysine	728	137.02	137.57	111.40	111.54	134.20	134.34	87.98	76.03	74.31	118.20
Methionine	406	31.90	32.64	35.96	35.84	32.88	33.00	33.50	26.60	31.16	39.40
Phenylalanin + Tyrosine	882	114.00	114.29	114.85	114.80	107.77	113.49	104.48	108.84	110.43	109.75
Therionine	616	77.76	77.84	68.10	68.43	76.54	76.87	58.28	63.39	65.83	72.32
Valine	658	94.98	95.06	100.30	100.53	101.75	102.05	61.32	69.91	68.31	109.88
Tryptophan	-	-	-	-	-	-	-	-	-	-	-

* FAO/WHO (1973).

It is observed in mixture No. 2, that the recommended daily requirements would be met with more than 100% of histidine, isoleucine, lysine and phenylalanine; and with 32.64, 77.84, 85.85 and 95.06% for methionine, therionine, leucine and valine, respectively.

In mixture No. 3 it could be noticed that the recommended daily requirements would be met with more than 100% of histidine isoleucine, lysine, phenylalanine and valine; and with 35.96, 68.10 and 77.23% of methionine, therionine and leucine, respectively.

The required essential amino acids in mixture No. 4, would be covered by more than 100% of histidine, isoleucine, lysine, phenyl-alanine and valine, while the other amino acids would be met with 35.84, 68.43 and 77.14% for methionine, therionine and leucine, respectively.

For mixture No. 5, it could be seen that the recommended daily requirements of the essential amino acids would be more than 100% of histidine, isoleucine, lysine, phenylalanine and valine. The other essential amino acids had lower percentages of the requirements being (32.88; 76.54 and 85.58%) for methionine, therionine and leucine, respectively.

In mixture No. 6, it could be noted that the recommended daily requirements of the essential amino acids would be met with more than 100% of histidine, isoleucine, lysine, phenylalanine and valine, while the other essential amino acids would supply lower percentages (33.00, 76.87 and 85.63%) for methionine, therionine and leucine, respectively.

With regard to mixture No. 7, it could be noticed that the daily requirements would be met with more than 100% for histidine and phenylalanine, while other essential amino acids has lower percentages (33.50, 58.28, 61.32, 65.49, 87.98 and 88.16% for methionine, therionine, valine, leucine, lysine and isoleucine, respectively.

The required essential amino acids, in mixture No. 8, would be covered by more than (100%) of histidine and phenylalanine. The other essential amino acids had lower percentages of the requirements.

In mixture No. 9 it could be noted that, the daily requirements would be met with more than 100% of histidine, isoleucine and phenylalanine. The other essential amino acids had lower percentages of the requirements.

In case of mixture No. 10, the daily allowances would be covered with more 100% for all the essential amino acids except methionine, therionine and leucine being 39.40, 72.32 and 81.65%, respectively.

2) Chemical protein score of the formulated children food mixtures:

As suggested in practice, the efficiency of protein utilization might depend mainly on the pattern and quantity of the essential amino acids present at the site of protein synthesis. FAO (1957) derived a reference pattern of essential amino acid limited mostly to essential amino acids and was calculated from a mean of the requirements of man, woman and infant for each individual amino acid . This organization (FAO), proposed a protein score that would depend on the most limiting amino acids in a given food or combination of foods as a prediction of protein biological value. This pattern was modified by FAO (1973) and over since the new pattern was widely used for protein scoring. Furthermore, there was no good experimental evidence to prove that this pattern of essential amino acids was infact, superior to the pattern found in proteins of such foods as milk and eggs which are known to be of very high quality (Smith and Cirde, 1980).

Table (12), interpreted the chemical score of each essential amino acid in the formulated mixtures which was calculated according to the previously mentioned latest pattern of (FAO/WHO Committee, 1973).

From the presented data, it could be seen that methionine is the most and first limiting amino acid in all mixtures. This might be true as it was claimed before that most of proteins in both human and animal diets were limited by their sulphur containing amino acids (Miller and Dema, 1958 and Sedky, 1958).

