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PREPARATION AND EVALUATION OF SOME INFANT CANNED FOOD FORMULAS

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ABSTRACT

The object of the present study was to prepare three canned infant food formulas with high nutritional value ready to eat and easy to use from locally available sources as beef and chicken meats and some vegetables for infants aged 6:12 months. The prepared formulas were chemically and biologically evaluated directly after prepared and storage at room temperature for six months. The results indicated that, prepared infant food formulas contained higher amounts of protein, especially formulas 1 and 2 reaching 26.25 and 23.92%, respectively. The prepared formulas contained also higher amounts of fat, ash and crude fiber which, ranged from 2.72 to 7.35%, from 4.99 to 6.95 % and from 2.85 to 5.95% respectively. Formula 1 had the highest values of thiamin, riboflavin, iron, calcium and phosphorus, while formula 3 had the highest values of ascorbic acid and β-carotene. For all formula, β-carotene and iron values surpassed the daily requirements for infants aged 6:12 months. The total indispensable amino acid contents of formula 1 and 2 were higher than that of hen's egg. The chemical score of the formulated infant foods revealed that methionine + cystine was the first limiting amino acids for all the formulas and lysine was the second limiting amino acid. The biological assay showed that formula I had the highest food conversion efficiency (F.C.E.) and protein efficiency ratio (P.E.R.) followed by formula 2 and 3 respectively. All formulas were free from coliform bacteria.

INTRODUCTION

Breast feeding is strongly recommended for full term infants and is more likely to be successful if begun during the first 24 hours after birth (Wurtman, 1982 and Megroud *et al*., 1990).

Most of malnutrition and under-nutrition problems of infants and young children in Egypt, as in many developing countries are mainly due to shortage in suitable cheap weaning foods. Solid foods are given in order to overcome the deficiencies in milk and as well as to supply babies with the indispensable nutrients. Moreover, such solid foods supply extra calories and contain appreciable amount of cellulose, which permits normal evacuation of the bowels. (El-Masry, 1973 and Fahmy and Roushdi 1982). Baby foods are not recommended until the infant is 4 to 6 months old. Cereal grains were the first solid ingredient used in baby food because of their high iron, thiamin and calories content (Shahwan 1976, Wurtman, 1982 and Willis, 1985).

Harpar (1970) found that precooked meats may be packed in cans or Jars as source of protein, iron and vitamin B complex. He added that canned strained baby meats may be used throughout the first year beginning at sixth month.

Zain and Siah (1996) prepared two canned baby foods from yellow sweet potato, rice and chicken which namely RSPA (40 percent rice + 60 percent sweet potato + anchovies) and RSPC (40 percent rice + 60 percent sweet potato + chicken)

Many efforts have bean carried out in Egypt to produce cereal-based protein rich food mixtures suitable for infants and pre-school age children from vegetable protein sources alone or mixed with skim milk powder (Ahmed *et al*. 1990; Selee 1990; Arafah, 1997 and Saied, 2000).

Only baby food mixtures consisted of vegetable and animal protein sources made in Egypt by Morcos *et al*. (1993).

Therefore, the present study was carried out to prepare high nutritional values canned soft cream infant foods from available locally vegetables or mixed with animal protein sources (beef or chicken meat) and to evaluate the chemical nutritional and biological properties of these formulas before and after storage at room temperature for six months.

MATERIALS AND METHODS

Materials:

The raw materials used through out the current study for preparing the different infant food mixture were as follows:

1. Fresh vegetables :

Green peas, potato, carrot, and tomato were purchased from the local market of Kafr El-Sheikh, Egypt.

2. Meat:

Fresh red beef meat and breast muscles of chicken were taken from the local market of Kafr El-Sheikh.

Methods:

Processing of raw materials:

Vegetables were washed by tap water, peeled, cleaned and washed again, then potato, carrot and tomato were cut in to suitable pieces. Beef and chicken meats were minced before use.

