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PREPARATION OF SOYMILK FROM SOYBEAN

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Attempts have been made in the present investigation of soymilk free off bitter taste and beany flavour. The conditions have been standardised for obtaining a palatable milk from soybean. Net protein utilization (standardized) of soymilk and skim milk have almost the same value. The NDP calories and PER of soymilk have indicated that soymilk can be substituted for cow's milk and can be used for feeding infants.

INTRODUCTION

In the present time, it is not advisable to depend entirely on the traditional protein sources for human nutrition, because of short supply of animal proteins. It is the need of the time to use the vegetable proteins as supplement or partial replacement of animal proteins in foods. Soybean is one of the good sources of protein selected as a raw material for the replacement of animal proteins. Quality of its proteins is good and protein content of soybean is high. Various products prepared from soybean commonly are in accepted form at a high level of nutritional quality and organoleptic appeal. Several patents have been issued on the soybean products. Muskatas [1] prepared a dry product by spray-drying method and formulated highly nutritious flavoured drinks. A couple of patents have been issued by Arndt [2,3] who described the preparation of soymilk and its products. Wagner [4] recommended a process for the preparation of milk analogues by comminuting soybean or other legumes in the presence of edible acids. De and Subrahmanyan [5] and Desikachar *et al.* [6] have standardised the conditions for obtaining a palatable milk-like emulsion from soybean. Rittinger *et al.* [7] described that soybean milk can be used as a satisfactory substitute for cow or human milk for feeding infants.

One of the easiest products to make from soybean is a water extract which is usually called soymilk because of its milky appearance. Soymilk is also a nutritionally acceptable substitute for infants allergic to cow milk. Production of soymilk will not only be a good substitute for animal milk but also a substitute for breast milk and a life saving product for lactose-allergic infants. It is also cheaper than that of animal milk.

Principal obstacle to the acceptability of soybean milk is its strong disagreeable flavour. Flavour has been objectionable. In the present investigation, attempts have been made in the direction of preparing low-cost soymilk free of bitter taste and beany flavour.

Chemical Composition of Soybean. It was reported [8] that various varieties of soybeans contain various amounts of proteins and fat.

The soybean taken for the present investigations were obtained from the Agriculture Research Institute. Tandojam, the chemical composition of whole bean was determined on dried basis as follows: protein (N x 6.25) 39.0, fat 23.2, ash 6.0, fibre 5.6, and carbohydrate 26.2%. .

EXPERIMENTAL

Method for the Preparation of Soymilk. Soybeans (110.0 g) were soaked in a hot solution of 0.1% sodium bicarbonate at 75–80° for 1 hr. Sodium bicarbonate solution was drained off and washed with hot water. Soybeans were then soaked in water and added *N*/10 HCl solution in order to bring the pH at 3, for 1 hr at 75–80°. The soybeans were again dipped in 0.1% sodium bicarbonate solution at 75–80° for 1 hr. Soybeans were again washed with hot water in order to remove the alkali, the soybeans were then kept in hot water at 75–80° for another 2 hr.

The soft soybeans were then blended with 600 ml hot water and blending was continued for 10 min at 75–80°, during blending 1.6 g trisodium phosphate were added. (In the laboratory the blender was used for blending and the solution was passed through colloidal mill. But. on large scale the wet grinding machine may be used). The milky solution was centrifuged at 1200 rev/min for 10 min. The supernatant was decanted off and the residue was again blended with 300 ml hot water for 10 min and then centrifuged. The supernatants were again decanted and both extracts were mixed and pH was adjusted at 6.8 with the help of *N*/10 HCl. Saturated calcium hydroxide solution (8 ml) and 8 ml of buffer solution (50 ml of 0.2*M* acid potassium phosphate + 23.65 ml of 0.2*N* NaOH made 200 ml with distilled H_2O, pH 6.8) were added. Finally 12 g sugar were

added, boiled and volume was made up to 600 ml by evaporating the extra water under reduced pressure and packed in sterilised bottles.

The total solid in milk was determined and the residue was also collected and dried. It was found that 46% of the total solids in soybeans were being extracted in water-soluble extract, i.e. milk and 44% of the total solid of soybeans was left in the residue and 10% was lost in acid, alkali treatment and washing.