The predicted values for the protein quality of the investigated mixtures are observed in Table (12). It could be seen that the highest values were obtained for the mixtures (3, 10 and 7), followed by mixture 4. Also, mixtures 5, 6, 2, 9 and 1 had more or less the same value, while mixture No. 8 had the lowest score value.

However, in the current study no agreement or disagreement with other research workers could be reported as for instance when El-Malky (1974) and Zein (1980), calculated their baby food chemical score, they used whole fresh egg as provisional pattern, while FAO/WHO pattern was used in this text as a referance.

Table (12): Amino acids score of the formulated children food mixtures compared with the provisional amino acids pattern (FAO/WHO Committee, 1973).

Amino acids	FAO pattern mg/g protein	Children food mixtures (mg/g protein)									
		1	2	3	4	5	6	7	8	9	10
Isoleucine	40	112.65	113.50	131.84	125.89	113.18	109.64	117.52	117.10	143.43	128.10
Leucine	70	119.29	119.70	131.39	125.44	122.75	118.15	114.02	110.76	115.84	124.42
Lysine	55	157.91	158.68	156.78	150.04	159.24	153.36	126.72	97.90	88.18	149.00
Methionin	35	32.22	32.99	44.35	42.25	34.19	33.02	42.28	30.02	32.40	43.54
Phenylalanine + Tyrosine	60	145.91	146.41	179.51	171.49	142.01	143.88	127.58	121.76	118.56	127.22
Threonine	40	104.27	104.47	111.51	107.09	105.67	102.09	128.67	87.31	98.05	114.52
Valine	50	108.84	109.02	140.53	134.45	120.04	115.83	87.81	89.49	80.59	137.71
Tryptophan	10	--	--	--	--	--	--	--	--	--	--
The first limiting A.A.		Meth.	Meth.	Meth.	Meth.	Meth.	Meth.	Meth.	Meth.	Meth.	Meth.
The second limiting A.A.		Ther.	Ther.	Ther.	Ther.	Ther.	Ther.	Ther.	Ther.	Ther.	Ther.
Chemical protein score		32.22	32.99	44.35	42.25	34.19	33.02	42.28	30.02	32.40	43.54

Comparing the essential amino acids data with the (FAO/WHO Committee, 1985) amino acid provisional pattern revealed that with all formulated children food mixtures. Many amino acids such as isoleucine, leucine, phenylalanine, therionine and valine matched or exceeded that of FAO pattern. All formulated children food mixtures were found usually low in methionine.

Fetuga et al. (1973) however stated that, apart from methionine, both lysine and tryptophan are the amino acids in shortest supply in most proteins of plant origin.

The reports of FAO/WHO Committee (1985) recommended that in looking at the amino acid composition of protein, the A/E ratios for the tested formulas as well as those for FAO/WHO patterns were presented in Table (13). Data indicated that sulphur amino acids were the most deficient amino acids in all formulas, in which methionine was the most deficient amino acid . Although differed greatly, the ratios for other essential amino acids matched or exceeded the corresponding ratios of the control.

Table (13): A/E ratio (mg essential amino acid/g of total essential amino acids) of the formulated children food mixtures compared with FAO/WHO committee (1985) provisonal pattern for preschool children.

Amino acid	Food mixtures 1	2	3	4	5	6	7	8	9	10	FAO/WHO provisional pattern*
Isoleucine	109.80	110.16	112.20	112.29	108.43	107.61	119.14	128.38	158.38	116.70	88
Leucine	203.48	203.30	195.68	195.81	205.80	202.94	202.29	212.50	223.83	198.37	206
Lysine	211.65	211.76	183.46	184.02	209.77	206.96	176.64	147.58	133.88	186.66	181
Methionine	27.48	28.02	33.03	32.97	28.66	28.36	37.51	28.80	31.30	34.82	78
Phenylalanine + Tyrosine	213.35	213.13	229.16	229.46	204.08	211.83	254.14	255.97	241.03	209.98	197
Therionine	101.63	101.38	94.90	95.52	101.28	100.20	99.01	104.12	100.35	96.64	106
Valine	132.61	132.25	149.30	149.92	143.75	142.10	111.28	122.65	111.23	156.83	109
Tryptophan	—	—	—	—	—	—	—	—	—	—	34

* FAO/WHO (1985).