Preparation of infant food formulas:

Three formulas were prepared with different amounts percentage from the prepared vegetables and meats as shown in table 1.

Table (1): Composition of infant food formulas.

Constituents %	Formula 1	Formula 2	Formula 3
Beef meat	30	-	-
Chicken meat	-	30	-
Green peas	20	20	50
Potato	20	20	15
Carrot	10	10	15
Squash	10	10	10
Tomato	8	8	8
Sodium chloride	2	2	2
Total (%)	**100**	**100**	**100**

The prepared formula (98g) were mixed with 50 ml of water then boiled until doneness (optimum cooking). The cooked formulas were minced and ground with 2% sodium chloride.

Each formula was put in sterilized cleaned jars with cover which pressed on top to insure getting ride or air bubbles and reach the required weight of 200 gm.

Jars were closed, while hot and sterilized immediately under the commercial conditions adopted at "Kaha Company". Sterilization was continued for 30 min at 120°C. After processing the jars were cooled immediately in portable and non-corrosive water until the temperature of the contents reached 35 to 40°C.

The sterilized jars were left to dry and stored at room temperature for 6 month. Samples were taken at zero time and every two months for chemical and bacteriological analysis.

Chemical analysis of infant food formulas :

- **Gross chemical composition :**

Moisture, ash, crude fiber, crude fat and crude protein were determined as recommended by A.OA.C (1990). Total and available carbohydrates were calculated by difference.

- **Minerals estimation :**

Calcium and iron were estimated using an atomic absorption spectrophotometer, Perkin Elmer 330. Total phosphorus was determined according to the method described by the A.O.A.C. (1990).

- **Vitamins assay :**

Ascorbic acid (v.c.) was determined according to the method described by A.O.A.C. (1990). Thiamin (V. B_1) and Riboflavin (V. B_2) were extracted from the samples according to the method explained in A.O.A.C. (1990), β-carotene was determined by column chromatography according to the method described by Association of Vitamin Chemists (1951).

- **Amino acids composition :**

Amino acids were determined in the acid hydrolyzate according to the method described by Pellet and Young (1980), using Backman Amino Acid Analyzer (Model 119CL) as described by Youssef *et al*. (1986). Tryptophan was determined using spectrophotometer method as described by Sastry and Tummuw (1985).

- **Chemical score (C.S.) :**

The chemical score is defined as follows :

$$C.S. = \frac{\text{Mg of indispensable amino acid in 1 gm of tested protein}}{\text{Mg of indispensable amino acid in 1 gm reference protein}} \times 100$$

According to (FAO/WHO, 1989), the lowest percentage of the ratio for all individual indispensable amino acid of this food called chemical score and the amino acid which has the lowest percentage is called limiting amino acid.

- **Biological evaluation of infant food formulas :**

The method used here was described by Miller and Bender (1955). Six liner of five albino rats were weaned at 23 days and put on a stock diet for one week, the liners were selected in such a way that the difference in weights of the animals did not exceed 5g. The six liners were divided into five groups in such a way that each group contained one rat from each liner and the range of the total weights of the groups did not exceed 2 gm. Each group of six rats (sex difference was neglected) was housed in separate cage at 25°C with 12 hours light/12 hours dark.

Three groups of rats were fed with the tested formulas. The fourth group was fed with non-protein diet, in this case the tested diet present in the bassal diet was replaced by maize starch. The fifth group was fed on casein as standard diet.

Food intake and rats weights were recorded daily for 4 weeks during the course study. Protein efficiency ratio (P.E.R) was determined according to Wilson *et al*. (1974) as g of weight gain/g of protein intake. Food conversion efficiency ratio (F.C.I.) was determined according to Rady (1993) as follow:

F.C.E. = g of food intake/g of baby weight gain.

- **Microbiological tests :**

The microbiological tests (total viable bacterial counts and coliform bacterial counts) in the stored infant food formulas and control sample, were conducted according to the method described in the A.O.A.C. (1990).

