

UTILIZATION OF SOME MILK BY-PRODUCTS AND CHICKPEA FOR PREPARING WEANING FOODS

Ali, Afaf O. A.; Akiela Saleh*; A. M. Abeid and M.M. El-Abd **

*** Regional Center for Food and Feed, Agric. Res.Center, Giza, Egypt.**

**** Dairy Science Dept. Faculty of Agric. Cairo Univ., Egypt**

ABSTRACT

Sweet cheese whey and permeate as milk by-products were used to prepare weaning food. Grinding chickpea was added as a fortified material. Effect of use ABT culture with obtained formulas also was studied. Examined formulas were tested for their chemical composition, mineral contents, amino acids and some vitamins contents, and microbiological properties. Total calories and protein content of prepared formulas were calculated as percentage of daily requirement (G.D.T.) for infant 9 months old.

Keywords: Whey-permeate-weaning food-chickpea-daily requirement G.D.R.

INTRODUCTION

Weaning foods must cover the gap between breast feeding and a family diet. Infant age 6-12 months are the major group of weaning food consumers. Their energy and protein requirements were used as a starting point to develop a strategy for home or small industrial scale manufacture of weaning foods. In addition such food must have an easy to swallow consistency and be microbiologically safe when consumed. On the other hand, the level of antinutritional factors must be minimized (Nout, 1993). Also, the weaning food mixture should be nutritionally well balanced in proteins and essential amino acids, vitamins and minerals, it should be pre-cooked if possible so that it can be fed to babies. The fiber content in the material should be low and within permitted limits (Desikachar, 1982). Thomas (1988) found that the cheese whey may have been used for treatment of diseases and illnesses stems from the fact that it has a high nutritional value. Whey contains considerable amounts of high protein, carbohydrates (lactose) water soluble vitamins and minerals. Permeate or liquid material not used in making cheese is a sweet liquid that contains minerals, lactose and water soluble vitamins.

Cheese whey and ultrafiltration permeate are the major by products in the dairy industry, having excellent functional properties and a very high nutritional value. Therefore, utilization of these by-products in baby foods is very important.

Sotelo et al., (1987 a,b) showed that chickpea based infant formula was not nutritionally inferior to a soybean based one and had the advantage that infant diarrhoea was much better controlled on the chickpea-than on the soybean-based formula. In addition the chickpea formula could be recommended for use by bottle-fed babies suffering from lactose intolerance. Amjad et al. (2006) studied the proximate composition, mineral constituents and amino acids profile of four important legumes (Chickpea, Lentil, Cowpea and Green pea) in order to evaluate their nutritional performance. They found that all four types of legumes were better suppliers of mineral matter,

particularly potassium, phosphours, calcium, copper, iron and zinc. Also tested legumes were rich in lysine, leucine and arginine and can fulfil the essential amino acid requirement of human diet except for S-containing amino acids and tryptophan. In order to make good, the deficiency of certain essential amino acids in legume protein, they must be supplemented with other vegetables, meat and dairy products (e.g. whey, yoghurt). Krshenin and Shamanova (1994) a Annotated cultured milk prepared using special strains of *L. acidophilus* and *Bifidobacteria* spp. to play an important role in child nutrition.

Sarkar and Misra (2002) concluded that a dosage of 100g of dietetic yoghurt supplements with *B. bifidum* NDRI and *P. freudenreichii supsp. Shermanii* MTC 1371 containing 10^8 cell/g of *B-bifidium* daily after meals for a period 7 days can be recommended for infant and children to provide lactic acid and antibiotic factor.

The objective of the present investigation was to prepare and evaluate some weaning food formulas, using chickpea, sweet cheese whey permeate and ABT culture.

MATERIAL AND METHODS

Chickpea :

The chickpea seed was obtained from local market of Cairo City. The seeds were cleaned manually and render then free of dust and foreign materials then stored in polyethylene bags in the refrigerator unit used.

Sweet whey:

It was obtained from the Dina farmers Egypt, The proximate analysis of sweet whey was moisture (92.3%), lactose (4.9%) protein (0.749%).

Permeate

It was obtained from the Domty factory of Egypt. The proximate analysis of permeate was moisture (94%) lactose (5.0%) and protein (0.2%).