IV- Fatty acids composition of children food mixtures:

1. Idenification of the fatty acids:

The authentically pure samples of fatty acids methyl esters were examined under the same set of reaction as indicated in the experimental section. The retention time (RT) of each was determined. Although the relative retention time (RRT) of each fatty acid was determined according to the retention time of oleic acid ($C_{18:1}$) which its RRT = 1.00.

Table (14) shows the retention time and relative retention time of different authentically fatty acids methyl esters.

2. Fatty acid composition of the formulated mixtures:

Table (15) summarizes the fatty acids composition of the prepared mixtures. Palmitic acid (C_{16}) consistituted the main saturated fatty acid, the values were higher in mixtures 9, 7 and 1 (15.992, 15.003 and 14.037%, respectively). While the values were more or less the same for mixtures No. 4, 10, 3, 8, 5 and 6 (13.569, 12.515, 12.471, 12.126, 11.676 and 11.576%, respectively). On the other hand, the value was very low in mixture No. 2 (2.16%).

Table (14): Retention time (RT) and relative retention time (RRT) of authentic fatty acids.

Fatty acids		RT	RRT
Lauric acid	(C_{12})	9.56	0.281
Myristic acid	(C_{14})	13.29	0.390
Palmitic acid	(C_{16})	19.60	0.575
Stearic acid	(C_{18})	24.78	0.728
Oleic acid	($C_{18:1}$)	34.06	1.000
Linolic acid	($C_{18:2}$)	38.54	1.132
Linolenic acid	($C_{18:3}$)	46.53	1.366

Table (15): Fatty acids composition of the formulated children food mixtures.

Mixtures No.	Fatty acids (%)						
	C_{12}	C_{14}	C_{16}	C_{18}	$C_{18:1}$	$C_{18:2}$	$C_{18:3}$
1	-	0.075	14.037	1.338	58.666	25.642	0.241
2	0.007	1.089	2.163	2.436	70.025	22.769	0.798
3	-	-	12.474	1.035	61.179	23.488	1.825
4	-	-	13.596	1.540	51.721	33.143	-
5	-	0.116	11.676	0.890	54.226	33.982	-
6	-	0.090	11.576	0.731	48.957	37.004	1.664
7	0.199	0.051	15.003	0.848	48.520	35.367	0.012
8	0.129	0.137	12.126	1.697	42.964	43.033	-
9	0.339	0.193	15.992	1.507	50.780	31.135	-
10	0.566	0.294	12.515	3.755	54.484	28.083	0.303

Oleic acid ($C_{18:1}$) consistituted the mainly unsaturated fatty acid in the mixtures, the values were higher in mixtures No. 2, 3, 1, 10 and 5 (70.025, 61.179, 58.666, 54.484 and 54.226%, respectively). While the values were more or less the same for mixtures No. 4, 9, 6 and 7 (51.721, 50.780, 48.957 and 48.520%, respectively). The lowest value was in mixture No. 8 (42.964%).

Also, linoleic acid ($C_{18:2}$) in the mixtures ranged between 22.769 and 43.033%. The values were higher in mixtures No. 8, 6 and 7 (43.033, 37.004 and 35.367%, respectively). The values were more or less the same for mixtures No. 5, 4, 9 and 10 (33.982; 33.143; 31.135 and 28.083%, respectively). The lowest value was in mixture 2 (22.769%).

Linolenic acid was found in mixtures No. 3, 6, 2, 10, 1 and 7 (1.825, 1.664, 0.798, 0.303, 0.241 and 0.012%, respectively.