RESULTS AND DISCUSSION

Chemical composition of prepared infant food formulas :

The produced infant food formulas were chemically analysed in order to determine its main features of chemical composition and bearing in mind evaluation of their nutritive values. The obtained data are shown in Table (2).

It was clear that formula 3 had the highest moisture content (because it was prepared from vegetable only, which have high moisture content). While the lowest moisture content was found in formula 1. Protein content was recorded the highest value in formula 1 which reached to 26.25% followed by formula 2 (23.92%), this may be due to the high content of rich protein sources i.e. beef and chicken meats. While the lowest amount in protein was detected in formula 3 (18.50%) due to the presence of vegetables. These values of protein content were within the range reviewed by ESO (1992).

Table (2): Gross chemical composition of prepared canned infant food formulas (g/100 g dry basis).

Samples / Analysis	Formula 1	Formula 2	Formula 3
Moisture	78.86	83.01	85.88
Crude protein	26.25	23.92	18.50
Crude fat	6.56	7.35	2.72
Ash	6.95	4.99	5.19
Crude fiber	2.85	3.24	5.95
Total carbohydrate	60.24	63.74	73.59
Available carbohydrate	57.39	60.50	67.64
Calculated calories (kcal/100 g)	397.11	403.83	369.04

Formula 2 was found to contained the highest percent of fat (7.35%), while the other values were 6.56 and 2.72% for formula 1 and 3, respectively.

The ash content, were 6.95, 5.19 and 4.99% for formulas 1, 2 and 3, respectively. Results in Table (2) indicate also that formula 3 had the highest value of crude fiber due to the great amount of vegetables present in this formula.

The data in Table (2) indicated that formula 3 contained the highest value of total carbohydrates (73.59%) followed by formula 2 (63.74%) while formula 1 had the lowest value (60.24%). On the other hand, formula 1 had the highest, calculated calorie values followed by formula 2 while formula III had the lowest caloric content (369.04 calories/100 g). These results may be due to the high content of fat present in formula 2 and 1.

These results are in agreement with the data of Fahamy and Roushdi (1982) who reported that baby infant mixed vegetable contained the highest value of total carbohydrates and fiber and had the lowest values of protein and fat compared with beef formula and vegetable chicken formula. They found also that beef formula had the highest protein value followed by vegetable chicken formula. Arafah (1997) reported that the protein was ranged between 19.17-25.39%, fat 5.3-6.12, ash 3.5-3.8, fiber 3.4-3.8 and total carbohydrates 62.01- 68.03 in six formulas prepared from corn flour, fish powder, soybean flour, carrot and potato flour.

Some vitamin contents of prepared formula:

Estimated vitamin contents of the three prepared canned infant food formulas are shown in Table (3). The amount of ascorbic acid (mg/100mg) present in the three formulas were 19.5, 22.25 and 30.07 for formula 1, 2 and 3, respectively. FAO/WHO (1989) showed that the daily requirement of ascorbic acid for infants aged 5:12 months was 35 mg. Therefore 180,158 and 117 gm (dry matter) of formula 1, 2 and 3 are required to fulfill their daily requirement of ascorbic acid.

The amount of thiamin content of the formulated infant food mixtures can be arranged descendingly as follows: formula I (0.64), formula 2 (0.57) and formula 3 (0.43) mg/100 g. FAO/WHO (1989) reported that the daily requirement of thiamin for infants aged 5-12 month was 0.5 mg, so 100 g from formula 1, 2, and 116 g formula 3 fulfill these requirement.

Table (3): Vitamin and mineral contents of prepared infant food formulas (mg/100 g dry weight basis).

