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Comparative Study of Soy Paneer Prepared from Soymilk, Blends of Soymilk and Skimmed Milk

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Abstract

The present investigation was made with an attempt to develop processed paneer by partial addition of different levels of skimmed milk and soymilk. Soy paneer sample A (control) was prepared with 100% soymilk using citric acid at a concentration of 1.5% as coagulant. Sample B and Sample C were prepared with soymilk and skimmed milk in the ratio of 50:50 and 75:25 respectively with the addition of citric acid (1.5%) as coagulant. The samples were first processed at 80°C for 20 minutes and later at 30°C for 15 minutes. The control and different treatments were analyzed for physico-chemical analysis (acidity, TSS, specific gravity, ash, moisture, fat and protein) and organoleptic characteristics like (colour, flavor, taste, texture and overall acceptability). It was found that sample C has highest protein, fat and ash content. The soy paneer samples were subjected to sensory analysis by nine point hedonic scale. The sample containing 75:25 levels of soymilk and skimmed milk was liked most by the sensory panelists in comparison to other samples.

Keywords: Soymilk; Skimmed milk; Soy paneer; Organoleptic

Introduction

Soybean (Glycine max) is a leguminous plant. Majority of non-vegetarian people do not consume animal products on a daily basis in quantities sufficient to provide the recommended amount of protein. Soybeans are a rich source of good quality protein. Besides nutritional benefits soybeans provide several therapeutic benefits too. Soybean is one of the very few plants that provide high quality protein. Soybeans contain all the major macronutrients required for good nutrition, as well as fiber, vitamins, minerals. Soybean protein provides all the essential amino acids in the amounts needed for human health. Soybean meal is the supplemental protein source most widely used in animal feeds. Soybean meal is an excellent source of protein, because nearly 480 g/kg of the Dry Matter (DM) is protein and the protein quality is high [1]. Soybeans have almost 40% protein, making soybeans higher in protein than any other legumes and many animal products. The quality of soy protein is virtually equivalent in quality to that of milk and egg protein. The composition of soybean seed not only affects the soymilk and soy paneer quality but also its yield [2]. Unlike many other good sources of protein, soybean not only has higher percentage of oil but also quality fatty acid profile. It has low saturated fat content with high amount of essential fatty acids. Soybean oil obtained from the soybean is also a good source of omega-3 and 6 fatty acids similar to those found in fish oils and are cholesterol-free. Soybeans are an excellent source of dietary fiber with both soluble and insoluble fiber.

Soymilk is a creamy, milk-like product made by soaking and grinding soybeans in water. However the water absorption of soybeans in soaking is directly related to the changes in textural characteristics and grinding properties of soybeans for processing [3]. Soybean or soymilk has always been a rich source of protein which is inexpensive [4] and abundantly available. Soymilk is used in various food products such as tofu, fruit flavored puddings, calcium and protein rich soymilk. Soy milk (also called soymilk, soybean milk) and sometimes referred to as soy drink/beverage is a beverage made from soybeans. A stable emulsion of oil, water, and protein, it is produced by soaking dry soybeans and grinding them with water. Soy milk contains about the same proportion of protein as cow's milk: around 3.5%; also 2% fat, 2.9% carbohydrate, and 0.5% ash besides being rich in protein, vitamins and minerals. Soy milk is an intermediate product in the manufacture of soy paneer. It is often used in confections, meat fillers, beverages, and as part of infant formulas for children allergic to dairy milk [5]. Soymilk is very economical, lactose free, highly digestible and nutritious alternative of dairy and meat centered diet. It is cholesterol free product, has a very low fat content and is rich in polyunsaturated fatty acids of phospholipids. Generally soymilk contains around 7-8% TSS in it. Adding 3-4% sugar and about 0.05% salt brings it to a sugar, salt and total solid level approximately identical to toned (2% fat) cow's milk, i.e. about 12-13% TSS. It can be made into yogurt (curd) or tofu (paneer) or used directly in cooking. In addition to that blends of the soymilk with cow/buffalo milk have been successfully tried for the preparation of different varieties of soy paneer. Soymilk contains some anti-nutritional constituents also. Soymilk is good source of calcium and helps to avoid osteoporosis. Soluble fiber in soymilk controls blood sugar. It is good for pregnant women and lactating mothers. Soymilk reduces menopausal symptoms and bone deformities. Soya foods contain calcium, magnesium and phosphorus, which help to strengthen teeth and prevent nerve disorder. Soybean consumption on regular basis delays the ageing process.

