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STUDIES ON PROCESSED PROTEIN FOODS BASED ON BLENDS OF GROUNDNUT, BENGALGRAM, SOYABEAN AND SESAME FLOURS AND FORTIFIED WITH MINERALS AND VITAMINS

1. PREPARATION, CHEMICAL COMPOSITION AND SHELF LIFE

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A considerable amount of work has been carried out during recent years in different countries in developing protein rich foods of vegetable origin suitable for supplementing the diets of preschool children belonging to the low income groups of the population. [1-4] The most promising protein-rich raw materials available in developing countries are the low-fat oilseed meals from groundnut, soya,sesame, cottonseed and coconut. The availability of these meals vary considerably from country to country and also in the different regions of the same country.[4-5] For example, in India coconut meal is the chief protein source in Kerala state; Bengal gram and soya bean in Punjab, Uttar Pradesh,West Bengal, Bihar and Orissa states, groundnut, cottonseed, and to a lesser extent sesame in Gujarat, Maharashtra,Andhra, Madras and Mysore states.[5] In earlier publications from this laboratory, the results of studies on the preparation, shelf life and nutritive value of protein foods based on (1) groundnut and Bengal gram (2) groundnut, Bengal gram and coconut and (3) groundnut and soya have been reported.[6-8] There is evidence to indicate that by suitable blending of two or more protein foods available in the region and fortifying with limiting amino acids, it is possible to obtain a protein blend of high nutritive value.[9,10] The present paper reports the results of studies on the preparation, chemical composition and shelf life of two samples of processed protein foods based on (1) 40 : 40 : 20 blend of groundnut, Bengal gram and sesame flours and (2) 40 : 30 : 30 blend of groundnut, soya bean and sesame flours, fortified with limiting amino acids, essential vitamins and minerals.

Experimental

Material : Low-fat groundnut flour and roasted Bengal gram flour were prepared according to Parpia *et al.* [11] Full-fat soya flour was prepared according to Narayana Rao *et al.*[8] and low fat sesame flour according to Subrahmanyan *et al.* [6] The composition of the seasoning premix was the same as that described by Subrahmanyan *et al.* [6]

Process details : The compositions of Protein Foods I and II are given in Table I. The different ingredients were mixed throughly in a mechanical mixer. The *unseasoned* form was flavoured with vanillin (0.05%) while the *seasoned* form was flavoured by the addition of spice premix(at 3% level) and common salt (at 2% level).

Fortification with calcium salts, vitamins and limiting amino acids : The Protein Foods I and II were fortified with calcium salts, vitamins A and D, thiamine and riboflavin which were added in the form of a dry premix in groundnut flour, A part of the food was also fortified with l-lysine (to raise the lysine content to 6 6g/16 gN) and with dl-methionine (to raise the total S-amino acid contents to 4.3g/16gN).

Chemical composition : The chemical composition of the protein foods, determined according to the standard methods of A. O. A. C [12] is given in Table II, as compared with that of skim milk powder.

Shelf life : The method used for study-

Table I. *The percentage composition of Protein Foads* I and II*

Ingredients	Protein Food I	Protein Food II
Groundnut flour (low fat)	40	40
Bengal gram flour ...	40	—
Sesame flour (low fat)	20	30
Processed soya flour (full fat)	—	30

* The protein foods were fortified with calcium carbonate and tricalcium phosphate and also with vitamins A and D, thiamine and riboflavin.