Constituents	Description			
	Formula 1	Formula 2	Formula 3	Daily requirements for infants aged 5-12 month*
Vitamins :				
Ascorbic acid	19.5	22.25	30.07	35.00
Thiamin	0.64	0.57	0.43	0.50
Riboflavin	0.30	0.24	0.09	0.60
β-carotene	23.44	21.95	57.11	0.90
Minerals :				
Iron	16.30	12.04	10.17	10.00
Calcium	521.00	448.00	300.00	540.00
Phosphorus	220.00	194.00	159.00	400.00

*** Food and Nutrition Board (1989).**

The obtained results in Table (3) revealed that riboflavin content was ranged from 0.09 to 0.30 mg/100 g these values are lower than that the daily requirement reported by FAO/WHO (1989) which reported as 0.60 mg. On the other hand, all of the examined formulas had excess amount of β-carotene (21.95 – 57.11 mg/100 g dry matter), the daily requirement is 0.90 mg as reported by Filer and Martinez (1964).

Generally formula 3 had the highest values of ascorbic acid and β-carotene and the lowest values of thiamin and riboflavin. On the other hand formula I had the highest values of thiamin and riboflavin and lowest values of Ascorbic acid.

Mineral contents of prepared formulas:

Iron, calcium and phosphorus were determined in prepared infant food formulas and the results are shown in Table (3). The iron content for formula 1, 2 and 3 were 16.30, 12.04 and 10, 17, respectively. These values might be quite sufficient to provide infants aged 6-12 with their daily requirement from iron (10 mg) during the first year according to FAO/WHO requirements (1989).

The highest value of calcium was present in formula (1) 521 mg/100 g followed by formula (2) 448 and formula (3) 300 mg/100 g (dry weight basis). FAO/WHO (1989) recommended that infants should be supplied with 540 mg calcium per day during the first year of age. Then consumption of 104, 120, 180 g (dry weight basis) of formula 1, 2 and 3 would fulfil the daily requirement of calcium, respectively.

From Table (3) it's clear that formula 1 had the highest value of phosphorus while formula 3 had the lowest value.

Generally, from the results in Table (3) it can be concluded that formula 1 had the highest values of iron, calcium and phosphorus followed by formula 2, while formula 3 had the lowest values of these minerals.

Amino acids composition of prepared formulas:

The amino acid contents of the studied formulas are given in Table (4). The total indispensable amino acid of formula 1 and formula 2 recorded the highest values (6427 and 6116 mg/100 g protein, respectively). While the lowest value was observed in formula 3 (5750 mg/100 g protein). Leucine, valine, lysine and isoleucine were predominant among the indispensable amino acids, where glutamic and asparatic acids were the highest within the dispensable amino acids in all prepared formulas.

Generally, the quantities of total indispensable and dispensable amino acids in formula 1 and 2 were higher than those of hen's egg. While hen's egg was slightly higher in indispensable amino acids than formula 3.

These values indicate that all formulated infant food mixtures contained relatively high quantities of indispensable amino acids. This may be due to the presence of some complementary resource to these mixtures, i.e., beef and chicken meats and green peas.

Table (4): Amino acid composition of prepared canned infant food formulas (mg amino acids/100 g protein)

Amino acids	Formula 1	Formula 2	Formula 3	Hen's* egg as standard	Daily requirements for infants aged 6-12 month**
Indispensable:					
Isoleucine	806	915	830	788	810
Leucine	1130	1070	950	1091	1350
Lysine	820	795	750	863	765
Methionine	320	310	285	416	585
Phenylalanine	786	792	820	709	810
Threonine	725	595	600	634	540
Tryptophan	420	344	330	184	188
Valine	930	950	985	847	857
Histidine	490	425	370	301	288
Total	6427	6116	5750	5823	6193
Dispensable:					
Alanine	1030	920	950	733	
Agrinine	920	860	820	754	
Aspartic acid	1681	1530	1485	1190	
Cystine	248	246	262	301	
Glutamic acid	2010	1820	1650	1546	
Glycine	710	620	650	410	
Proline	1320	1185	1124	515	
Serine	525	485	410	946	
Tyrosine	605	550	530	515	
Total	**9049**	**8216**	**7881**	**6940**	

*** Amino acid content of foods and biological data on proteins (FAO, 1970).**

**** Food and Nutrition Board (1989).**

Chemical score (C.S) of indispensable amino acids :

Chemical score of the indispensable amino acids of the investigated infant food formulas are shown in Table (5). The results indicate that thrionine and valine of all the three formulas were found to be more abundant than needed for balance according to the FAO (1970). While the other indispensable amino acids were lower than needed for balance.