V- Biological assays and its interpretation in terms of biological values of the formulated children food mixtures:

From the preceding chapter it could be claimed that the theoretical quality of protein would depend mainly on its essential amino acid pattern. However, its quality in practice might depend also on the conditions under which it could be eaten to cover basal requirements to meet the stress of infections and in case of infants and children to cover and promote growth requirements. Jelliffe (1968) stated that the utilization of amino acids by body was affected also by calorie intake by the relative quantities of carbohydrates and lipids, by the nature and quantitive distribution of minerals, and by the absence or abundance of various vitamins. Furthermore, the value of a given quantity of protein might vary considerably according to wheather the whole was ingested during a single meal, or its ingestion distributed amino acids might depend on the nature of the diet as a whole, the timing of meals, and the efficiency of digestion and absorption from the gastrointestial tract. Therefore, further information such as biological data would be needed to confirm the essential amino acids pattern and chemical score findings.

In the current study it was also decided to evaluate the ten formulated diets (together with casein and protein free diet as controls), with a view to biological evaluation testing methods. Biological assays were carried out on experimental animals which were small fastgrowing albino rats. The obtained results were expressed in various terms including: weight gain, feed efficiency (FE), protein efficiency ratio (PER), net protein utilization (NPU), net protein ratio (NPR), digestibility coefficient (DC) and biological value (BV).

1) **Weight gain and total food and protein consumption**:

Table (16) presented information and data on weight gains as percentage to the starting weight, total food consumption and protein intakes. It could be observed that diets 2, 8, 9 and 4 showed the highest percentage of weight gain (71.67, 68.81, 63.33 and 61.47%), respectively. In this content it would be noted that those diets were supplemented with, broad bean, chickpea and dried peas, respectively.

Next to those was diet 3 (59.78%) which was supplemented with dry peas. While diet 6 (44.77%) obtained the lowest percentage of weight gain.

Table (16): Gain or loss in body weight and food intake of the experimental animals fed on the formulated diets, protein free and control casein diet for 10 days.

Experimental diet	Initial body weight (g)	Final body weight (g)	Weight gain		Food intake	
			g	%	Total food consumed (g)	Consumed protein (g)
Mix. 1	49.60	74.74	25.14	50.69	61.00	6.10
2	50.40	86.52	36.12	71.67	59.00	5.90
3	50.80	81.17	30.37	59.78	68.00	6.80
4	50.20	81.06	30.86	61.47	62.40	6.24
5	49.00	72.85	23.85	48.67	50.00	5.00
6	51.20	74.12	22.92	44.77	62.60	6.26
7	50.40	78.32	27.92	55.40	53.60	5.36
8	47.80	80.69	32.89	68.81	63.00	6.30
9	47.40	77.42	30.02	63.33	60.00	6.00
10	49.40	74.53	25.13	50.87	50.20	5.02
Casein diet	49.60	72.44	22.84	49.05	50.00	5.00
Protein free diet	48.40	35.99	-12.41	-25.64	68.00	0.00

With regard to the total food and protein intake it could be noticed that the highest quantity of food and protein supply was consumed by rats fed diet 3. It could be noted here that neverthless this relatively high food consumption, the fed animals gained the lowest weight gain. With diet 8 it could be seen that the tested animals at high quantity had also gained comparatively good weight gain. As for diets 9 and 2, the animals consumed the same quantity approximately, but animals fed diet 9 had 63.33% increase in body weight. While those which consumed diet 2 increased by 71.67% in weight. This might be atributed to the better protein quality of diet 2. The same explanation could also describe the same situation of diets 6 and 4, respectively. The casein diet was consumed at the lowest quantity, its fed animals gained relatively (49.05%).

2) **Feed efficiency (FE)**:

It was used to perform nutritional experiments which might be designed to evaluate the efficiency of a diet. A comparison between the weight gain of the fed experimental animals and the amount of food consumed was carried on. The use of this method was to assume that the gain in weight might always reflect similar gain proportions of water, fat, protein and salts. This classic technique was used in evaluating the efficiency of the tested diet (Nasralla, 1978).

Table (17) indicates the feed efficiency (FE) of tested mixtures together with the control (casein diet). It is clear from the data in this table that the best value for (FE) was obtained for mixture 8 (0.302) which was supplemented with chickpea. Next to this value was for mixture 3 (0.29) which was supplemented with dried peas, followed by mixture 2 (0.268) which was supplemented with broad bean. The lowest value was for mixture 6 (0.179) which was supplemented with lentil.

