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PREPARATION AND BIOLOGICAL EVALUATION OF SOY CURD FROM SOYBEAN

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A method for the preparation of soy curd free from beany flavour and trypsin inhibitor has been developed. Results of biological evaluation revealed that nutritional values of the product were comparable to that of casein. Soy curd is the most suitable proteinous product to be used in Pakistani diets.

Key words: Soybean product, Biological evaluation, Preparation of soy curd.

Introduction

In the earlier reports, preparation of soy milk[1], soy dhal[2], weaning food[3] (soylac) and post-diarrhoeal[4] food from soybean has been described. Soybean is used in various food preparation to improve their nutritional value[5]. Protein quality of soybean is known to be very good. Soy curd is also a product which could be prepared from soybean. In the preparation of soy curd, soy milk is the first product from soy bean.

Schroeder *et.al.* [6] reported the use of calcium sulphate in the preparation of soy curd from soy milk. Lu, Carter, *et.al.*[7] used other calcium salts for the preparation of soy curd and determined that the amount of other salts needed to precipitate soy protein, was less than one half of calcium sulphate. Raw soybean contains a trypsin inhibitor which is considered undesirable. The present investigations were made to prepare the soy curd free of trypsin inhibitor.

Materials and Method

(i) The soybean taken for the present investigation was obtained from the Seed Division of Ghee Corporation of Pakistan. The chemical composition of whole bean was determined according to the method given in AOAC (on DMB).

(ii) Reagent grade sodium bicarbonate was used for preparing 0.1% solution in water.

(iii) 2% Calcium chloride was also prepared by diluting with water.

(iv) Sodium chloride 4% solution and potassium phosphate.

Preparation of soy curd. Soybeans (1 kg.) were soaked in a solution of sodium bicarbonate (0.1% w/v) at 80° for 2 hrs. Sodium bicarbonate solution was drained off and soybeans washed with hot water. Soybeans were then kept in hot water at 80° for an additional 2 hrs. The soft soybeans were homogenized with 9 litres of hot water, containing 15 grams of potassium phosphate, in a blender for 10 mins. at 80°. The slurry was then passed through a colloidal mill. The homogenised slurry was strained through cheese cloth and water soluble extract was boiled for 5 mins. After cooling to 80°, a 2% calcium chloride solution was added slowly while stirring until soy protein started to coagulate. Approximately 450 ml of the calcium chloride solution was required for the purpose. The coagulated material was passed through cheese cloth to obtain soy curd. The curd was washed three time with hot water at 80°C, then it was treated with a 4% sodium chloride solution for 1 min. Soy curd was finally transferred to a wooden press box lined with cheese cloth to drain water. It was pressed until draining had almost stopped.

One kg of soybean (containing 6% moisture) yielded 1.28 kgs of soy curd. Nutrients in soy curd and other products are given in Table 1.

TABLE 1. AMOUNTS OF NUTRIENTS IN BREAK UP PRODUCTS FROM 100 GM. OF SOYBEAN

Nutrients	Whole soybean MFB (g)	Soy-bean residue (g)	Soybean loss in washings etc.(g)	Soybean curd (MFB) (g)	Soybean curd wet basis (g)
Total weight	100.00	44.0	11.0	45.0	136.0
Protein (Nx6.25)	38.5	12.2	2.8	23.5	23.5
Fat	23.0	8.7	2.7	11.6	11.6
Ash	6.0	2.2	1.8	2.0	2.0
Fiber	5.7	5.7	Nil	Nil	Nil
Carbohydrates by difference	26.8	15.2	3.7	7.9	7.9
Moisture	-	-	-	-	91.0

The soy curd thus prepared and by-products were examined for chemical composition and the results are given in Table2.

Thin slices of soy curd were cut and dried in a vacuum oven at 30°. The dried slices were ground in a coffee grinder and stored for determination of trypsin inhibitor and for biological evaluation.

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Table 2. Chemical composition of soybean, soy curd and by-products

Products	Moisture (%)	Protein (Nx6.25) (%)	Fat (%)	Ash (%)	Fiber (%)	Carbohydrates (%)
Soybean raw	6.0	36.2	21.6	5.6	5.35	25.25
Soybean on (MFB)	-	38.5	23.0	6.0	5.70	26.80
Soybean residue on MFB	-	27.7	19.8	5.0	13.00	34.50
Soybean in washing MFB	-	25.5	24.5	16.4	-	33.60
Soy curd on MFB	-	52.2	25.8	4.5	-	17.50
Soy curd	67.0	17.2	8.5	1.5	-	5.80

Determination of trypsin inhibitor. Trypsin inhibitor units of soy curd and soybean were determined according to the method of Brocher *et.al* [9]. The results are shown in Table 3.