Data in Table (5) show that chemical score of formula 1 had the highest chemical score (79.22) followed by formula 2 (77.55)/ and formula 3 (76.29). Methionine and cystine were the limiting amino acid in all formulas. So these formulas should be enriched with methionine and cystine.

Table (5): Chemical score of indispensable amino acids of prepared canned infant food formulas.

Samples / Amino acids	Formula 1	Formula 2	Formula 3	Reference protein FAO (1970)
Isoleucin	103.99	117.61	106.69	126.20
Leucin	103.57	98.08	87.08	131.40
Lysine	95.02	92.12	86.91	136.5
Methionine + cystine	79.22	77.55	76.29	84.50
Thrionine	114.35	93.85	94.64	85.7
Valine	104.79	112.16	116.29	108.4
Phenylalanine + tyrosine	113.64	109.64	110.29	136.5

Biological evaluation of prepared canned infant food formulas :

Data in Table (6) show the protein efficiency ration and food conversion efficiency, values for formulated infant food diets and casein. It was noticed, that food conversion efficiency (F.C.E.) and protein efficiency ratio (P.E.R.) of formula 1 and 2 were higher than that of casein, while formula 3 had the lowest values of F.C.E. and P.E.R. The relatively high P.E.R. value of formula 1 and 2 described to the relatively high indispensable amino acids score of this formulas. It was noticed that moderated diet which has moderated ratio from animal and plant proteins has good abitability and high digestibility. These observation are in agreement with that reported by Malleshi and Desikacher (1986) and Hassona *et al*. (1991).

Table (6): Biological evaluation of prepared canned infant food formulas.

Parameters	Formula 1	Formula 2	Formula 3	casein
F.C.E.*	5.43	5.17	4.75	5.12
P.E.R.**	2.19	2.05	1.83	1.98

*** Food conversion efficiency**

**** Protein efficiency ratio**

The values of F.C.E. are in agreement with that finding by Saied (2000), but the values of P.E.R. are higher than the P.E.R. of the same author.

Effect of storage at room temperature for 6 months on chemical composition and microbial content of prepared canned infant food formulas.

Results in Table (7) indicated that moisture, protein, fat, ash and fiber contents were slightly decrease during storage period in all prepared formulas. On the other hand, total carbohydrates were slightly increased with increasing of storage period from 60.24 to 61.15%, 63.74 to 69.52% and from 73.59 (zero time of storage) to 74.20 at the end of storage period for formula 1, 2 and 3, respectively.

These results are partially agreement with Buyomi *et al*. (1979) they reported that during storage of canned poultry meat for 6 month, the total protein was decreased and ash content was increased.

Table (7): Effect of storage at room temperature for 6 months on chemical composition and bacterial count of prepared canned infant formulas.