3) **Protein efficiency ratio (PER)**:

The PER was expressed as the gain in body weight per gram of protein consumed. It could be said that it might imply the ordinary relationship between the rate of growth and protein intake.

The PER of all the formulated children food mixtures under investigation together with the casein control diet were also present in Table (17). It might be noted here that the PER of all experimental diets were 10 times magnified image of the FE values for all mixtures. This might be true because in the FE equations the total food intake was in the denumerator part of it, while in the PER equations only the consumed protein which was only 10% of all tested diet was at the lower part of the equation denumerator.

Table (17): Feed ecfficiency (FE) and protein efficiency ratio (PER) of rats fed on 10% protein in different diets for 4 weeks.

Diet	Initial body weight (g)	Final body weight (g)	Weight gain (g)	Protein consumed (g)	FE	PER	Corrected PER
Mix. 1	50.60	105.25	54.65	25.90	0.208	2.08	2.49
2	50.40	126.64	76.24	28.20	0.268	2.68	3.21
3	48.20	111.50	63.30	30.20	0.290	2.90	3.47
4	51.60	116.57	64.97	29.50	0.219	2.19	2.62
5	50.80	94.09	43.29	18.00	0.239	2.39	2.86
6	50.40	108.36	57.96	32.00	0.179	1.79	2.14
7	48.20	121.42	73.22	32.50	0.224	2.24	2.68
8	50.60	132.35	81.75	26.90	0.302	3.02	3.61
9	49.60	127.72	78.12	29.30	0.265	2.65	3.17
10	48.80	94.02	45.22	21.00	0.213	2.13	2.55
Casein diet	48.50	123.73	75.13	35.70	0.209	2.09	2.50

Mixtures 2, 3, 5, 7, 8 and 9 (which exhibited the highest PER values) showed PER values more or less similar to those mentioned by Protein Advisory Group (1970) who reported that the PER of TRL (a fortified cereal baby food) which was produced in Turkey, Chilli, Iran and Ethiopia, and Superamin which was produced in Algeria had PER values of 2.58, 2.47, 2.16, 2.21 and 2.40, respectively.

The presented results are also in good agreement with that of Hussein (1987) who formulated two kinds of baby foods which consisted of raw and extruded, broken rice flour, semolina, yellow corn grits flour, dry peas flour, soybean meal, dried skim milk and sucrose with PER values of 2.72 and 2.69 for 1 and 2, respectively.

4) **Net protein utilization (NPU)**:

Miller and Bender (1955) and Bender and Doell (1957) defined the NPU as the biological value and digestibility of the product. Their theory was based on a 10 days animal assay method to estimate the fraction of food nitrogen, of tested protein eaten, which was retained by weanling rats. A group of rats on nonprotein diet provides the endogenous or maintenance nitrogen correction. The body nitrogen deposited as new tissues by the animal fed the tested diet, was estimated with references to total nitrogen consumed.

In the present study it was decided to evaluate the NPU values of the ten formulated mixtures togeher with a casein diet as control. From Table (18) it could be noted that mixture 2 had the best value (73.94%), followed by mixtures 7, 4 and 10 which had values 71.10, 65.93 and 64.93, respectively. The lowest NPU value was found in mixture 9 (51.66).

5) **Net protein ratio (NPR)**:

This criterion was dependant on the loss in body weight of rats fed on the protein free diet plus the weight gain of the rats fed on tested diets, this sum was divided by the protein intake of the tested diets. The outcome of this calculation was expressed as the net protein ratio. This ratio might be considered as a result of both maintenance of the tissues and growth of the growing animals.

Table (18) shows the different NPR of the studied mixtures together with the control casein diet. The best results for such values were obtained with mixture 8 which was supplemented with chickpea, followed by mixture 2 with NPR value of 8.14 which was supplemented with broad bean. Next to these was the value of mixture

Table (18): Net protein utilization (NPU) and net protein ratio (NPR) of rats fed on 10% protein in different diets for 10 days.