Soy paneer is known for its extraordinary nutritional benefits, as well as its versatility. Soy paneer is a soft cheese-like food made by curdling soya milk with a coagulant. To improve the texture and increase the yield of tofu, researchers has been engaged to find better coagulation methods, concentration of coagulants and optimum temperature of coagulation. Researchers [6] studied the effect of two different coagulants calcium sulphate and modified nigari (Japanese

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name for magnesium chloride), three stirring speeds (137, 207 and 285 rpm), and six stirring times (5, 10, 15, 20, 25 and 30 sec) on yield and textural properties of soft tofu. They found that tofu made by the highest stirring speed (285 rpm) had a lower yield, but higher brittleness force, hardness and elasticity than tofu made at 207 rpm. Other factors that affected yield of tofu were whole soybean (higher yield) versus soybean flakes [7], heating method where steam injected cooker system had higher yield as compared to steam jacketed kettle system [8]. Soy is easily digestible from of protein, and is the only complete protein food source in the plant Kingdom. Other health benefits of soy include calcium, iron, B vitamins and naturally occurring phyto-estrogens. The effect of soybean storage affects the textural properties of the soy paneer developed from it [9]. Soy paneer is usually packaged in water and should be refrigerated and kept in water until used. Soy paneer can be frozen for up to three months. It is dense and can be cubed and stir-fried, grilled, scrambled, pickled, smoked, baked, barbecued or served in soups. Different yogurt-like products were prepared from the combination of skim milk and soymilk [10]. The present study was selected to develop Soy paneer from soymilk and blend of soymilk and skimmed milk and to evaluate the sensory and physico-chemical properties of the product.

Materials and Methods

Soybean seeds of the variety "Pooja" were procured from the local market. The coagulant used in the experiment was citric acid.

Preparation of soymilk

Soy bean seeds were soaked in water (1:3 w/v) for 14-16 hrs. The soaked water was decanted and the seeds were washed with fresh water. Hundred grams of soaked soybean seeds per litre of water was used for grinding i.e. 1:10 (w/v). The resulting suspension was filtered through a double layered muslin cloth. The muslin cloth was wrapped around the bean pulp, okara and squeezed till all the liquid was extracted. The filtrate obtained was boiled in water bath at 80°C. The soymilk was then cooled and refrigerated for 3 days [11]. The flow chart for the preparation of soymilk is shown in the Figure 1.

Preparation of soy paneer

Soy paneer is one of the most popular soy-products and is prepared by coagulating soymilk. Soypaneer has been reported as low-calorie food and is rich source of iron, calcium, low in saturated fat and as a source of isoflavones which can mimic human estrogens and can have beneficial effects on human health [12]. Soy paneer was prepared in the laboratory at Department of Food Technology, University of Kashmir (India) using 1L of soymilk for each experimental trial. A solution of 1.5% citric acid was used to coagulate soymilk. Soymilk samples were heated to coagulation temperatures of 80°C. The coagulant was added into soymilk slowly with gentle and continuous stirring. After complete coagulation, stirring was stopped and contents were left undisturbed at room temperature of 30^0C for 15 min. Whey was then removed by straining through a muslin cloth. The coagulum (soy paneer) obtained was pressed. It was removed and soaked in cold water for 30 min [11]. Then it was taken out and the free water on the surface was removed by wrapping paneer blocks on a clean muslin cloth. The method adopted in the preparation of soy paneer is shown in Figure 2. The soy paneer yield was expressed as kg soy paneer per kg of raw dry beans [13]. Tofu-making procedures generally include soaking and grinding of soybeans in water, filtering, boiling and coagulation of soymilk, and molding and pressing of bean curds. Tofu is usually sold in the form of a wet cake with a creamy white color, smooth texture, and bland taste [14].

Physico chemical analysis

Determination of acidity: Acidity in soymilk was determined by using the procedure described in Handbook of analysis and quality control for fruit and vegetable products (second edition) by Rangana, [15]. However for soy paneer, dilute it with water before titration in the ratio of 1:1.

Determination of total soluble solids (TSS): Total soluble solids (TSS) of soymilk as well as soy paneer were determined by using a hand refractometer or Abbey's refractometer and readings were expressed as Brix.

Determination of specific gravity: Specific gravity of soymilk was calculated by using Lactometer. The soymilk sample was filled in a 100 ml cylinder. Lactometer was introduced into the cylinder Readings were taken at which the soymilk touches the stem of the lactometer. Specific gravity was calculated using the formula as:

$$Specific\ Gravity = \frac{CLR}{1000} + 1$$

Where,

CLR is correct Lactometer reading.

Determination of ash: Ash percentages of soymilk and soy paneer samples were determined by using the procedure as described in Handbook of analysis and quality control for fruit and vegetable products (second edition) by Rangana [15].