Table 3. Trypsin inhibitor units of soybean and soy curd

Products	Inhibition (%)	Trypsin inhibition Units$x10^{-3}$
Soybean untreated	54.5	2.4
Soybean treated	2.0	0.09
Soy curd	Nil	Nil

Net protein utilization. The raw soybeans were ground to pass a 60 mesh sieve. Soybean flour, ground soy curd and casein were mixed in a semi-synthetic diet by replacement of maize starch in such a manner that the ultimate protein content was Ca 10%. All the ingredients required for the diets were thoroughly mixed in an electric food mixer. The composition of diets are shown in Table 4.

Table 4. Composition of experimental diets

Siets	Soy curd on MFB	Casein	Soy bean	Maize starch	Fat	Glucose	Potato starch
Non Protein	-	-	-	500	150	150	100
Casein diet	-	115	-	385	150	150	100
Soy bean	-	-	260	240	150	150	100
Soy curd	191	-	-	309	150	150	100

The diets also contained vitamins mixture 50 g and mineral mix. 50 g^{10}.

The NPU of the diets was determined according to the method of Miller and Bender [11] using male albino rats weighing 35-40 gm. NPU operative value (NPU op) were converted to NPU standardized (NPU st) using the formula[12]:

$$\text{NPU st} = \frac{\text{NPUop x 54}}{\text{54-P}} - 8 \text{ where p is protein calories \%}$$

Net Dietary protein calories percent (NDP Cal %) were calculated by the formula:

$$\text{NDP Cals \%} = \text{NPU}_{op} \text{ x protein calories \%}$$

Protein Efficiency Ratio (PER) was determined at 10% protein level according to the method of Campbell [10] using albino rats weighing 35-40 gms. Besides a test group a reference standard group of rats on casein diet at 10% protein level was also maintained. Feeding was continued for 4 weeks and a record of weight gain and food intake was maintained. PER was calculated by dividing the weight gain with protein intake. The faeces collected during NPU experiment, were dried at 105x for 48 hrs. Digestibility of diet was calculated by using the following formulae:

$$\text{Digestibility} = \frac{\text{Dry weight of food intake - weight of dried faeces}}{\text{Dry weight of food intake.}} \text{ x } 100$$

The results are shown in Table 5

Table 5.

Diets	NPU_{op} (%)	NPUst (%)	NDP Cals. (%)	Digestibility (%)	PER	Remarks
Soy Curd	61.2	68.7	6.4	92	2.4)	Difference
Casein	63.5	69.9	6.5	92	2.5)	insignifica-
Soybean	51.0	55.3	5.3	85	1.34	tion)

For composition of diets see Table 4.

Discussion

Use of soybean and its products are receiving increasing attention during recent years as human food. Soy curd is one of the best products of soy bean. It was observed from Table 1 that 45% of the total solid in soybean was extracted in soy curd and 44% was left in residue and 11% was lost in chemical treatment and washings. In other words, 100 gms of soybean yields 136 gms of soy curd (moisture containing). It showed that considerable amount of soybean was extracted as soy curd. Soy curd contained a high percentage of proteins (52.2% MFB) and was free of trypsin inhibitor (Table 2). It was also observed that soybean residue contained 27.7% protein and 19.8% fat, thus the residue would be suitable for use in poultry feeds. It was observed from Table 5 that net protein utilization of soy curd and casein were 61.2 and 63.5 respectively and NPU st of soy curd and casein were 68.7 and 69.9 respectively. NDP calories % value of soy curd was slightly less than that of casein. PER (protein efficiency ratio) of soy curd and casein were calculated as 2.4 and 2.5 respectively. Statistical analysis of data revealed that there was no significant difference between the PERs of soy curd and casein.

In the light of above results it is concluded that raw soybean contain an anti-nutritional factor which was removed

during the process of its preparation and as a result the nutritive values were highly improved. It is also concluded that soy curd can be substituted for animal milk cheese as a source of protein. Present studies also indicate that soy curd is the most suitable proteinous product to be used in Pakistani diets.

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