Diet	Body nitrogen (g)	Nitrogen intake (g)	NPU %	NPR %
Mix. 1	6.55	4.88	55.94	6.39
2	7.31	4.72	73.94	8.14
3	6.80	5.49	54.28	6.85
4	6.39	4.92	65.93	6.86
5	6.59	4.00	64.25	7.32
6	6.64	5.00	52.80	5.88
7	6.87	4.29	71.10	7.43
8	6.70	5.04	57.14	8.09
9	6.30	4.80	51.66	7.13
10	6.43	4.02	64.93	7.01
Diet containing casein	7.33	4.70	70.25	6.96
Non protein diet	3.82	0.00	--	--

7 (7.43%) which contained wheat, chickpea, lentil, rice and peanut. The lowest value was of the mixture 6 (5.88%).

6) **Digestibility coefficient (DC):**

The digestibility may be affected by methods of processing and cooking, quantities consumed and by the state of the digestive tract. Furthermore, the calorie yield of any food and the value of its proteins and other nutrients which it might contain would obviously be influenced by its digestibility (Aykroyd and Doughty, 1969).

True digestibility coefficient (DC) was obtained in this investigation by applying Mitchell (1924) theory which was based on subtracting both nitrogen faeces of the animals fed the tested and non protein diets from the nitrogen intake of the tested diet fed animal. The result of this substraction was divided by the nitrogen intake of the animal fed the tested diet.

Table (19) demonestrated the digestibility coefficient of the ten formulated diets and also the control casein diet. The highest value was obtained with mixture 2 (91.53%). Next to this value came mixtures 9 and 4 (89.58 and 89.43%, respectively). While, 88.59% value was corresponding for mixture 7, followed by mixture 5 which

Table (19): Digestibility coefficient (DC) for different diets fed to rats at 10% protein for 10 days.

Diet	Nitrogen intake (g)	Fecal nitrogen (g)	DC (%)
Mix. 1	4.88	2.60	80.73
2	4.72	2.06	91.53
3	5.49	2.78	79.60
4	4.92	2.18	89.43
5	4.00	2.19	86.75
6	5.00	2.69	79.40
7	4.29	2.15	88.59
8	5.04	2.37	85.91
9	4.80	2.16	89.58
10	4.02	2.23	85.82
Diet containing casein	4.00	2.24	85.50
Non protein diet	--	1.66	--

had 86.75%. The least value was obtained from mixture 6 (79.40%).

7) Biological value (BV):

As it was previously mentioned that the NPU value might be the result of both the biological value and digestibility of the protein. Therefore, the apparent BV could be obtained if the NPU and DC were known. This was carried out by El-Hashimy (1976) who found it possible to calculate the BV of tested protein from its NPU and DC value.

It is clear from Table (20) that the three mixtures 2, 5 and 10 gave the highest BV (80.83, 80.69 and 78.55%, respectively), while mixtures 1, 3, 6, 7, 8 and 9 gave (76.91, 75.05, 74.06, 71.05, 70.45 and 64.66%, respectively). The lowest value was found in mixture 4 (64.32%).

The three bio-values (DC, NPU and BV) mentioned in Table (20) were also studied by other workers. For instance, Brandizoeg *et al.* (1981) reported 86 and 88%, 57 and 61%, 65 and 71% for DC, NPU and BV, respectively, for weaning food mixtures made of 70:30 of ragi and green gram flour as a product from malted and

Table (20): Estimation of biological value (BV) of dietary protein from their net protein utilization (NPU) and digestibility coefficient (DC) values determined by rats feeding for 10 days.