ABT culture

FD-DVs-ABT-2- Probio-Tec.,contianing *lactobacillus acidophilus* LA-5. *Bifidobacterium BB-12* and *S. thermophilus*. Chr. Hansesn's was used.

Corn oil:

It was obtained form the local market of Cairo city.

Orange flavoured:

It was obtained from the Delta Aromatic Giza-Egypt.

Table (1): The ingredients of the prepared formulas.

Formulas	Whey liter	Permeat liter	Chickpea (gm)	Corn oil (gm)	ABT culture (gm)	Orange flavur (mg)
C.W	1	-	75	21.0	-	0.1
CP	-	1	100	21.0	-	0.1
CWA	1	-	75	21.0	0.1	-
CP.A	-	1	100	21.0	0.1	-

CW = chickpea-whey formula.

CP= chickpea-permeate formula.

CWA= chickpea-whey-ABT culture formula.

CPA= chick pea- permeate ABT culture formula.

Fig. (1): Preparation of weaning food formulas

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Methods:

Preparation of weaning food formulas: Table (1) shows that the basic formulas of weaning foods were consisted of chickpea with whey or permeate and ABT culture .

The chickpea was soaked in water for 8 hrs. and then blanched in boiling tap water for 15 min. then cooled by tap water and dehulled manually. The dehulled seeds were dried at 60°C for 12 hrs. Figure 1 shows the flow sheet of preparation.

Chemicals analysis

Total protein, crude fat, crude fiber, ash were determined according to AOAC(2000) . total carbohydrates were determined according to Dobois et al., (1956). Minerals content, (Ca, P,Fe, Zn, Na, Pb and Cd) were determined according to AOAC (2002). The system used for the analysis was ICP Optima 2000 DV. Amino acids analysis except for tyrosine and tryptophane was carried out according to the method of the Official Journal of the European Communities (1998). Using high performance Amino acid Analyser, Beckman 7300. Vitamins B₁ (Thiamine) and B₂ (Riboflavin) were determined according to method of National Food Agency of Denmark, Ministry of Health, Institute Food Chemistry and Nutrition /Danish Official (1996). Total energy was calculated for the final product according to Tamime et al., (1987) . The percentage of the fat calories to the total calories intake for each blend and the amount of fat (gm) per 100 available calories for each product was calculated according to Seleet (1990). The total bacterial count of the formulated samples was carried out using nutrient agar medium (Difco,1984). Lactic acid bacteria (L.A) determined according to Badis et al., (2004). Moulds and yeasts were determined using Rose Bengal Agar according to (Difco 2003).

RESULTS AND DISCUSSIONS

Table (2): Chemical composition of prepared weaning food formulas (on dry weight basis)

Formula	Total protein	Crude fat	Crude fiber	Total Carbohydrate	Ash
Chickpea +whey CW	17.75	13.45	3.39	61.88	3.36
Chickpea +permeate CP	14.0	17.0	2.94	59.89	3.6
Chickpea+whey +ABT(CWA)	16.7	13.5	3.86	58.4	4.0
Chickpea+permeate+ABT (CPA)	14.6	16.7	2.32	60.2	4.2
Chickpea	25.3	6.66	3.79	59.95	1.4

Data in Table (2) show that the total protein content of weaning formulas ranged between (14.0-17.75%). C.W contained the highest protein. Generally these results are closed to the requirement of The Egyptian Standards (1977 and 1990), which stated that protein content for vegetarian baby food fortified with milk should not be less than 18% on wet matter basis and 15% on dry matter basis, respectively.

General weaning formulas containing permeate show lower protein content than those containing cheese whey. This finding can be attributed to

the higher protein content of cheese whey (0.749%) than that of permeate (0.2%).

The highest fat content was observed in C.P (17.0) while the lowest one was recorded for C.W (13.45). These results are higher than the Egyptian Standards (1977 and 1990), which stated that fat content should not be more than 5%. These results are nearly to those recorded by (EL-Adawy et al., 2001) for weaning foods containing legumes and whey. In the same table, the total carbohydrate content of weaning formulas ranged between (58.4-61.88%). These values are higher than that published by (Kapoor & Gupta 1981). They reported that carbohydrates content were 50% for Low-cost, protein energy-rich weaning food of acceptable quality which prepared from soybean and cheese whey.