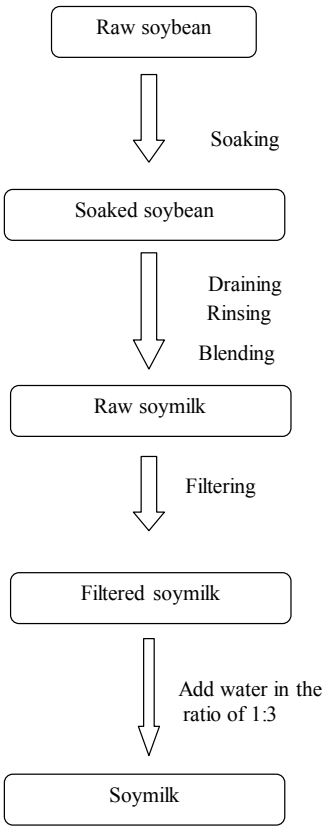

Figure 1: Flow chart for the Preparation of soymilk.

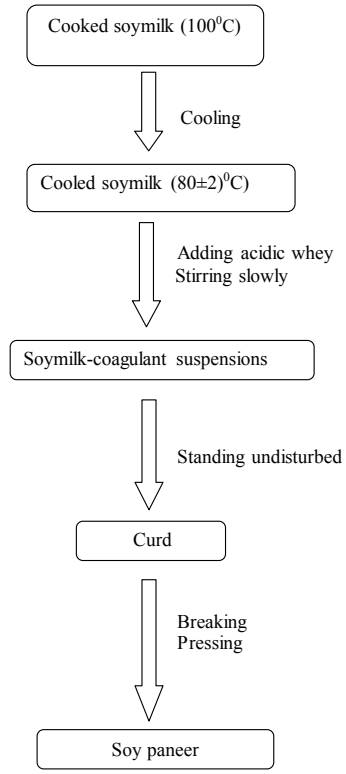

Figure 2: Flow Chart for the preparation of Soy paneer.

Determination of moisture: The moisture content was determined as per the procedure given in manual in dairy chemistry, I.C.A.R.

Determination of fat: Fat percentage was determined by Gerber method as per adopting the procedure as laid down in manual in dairy chemistry I.C.A.R.

Determination of protein: The protein content was determined by kjeldahl method described in AOAC [16].

Sensory evaluation of soy paneer samples: Sensory evaluation of the soy paneer prepared from different samples was done by using nine-point hedonic [17].

Statistical analysis: All treatments were evaluated in triplicate. Data were analyzed using the basic statistics and mean, median and range were calculated and differences among treatment means were evaluated by ANOVA (analysis of variance). Statistical significance was established at $p < 0.05$. Correlation coefficients were calculated using Pearson's technique for all parameters involved [18].

Results and Discussion

The results obtained for soymilk and soy paneer samples are discussed as:

Fat percentage

The average value of fat in soymilk sample A was found to be 1.80 %. The sample B & sample C of soymilk have average fat percentage of 1.9 and 2.55 respectively as shown in Table 1.

The average fat percentage in soy paneer sample A was 1.85 %. The sample B & sample C of soy paneer have average fat percentage values of 1.700 % and 2.55 % respectively as shown in Table 2. A statistically significant difference was observed in fat percentage of three samples of soymilk and soy paneer. The results obtained were in accordance with the work done by Jain and Mittal [19].

Protein percentage

The sample A of soymilk consists of 8.0 % proteins on average. The sample B & sample C of soy paneer have an average protein of 8.7 % and 9.6 % respectively as shown in Table 1.

The average protein percentage in soy paneer sample A was 7.6 %. The sample B & sample C of soy paneer have average protein percentage values of 8.8 % and 9.6 % respectively as shown in Table 2. A statistically significant difference was observed in protein content of three samples of soymilk and soy paneer.

Moisture percentage

The average moisture percentage in soymilk sample A was found to be 88.35. The sample B & sample C of soymilk have an average moisture percentage of 82.94 and 80.55 respectively as shown in Table 1.

The sample A of soy paneer was found to have 88.68 moisture percentages. The sample B & sample C of soy paneer have moisture percentage values of 85.32 and 82.65 respectively as shown in Table 2. There was a non-significant difference in moisture content in three samples.

Titrable acidity

The average value of acidity in soymilk sample A was calculated as 0.63 %. The sample B & sample C of soymilk have acidity of 0.65 % and 0.74 % respectively as shown in Table 1.

The sample A of soy paneer consists of 0.57 % acidity. The sample B & sample C of soy paneer have acidity values of 0.62 % and 0.70 % respectively as shown in Table 2. There was a no significant difference in acidity in three samples of soymilk and soy paneer. The ratio of soy milk and skim milk had no significant effect on titrable acidity. It is in accordance with the work done by.

Specific gravity

The specific gravity of soymilk sample A was found to be 0.98. The soymilk sample B & sample C has mean specific gravity values of 1.0 and 1.03 respectively as shown in Table 1. A significant difference was observed in specific gravity of the three samples.