Diet	NPU %	DC %	BV %
Mix. 1	55.94	80.73	76.91
2	73.94	91.53	80.78
3	59.74	79.60	75.05
4	57.52	89.43	64.32
5	70.00	86.75	80.69
6	58.80	79.40	74.06
7	62.94	88.59	71.05
8	60.52	85.91	70.45
9	57.92	89.58	64.66
10	67.41	85.82	78.55
Diet containing casein	65.25	85.50	76.32

unmalted grams. Through nutritional studies on weanling rats Morcos and Gabrial (1983) investigated 10 baby food mixtures containing 17.7-23.2% protein which were based on polished rice, lentil, defatted sesame, groundnut and soya flour, chickpeas, maize flour, sunflowr kernels, fenugreek seeds, wheat flour, potato flakes, skim milk powder and yeast. They reported that the DC ranged from 91.6 to 96.9% NPU from 60.3-73.7% and BV from 64.0-80.5%.

VI- Determination of trypsin inhibitor activity (TIA) in the raw and treated legumes and formulated mixtures:

Osborne and Mendel (1917) stated that pulses unless cooked for several hours, will not support normal growth in rats. They attributed their findings to the So- called trypsin-inhibitor activity. Their finding was later confirmed by several other workers such as Liener (1982).

Legumes were used as supplementary items in all mixtures, it was thought beneficial to determine the trypsin-inhibitor activity in the used legumes before and after treatment process which included soaking, cooking, dehydration and milling.

1) Trypsin-inhibitor activity (TIA) in the raw and treated legumes used in mixtures preparations:

(TIA) of the used raw and treated legume seeds were studied. The obtained results are shown in Table (21). It could be indicated that the (TIA) in the untreated raw legume seeds was relatively high. However, the highest (TIA) contents was found in chickpea being 45.60 Trypsin-inhibitor units TIU/mg followed by lentil, broad bean and dried peas (28.60, 18.40 and 9.40 TIU/mg, respectively).

Table (21): Trypsin-inhibitor activity (TIA) of raw and treated legumes used in preparation of the formulated children food mixtures.

Legumes	Trypsin-inhibitor activity TIU/mg samples		Residual*	Destruction**
	Raw	Treated	%	%
Broad bean	18.40	1.45	7.88	92.12
Lentil	28.60	1.42	4.96	95.03
Dried peas	9.40	0.55	5.85	94.15
Chickpea	45.60	1.62	3.55	96.45

$$* \text{ Residual} = \frac{\text{Treated}}{\text{Raw}} \times 100$$

$$** \text{ Destruction} = \frac{\text{Raw} - \text{treated}}{\text{Raw}} \times 100$$

The presented data agree with Aboul-Seoud (1984) who reported that the (TIA) in raw chickpeas, broad beans and peas were 49.00, 20.00 and 6.00 TIU/mg, respectively. While, Sidky (1986) reported that the (TIA) in raw lentil was 27.90 TIU/mg.

In the present study, series of steps were carried out to minimize, these compound such as, soaking in tap water over-night (about 12 hours) at room temperature (30°C), followed by cooking for about 5-15 min using pressure cooker, and drying at 65-70°C.

It is indicated from Table (21) that the treated legume flours had lower (TIA) compared with the raw materials. It was decreased to 1.62, 1.45, 1.42 and 0.55 TIU/mg for defatted chickpeas, broad bean, lentil and dried peas flours, respectively.

The highest percentage of residual was observed in the treated broad beans flour, while the lowest percentage of residual was found in chickpea flour. Similar results were obtained by Albrecht et al. (1966) who recommended that, soaking the whole soybeans overnight and then boiling it for only 5 min, proved to be sufficient enough to inactivate the (TIA). Aboul-Seoud (1984) also reported that, the (TIA) of cowpea seeds was completely destroyed with blanching for 10 min. after soaking.

2) Trypsin-inhibitor activity in the formulated children food mixtures:

Data in Table (22) indicate the (TIA) in the formulated children food mixtures. It could be noted that, the (TIA) was affected by different treatments. The activity of trypsin-inhibitor was relatively low in all formulated children food mixtures which ranged from 0.24 to 0.72 TIU/mg of samples. The (TIA) was relatively low in all mixtures which were supplemented with treated legumes flours.

Finally, it could be concluded that the nutritive quality of the formulated children food mixtures was not affected by legume supplementation. These results are in agreement with those obtained by Churella et al. (1976) and Sidky (1986).