Storage time (month)	Components							
	Moisture %	Protein %	Fat %	Ash %	Fiber %	Total carbohydrates %	T.V.B.C.*	Coliform bacterial counts
Formula 1:								
Zero time	78.86	26.25	6.56	6.95	2.85	60.24	0.5×10^2	0.0
2	78.69	26.00	6.50	6.80	2.80	60.70	0.8×10^2	0.0
4	78.40	25.80	6.35	6.72	2.70	61.13	1.2×10^2	0.0
6	78.15	25.50	6.20	6.60	2.65	61.15	1.7×10^2	0.0
Formula 2:								
Zero time	83.01	23.92	7.35	4.99	3.24	63.74	0.4×10^2	0.0
2	82.80	23.60	7.21	4.76	3.05	64.43	0.7×10^2	0.0
4	82.40	23.30	7.10	4.62	3.00	64.38	1.0×10^2	0.0
6	82.10	23.05	6.98	4.50	2.97	64.52	1.4×10^2	0.0
Formula 3:								
Zero time	85.88	18.50	2.72	5.19	5.95	73.59	0.34×10^2	0.0
2	85.73	18.20	2.60	5.05	5.85	74.15	0.6×10^2	0.0
4	85.50	17.85	2.52	4.90	5.70	73.98	0.9×10^2	0.0
6	85.21	17.55	2.40	4.60	5.60	74.20	1.3×10^2	0.0

*** T.V.B.C. = Total viable bacterial counts. (cells/gm).**

Total bacterial and coliform count of prepared canned infant food formulas:

Total viable bacterial and coliform bacterial counts were examined in the stored samples for six months at room temperature. As shown in Table (7), prepared canned infant food formulas was free from coliform bacteria at all storage periods. Concerning total bacterial counts, it was observed that the initial total count in canned formulas 1, 2 and 3 were 0.5×10^2, 0.4×10^2 and 3.5×10^2 cells/1gm, respectively. During storage of these canned samples for 6 months at room temperature slight increase was noticed in total count to 1.7×10^2, 1.5×10^2 and 1.3×10^2 cells/1gm for canned formulas 1, 2 and 3, respectively. Similar results were obtained by Elias *et al*. (1979).

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إعداد وتقييم بعض الوجبات الغذائية المعلبة للأطفال

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قسم الصناعات الغذائية - كلية الزراعة بكفرالشيخ – جامعة طنطا

تهدف هذه الدراسة الى إعداد ثلاث وجبات غذائية معلبة للأطفال عمر من 6 — 12 شهر مرتفعة فى قيمتها الغذائية من مكونات محلية مثل اللحم البقرى ولحم الدجاج وبعض الخضروات، حيث قيمت هذه الوجبات المعلبة غذائياً وكيميائياً وبيولوجياً بعد إعدادها مباشرة وخلال فترة التخزين لمدة 6 شهور على درجات حرارة الغرفة وأوضحت النتائج ما يلى:

ارتفاع محتوى الوجبات الثلاثة المحضرة خاصة الوجبة الأولى والثانية من البروتين حيث كانت نسبته 26.25% ، 23.92% على الترتيب. كما تراوحت نسبة الدهن والرماد والألياف فى هذه الوجبات بين 2.72-7.35% و 4.99 — 6.95%، 2.85-5.95% على الترتيب. كما أثبتت النتائج أن محتوى الوجبة الأولى والثانية من الريبوفلافين والحديد والكالسيوم والفوسفور كان مرتفعاً بينما احتوت الوجبة الثالثة على كميات مرتفعة من حمض الأسكوربيك والبيتاكاروتين، ووجد أن جميع الوجبات المحضرة تحتوى على كميات كافية لاحتياجات الأطفال اليومية من الحديد والبيتاكاروتين. وأوضحت النتائج أيضاً أن الوجبات المعلبة خاصة الأولى والثانية ذات محتوى عالى من الأحماض الأمينية الأساسية مقارنة ببروتينات البيض، بينما كانت تحتوى الوجبات الثلاثة خاصة الوجبة الثالثة من الميثونين والسيستين والليسين أقل منها فى حالة بروتينات البيض. وأوضح التقييم البيولوجى والميكروبيولوجى أن الوجبة الأولى قد أعطت زيادة ملحوظة فى معدلات استهلاك الوجبات وكذا كفاءة البروتين يليها الوجبة الثانية والثالثة بالإضافة الى خلو هذه الوجبات الثلاثة المعلبة من بكتريا القولون.