Ash content of four weaning food formulas ranged from 3.6 to 4.2%. These results are nearly similar to that of the requirements of the Egyptian Standards (1977) which suggested that ash content should not be more than 3%. All formulas show acceptable content of crude fiber referring to FAO/WHO (1985), which stated that the fiber content should not exceed 5%.

Table (3): Minerals contents of prepared weaning food formulas (mg/100g formula).

Formulas	Minerals						
	Ca	Na	P	Iron	Zn	Pb	Cd
Chickpea +whey CW	438.4	278.2	545.1	3.7	3.07	6.166	0.195
Chickpea +permeate CP	290.8	361.8	472.7	3.1	3.56	0.09	0.19
Chick pea+whey +ABT(CWA)	401.6	230.4	496	3.7	3.25	0.167	0.189
Chickpea+permeate+ABT (CPA)	301.9	367	464.8	3.1	3.83	0.1	0.185
Chickpea	4.9	325.6	1.7	N.D.	11.9	N.D.	N.D.

N.D. : not determined

Table (3) show some minerals contents of prepared weaning food formulas. The obtained results clearly show higher content of calcium, phosphorus and iron in whey formulas than permeate formulas. Regarding sodium and zinc contents the opposite was true, where whey formulas contained less values than permeate formulas.

Table (4): Thiamine (B₁) riboflavin (B₂) contents of prepared weaning food formulas (ug/100g).

Formula	Vitamins	
	Thiamine (B ₁)	Riboflavin (B ₂)
Chickpea +whey CW	419.01	386.7
Chickpea +permeate CP	360.8	435.98
Chickpea+whey +ABT(CWA)	360.67	387.05
Chickpea+permeate+ABT (CPA)	336.05	395.6

Generally obtained results of calcium content are nearly similar to the requirements of The Egyptian Standards (2005), which reported that calcium content should not be less than 320mg/100g weaning food. While iron content of all formulas was less than the requirements of the same standards (6mg/100g). Therefore, these formulas should be fortified with iron sources.

The value of lead content of all formulas were slightly higher than that recorded in The Egyptian Standard (2005) which reported that the lead and content should not be more than 1mg/1000g. Data presented in Table (4) revealed that thiamine content of whey formulas was slightly higher than that of permeate formulas while riboflavin contents showed opposite trend.

Generally these results are higher in B₂ and slightly lower in B₁ than the values of Egyptian Standard (2005), which suggested that B₁ and B₂ contents should not be less than 400 Ug/100g and 240 Ug/100g respectively.

Table (5): The amino acids content of prepared weaning food formulas mg/100g.

Formula	Chickpea	Chickpea + whey	Chickpea +permeate	Chickpea+whey A.B.T	Chickpea+permeate A.B.T
Asp	2.65	1.73	1.36	1.62	1.15
Glu	3.42	2.41	1.80	2.18	1.54
Ser	1.14	0.75	0.54	0.62	0.53
Gly	0.84	0.49	0.45	0.47	0.38
His	0.79	0.62	0.48	0.59	0.45
Arg	1.40	1.01	0.95	0.96	0.95
Ther	0.87	0.73	0.45	0.62	0.43
Ala	0.80	0.58	0.45	0.54	0.36
Pro	1.10	0.88	0.65	0.85	0.58
Val	1.04	0.78	0.56	0.72	0.46
Meth	0.40	0.27	0.18	0.26	0.16
Cys	0.37	0.31	0.22	0.32	0.21
Iso leu	1.00	0.73	0.53	0.69	0.42
Iue	1.74	1.26	0.89	1.19	0.75
Phen	1.28	0.74	0.69	0.74	0.51
Iys	1.64	0.95	0.75	1.03	0.56

Amino acids contents of prepared formulas are shown in Table (5). Obtained results obviously show that whey formulas have higher values of all amino acids than permeate formulas. This finding can be attributed to the higher content of total protein in whey than permeate as previously mentioned.

Table (6): Calculated calories from 100g of prepared weaning food formulas.