Table (22): Trypsin-inhibitor activity (TIA) in the formulated children food mixtures.

Formulas No.	Trypsin-inhibitor activity TIU/mg samples*
1	0.65
2	0.67
3	0.25
4	0.24
5	0.66
6	0.64
7	0.62
8	0.71
9	0.72
10	0.26

* TIU = Trypsin-inhibitor units.

VII- Microbiological examination of the formulated children food mixtures:

The formulated children food mixtures were tested for total bacterial count. The obtained results revealed that the bacterial count of the formulated children food mixtures ranged between 7.5 to 9.6×10^2 per gram. The low total bacterial counts per gram of the examined samples might be due to their low moisture contents. on the other hand, the reduction of the total count as a result of the different aseptic processing conditions under which the production of formulas was carried out.

The current results were within the advisable standards reported by Skovgaard (1969) who recommended that a total bacterial count up to 10^4 per gram for dried baby foods might be safe enough to be used by babies. The obtained results are also lower than the total count in dried baby foods (10^4) which were suggested by Sprang (1969).

The total count in all formulated baby food mixtures is below the limits of the dietary food ordinance recommendations by Fromm and Strahtmann (1970), who reported that microbial content of infant foods should be reduced to average of 10^3-10^4 organisms per gram. This result is in agreement with Sidky (1986) who reported that the total bacterial count of her eight formulated baby food mixtures ranged between 10^2 and 10^3 per gram.

VIII. **Organolyptic quality of children food mixtures:**

Samples of these ten children food mixtures were prepared for organoleptic tests. Samples were mixed with boiled water (30 g/100 ml water) to give gel form. On the other hand, the baby food was "Cerelac", was prepared with the same method to give gel form. The color, taste and odor of the samples were tested by ten panel judges and some preschool children.

"Cerelac" was used as reference and was given a grade equal to 100.

The quality of every mixture was given a grade relative to the grade of the same quality of "Cerelac". Samples having grade above 70 were considered palatable, while grades 50-70 were acceptable samples. Samples given a grade below 50 were considered unpalatable (Zein, 1980).

Results in Table (23) indicated that, the highest score was recorded for mixture (2) and was palatable. The qualities of mixtures (1, 3, 4, 5, 8, 9 and 10) were nearly similar and within the acceptable range. On the other hand, the color, taste and odor of mixture (7) had the lowest score. Its color was acceptable, while its taste and odor were rejected as unplatable.

Table (23): Organoleptic tests of the formulated children food mixtures as compared with "Cerelac".

Mixture No.	Color	Taste	Odor	Over-all quality
1	77	74	77	228
2	80	78	81	239
3	76	73	75	224
4	78	75	79	232
5	80	76	79	235
6	78	74	79	231
7	74	42	46	162
8	76	70	75	221
9	75	59	75	209
10	78	69	77	224
"Cerelac"	100	100	100	300

Palatable = more than 70.

Acceptable = 50 to 70.

Unpalatable = Less than 50.

IX. **Costs of the children food mixtures**:

Costs of the formulated children food mixtures as compared with, Cerelac, Gerber and Galactina could be calculated are shown in Table (24).

It is shown from Table (24) that the costs of producing the formulated mixtures commercially, are more less than those of the local baby foods (Cerelac and Gerber) and imported baby food (Galactina). In addition the prices of these formulated children food mixtures shall be quite suitable for the low national income in Egypt.

Table (24): Costs of children food mixtures compared with some local and imported commercial baby food mixtures.

Mixture No.	Price of ingredients P.T./100 g	Total costs of 100 g mixture production *
1	33.5	120.6
2	36.0	123.8
3	34.7	122.4
4	37.5	125.6
5	40.9	129.9
6	73.7	170.9
7	33.4	120.5
8	53.4	145.5
9	51.5	143.0
10	43.2	132.8
Cerelac	-	187.5
Gerber (oats and milk cereal)	-	237.5
Galactina (proto-cereal)	-	300.0

* These costs include all direct, indirect costs+25% profit if produced commercially in a factory of baby foods.