A part of the milk thus prepared was dried in an oven and the dried milk was analysed for the determination of protein, ash, fibre, fat and carbohydrates. The chemical composition is given in Table 1.

Nutritional Evaluation of Milk. Protein (Nx 6.25), fat, ash, fibre of milk powder were determined according to the methods given in A.O.A.C. [9]. The dried soymilk and skim milk were mixed in a semisynthetic diet so that the protein content of the diet was 10%. The composition of the diets/kg is shown in Table 2.

Net protein utilization (NPU) of diets were determined according to the method of Miller and Bender using Albino rats weighing 40–45 g. The NPU values at 10% protein level were converted to NPU (standardized; Table 3) using the formula [11]:

$$NPU_{st} = \frac{NPU \times 54}{54-P} - 8$$

where P is protein cal %

Net dietary protein calories (ND_p cal%) were calculated by the formula [12].

ND_p cal % = NPU op x Protein calories %

Protein Efficiency Ratio (PER). Soymilk, powder and casein (B.D.H) were mixed with a semisynthetic diet containing vitamins and minerals in such a manner that protein content was ca. 10%. The composition of diets is shown in Table 2. Sixteen Albino rats weighing 35–40 g were divided into 2 groups in such a manner that average weights of rats of both groups were identical. One group was fed on soymilk diet and the other one on casein diet. The rats were kept in wire meshed cages in an air-conditioned room maintained at 80°F (± °2F). Feeding was continued for a period of 4 weeks and record of weight gain and food intake were maintained. One drop of vitaminised oil containing vitamin A, D, E and K^{10} was also given to each rat per week. PER was calculated by dividing the weight gain with the protein intake during the experimental diets as shown in Table 4.

DISCUSSION

In the present investigation the attempts have been made for preparation of low-cost soymilk free of bitter taste and beany flavour. The main obstacle in its inacceptability was removed during process of its production. The conditions have been standardised for obtaining a palatable milk from soybean. The only drawback in the present method of production of soymilk is the wastage of 10% in chemical treatment and washing. So it is better to be con-

Table 1

Constituents	Liquid milk on 10% solid basis	Dried milk (%)
Protein (Nx 6.25)	4.04	40.4
Fat	2.2	22.0
Ash	0.42	4.2
Fibre	–	–
Carbohydrates	3.34	33.4

Table 3. Protein values of diets.

Diet	Protein cals	NPU_{op} (%)	NPU_{st} (%)	ND_p calories
Skim milk	10.0	75.5	84.7	7.55
Soymilk	10.3	68.5	84.6	7.05

Table 2. Composition of diets.*

Diet	Proteins source	Casein	Skim milk	Soy-milk	Maize starch	Fat	Glu-cose	Potato starch
1	Non-protein	–	–	–	500	150	150	100
2	Skim milk	–	286		214	150	150	100
3	Soymilk	–	248	–	252	150	150	100
4	Casein	115			385	150	150	100

*The diets also contained; vitamin mixture 50 g; mineral mixture 50 g.

Table 4. Biological evaluation of soymilk and casein diet.*

Source of protein diet	Protein on dry wt basis (%)	Dried food	Protein intake	Weight gain	PER	Remarks
Soymilk	10.05	248	25.0	60.0	2.4	
Casein	10.5	216	22.7	59.0	2.6	Difference insignificant

Mean value of 8 rats.

tent with a small quantity and greater acceptability than a greater quantity of product with limited acceptability.

The net protein utilization of soymilk was slightly less than that of skim milk but the NPU_{st} of soymilk and skim milk gave almost the same value. It was also shown from Table 3, that ND_P calories % value of soymilk and skim milk are above 77. Hence the soymilk is suitable for feeding infants.

The growth rate of rats fed on casein and soymilk diets are similar. The gain in weight during the 4 week period for rats fed on soymilk and casein diet were 60 and 59 g respectively. PER of soymilk and casein diets were calculated as 2.4 and 2.6 respectively. Statistical analysis of the data revealed that there was no significant difference between the PERs of soymilk and casein employed. The above results indicate the soymilk can be substituted for casein as a source of protein.

In general the results obtained by the present investigation indicate that soybean milk can be used as a satisfactory substitute for cow and human milk for feeding infants.

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