Formulas	Sources of calories (K.Cal)			Total k.cal	% fat calories total k.cal	% fat g/100 vaiable K.cal
	Fat	Protein	Carbohydrate			
Chickpea +whey CW	121.05	71.0	247.52	439.57	27.54	3.1
Chickpea +pemeat CP	153	56.0	239.56	448.56	34.11	3.8
Chickpea+whey +ABT(CWA)	121.5	66.8	233.6	421.9	28.8	3.2
Chickpea+permeate+ABT (CPA)	150.3	58.4	240.8	449.5	33.44	3.71

The total calculated calories from 100g dried weaning formula could be seen in Table (6). The carbohydrates represent the major source of calories in all formula approximately 55% followed by fat 30% then protein 16% . The FAO/WHO (1976). suggested that, infant formula fat content should be between 3.3 to 6.0 g/100 g available calories. It appears from

tabulated results that the fat level of the composed infant formulas ranged from 3.1-3.8 g/100 available calories. These findings are in accordance with those obtained by El-Adawy et al. (2001).

Table (7): Evaluation of protein and energy level (G.D.R) prepared weaning foods compared with the recommended daily requirements.

Formula	*GDR g protein of	G.D.R gm energy	
	**13.7	825 boys k.cal.	765 girls k.cal.
Chickpea +whey CW	77.2	188	174
Chickpea +pemeat CP	98	183	171
Chickpea+whey +ABT(CWA)	82	196	181
Chickpea+permeat+ABT (CPA)	93.8	184	170

* G.D.R. gram consumed of food to cover the protein's and energy daily requirements of infant 9 months old.

** Michaelsen et al. (2000)

The results illustrated in Table (7) show an evaluation of protein and energy level by grams consumed of food to cover the daily requirements (G.D.R) of infant 9 months from the weaning food formulas compared with the recommended daily requirement. Obtained results clearly show that providing infant 9 months old with the daily requirement of protein and energy needs from 77.2-98 gm of prepared formulas for protein and 183-196, 170-181 gm for boys and girls respectively.

Table (8): The microbiological properties of prepared weaning food formulas (C.F.U).

Formula	T. count	Molds& yeasts	Lactic acid bacteria
Chickpea +whey CW	60x10 ⁵	4x10 ²	-
Chickpea +pemeat CP	50x10 ⁵	-	-
Chickpea+whey +ABT(CWA)	30x10 ⁵	2x10 ²	1x10 ⁴
Chickpea+permeat+ABT (CPA)	20x10 ⁵	2x10 ²	1x10 ⁴

Microbiological properties of weaning food formulas are presented in Table (8). The obtained values show that bacterial total counts ranged between 20x10⁵ – 60x10⁵ C.F.U. while moulds and yeasts reached 2x10² – 4x10². These values are closed to those reported by Christian (1983), while they are higher than results of Marero et al. (1989).

Regarding lactic acid bacteria in formulas containing ABT culture, they reached 1x10⁴ C.F.U.

In conclusion this study showed that fortification either cheese whey or permeate with chickpea lead to formulate a good weaning food with high nutritional value.

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استخدام بعض نواتج اللبن الثانوية والحمص لتحضير أغذية الفطام
عفاف عمر سراج الدين على – عقيلة صالح* - عبد السلام محمد عبيد و
منير محمود العبد **
*** المركز الإقليمي للأغذية والأعلاف – مركز البحوث الزراعية- جيزة – مصر،**
**** قسم الألبان- كلية الزراعة – جامعة القاهرة – جيزة – مصر.**

تم استخدام شرش الجبن الحلو وراشح اللبن بطريقة الترشيح الفائق في تحضير أغذية للفطام وتم تدعيم هذه المنتجات الثانوية بواسطة الحمص المطحون، واستخدم بادي ABT مع بعض هذه الأغذية، وتم اختبار كل من التركيب الكيماوى والمحتوى المعدنى ومحتوى الأحماض الأمينية وكل من الثيامين والريبوفلافين بجانب بعض الأعداد الميكروبية، كذلك تم حساب السعرات الحرارية الكلية لهذه الأغذية والبروتين الكلى بها ومدى تغطية الاحتياجات اليومية للأطفال عمر 9 شهور من كل منها.

Ali, Afaf O. A.

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