Table II. *The nutritive value of Protein Foods I & II (unseasoned) as compared with skim milk powder* (Values per 100g)

Constituent	Protein Food I	Protein Food II	Skim milk powder
Moisture (g)	5.9	7.7	4.1
Protein (Nx 6.25)g	37.5	44.4	35.0
Fat (g)	7.2	13.6	1.0
Ash (g)	6.7	7.6	6 8
Carbohydrate by diff (g)	42.7	26.7	53.1
Calcium (g)	1.24	1.60	1.30
Phosphorus (g)	0.62	0.64	1.03
Iron (mg)	6.3	6.2	0.6
Thiamine (mg)	2.18	2.29	0.35
Riboflavin (mg)	2.69	2.68	1.39
Nicotinic acid (mg)	10.0	11 2	1.1
Vitamin A* (I. U.)	3660	3660	—
Vitamin D* (I. U.)	300	300	—
Calorific value	386	407	361

*added values

ing the shelf life of the product was similar to that of Subrahmanyan *et al.*[13] The protein foods were hermetically packed in seamed tin containers (250g. capacity) and stored at 37°C for a period of 6 months. Control samples were stored at 0°C. The samples were analysed periodically (once in two months) for peroxide value, fat acidity, thiamine and vitamin A according to the methods used in an earlier study.[8] The organoleptic quality of the foods was tested by a panel of 6 judges selected from among the institute staff. An organoleptic score system similar to that used by Chandrasekhara *et al*[14] was adopted. A product having a score of 2 or less was considered acceptable. The results of storage studies are presented in Table III.

Results and Discussions

The chemical composition of the Protein Foods is given in Table II. A daily supplement of 40-50 g. of the foods (costing 1.6 U. S. cents or 8 paise) will provide about 18 to 24 g. of protein which is approximately half the daily requirements of preschool children. It will also provide about one third to one half the daily requirements of different minerals and vitamins. The results given in Table III show that the Protein Foods keep well for a period of 6 months at 37°C when stored

Table III. *Shelf-life of seasoned and unseasoned Protein Foods I & II fortified with essential vitamins and minerals*

Constituent	(Period of storage) Initial		2 months		4 months		6 months	
	S*	US**	S*	US*	S*	US**	S*	US**
	Protein Food I							
Free fatty acids† (as oleic acid)	6 6	8.0	13.3	14 2	17 0	16.4	17.8	18.4
Peroxide value‡	0.18	0.28	0.84	0.63	1.07	1.13	1.48	2.67
Vitamin A (I. U.)	3660	3660	3156	3053	2965	2765	2526	2257
Thiamine (mg)	2.14	2.18	1.95	1.91	1.91	1.84	1.82	1.75
	Protein Food II							
Free fatty acids†	5 2	5 8	13 2	18.3	17.6	16.8	17.8	18 4
Peroxide value‡	0 25	0.22	0.33	0 39	0.68	0.67	0 90	1.02
Vitamin A (I. U.)	3660	3660	3317	3063	3103	2791	2672	2300
Thiamine (mg)	2.31	2.30	1.93	1.91	1.90	1.83	1.74	1.68

* expressed on the basis of fat present in the food

‡ Millimols of thio per g. of fat.

† seasoned—Initial moisture content 7.5%

** unseasoned—Initial moisture content 7.7%

in hermetically sealed tin containers. The losses of vitamin A and thiamine in the foods at the end of 6 months storage were about 38-39% and 18-27% respectively.

Summary

I. The results of studies on the preparation, chemical composition and shelf life Protein Foods (Protein Food I based on 40:40:20 blend of groundnut, Bengal gram and sesame flours and protein food II based on 40 : 30 : 30 blend of groundnut and sesame flours) fortified with calcium salts, vitamins A and D, thiamine and riboflavin are described. The Protein Foods are available in two forms (i) *unseasoned* flavoured with vanillin for use in porridge, puddings and sweet preparations and (ii) *seasoned* with spices and salt for use in soups and savoury preparations.

2) A daily intake of 50 g. of the Protein Foods costing about 1.6 U. S. cents (8 paisa) will provide about half the daily requirements of proteins, calcium and certain essential vitamins of preschool children.

3) Both the *unseasoned* and *seasoned* forms of the Protein Food kept well at 37°C for a period of 6 months when packed in hermetically sealed containers. The losses of vitamin A and thiamine at the end of the storage period were about 38-39% and18-27% respectively.

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