Sample	Fat %	Protein %	Moisture content	Acidity	Sp. Gravity	Ash %	Lactose %	T.S.S
A	1.85	8	88.35	0.63	0.98	1.8	0	7
B	1.9	8.7	82.94	0.65	1.9	0.38	4.5	7.3
C	2.55	9.6	80.55	0.74	2.35	0.47	5	8

Table 1: Chemical composition of soymilk samples.

Sample	Fat %	Protein %	Moisture %	Lactose %	Acidity	Ash %
A	1.85	7.6	88.68	0	0.57	1.87
B	1.7	8.8	85.32	3.8	0.62	0.38
C	2.55	9.6	82.65	4.7	0.7	0.47
Mean ± S.E	2.04 ± 0.40	8.66 ± 0.59	74.76 ± 2.11	2.55 ± 1.44	0.63 ± 0.04	0.38 ± 0.07

Table 2: Chemical composition of soy paneer samples.

Ash percentage

The average ash percentage in soymilk sample A was calculated as 1.80. The sample B & sample C of soymilk have ash percentage of 1.96 and 2.35 respectively as shown in Table 1.

The sample A of soy paneer has ash content of 1.87 %. The soy paneer sample B & sample C have ash content values of 0.38 % and 0.47 % respectively as shown in Table 2. A statistically significant difference was observed in ash content of soymilk and soy paneer samples. Similar findings are reported by Krishna [20].

Lactose percentage

The average lactose percentage in soymilk sample A was calculated as 0. The soymilk sample B & sample C has average lactose of 4.5 % and 5.0 % respectively as shown in Table 1.

The sample A of soy paneer was found to have Zero lactose percentage. The sample B & sample C of soy paneer have lactose content values of 3.80 % and 4.70 % respectively as shown in Table 2. There was a significant difference in lactose percentage in soymilk and soy paneer samples.

Total soluble solids

The average value of TSS in soymilk sample A was calculated as 7.0. The sample B & sample C of soymilk have average TSS value of 7.3 % and 8.0 % respectively as shown in Table 1. A non-significant difference was observed in TSS in three samples.

The differences between my data and findings of Park [21] can be explained by the factors such as differences in experimental parameters and natural qualitative and quantitative variability in the raw material. The yield and quality of soy paneer is affected by soybean and soy milk characteristics and is not affected by the size of soybeans [22].

Sensory evaluation of soy paneer samples

Sensory evaluation of the soy paneer prepared from different samples was done by using nine-point hedonic [17]. The various attributes for which the sample was calculated were colour, flavor, taste, texture and overall acceptability as shown in Table 3 and Figure 3.

Samples	Colour	Flavour	Taste	Texture	Overall acceptability
A	7.4	7.2	7.8	6.4	7.2
B	7.4	6.8	7.7	6.8	7.1
C	7.8	8	8.2	6.6	7.65

Table 3: Average score for sensory evaluation of soy paneer samples.

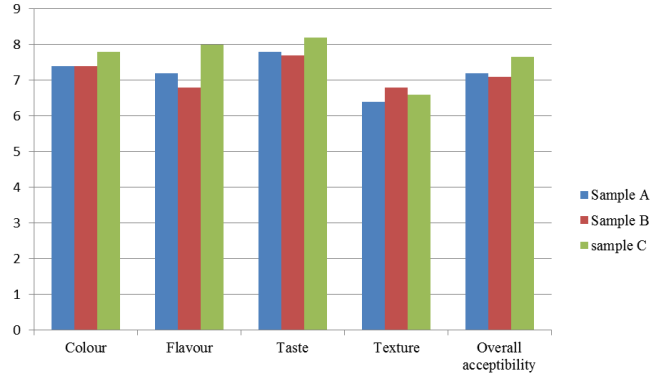

Figure 3: Representation of various sensory parameters of soy paneer in different samples.

The average score for Overall acceptability of the samples A, B and C was calculated as 7.2, 7.1 and 7.65 respectively. It was found that sample C (75% soymilk and 25% skimmed by Umunnakwe and Iwuoha [23] on soymilk.

Conclusion

It was concluded that the sample C with 75 % soymilk and 25 % skimmed milk was superior in quality with respect to its physical and chemical parameters. The sample C with 75 % soymilk and 25 % skimmed milk can be utilized for the production of soy paneer with higher consumer acceptability. The product can retain its quality attributes especially the colour and flavor during refrigeration storage. This study may help soy paneer manufacturers in India and other countries to control their overall quality. Soy paneer is the richest source of protein for vegetarian people in India. Increasing yield of soy paneer and providing a better texture will make it available for more and more people with increasing preference.

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