Development and Characterization of Soymilk Yogurt: Physiochemical, Nutritional and Aflatoxin Detection

Mudasir Ahmad Mir[1], and *Manika* Mehra[1]

[1]Department of Food Technology, NIAMST, Nims University Rajasthan, Dr BS Tomar City, Jaipur-Delhi Highway, Jaipur- 303121, Rajasthan, India

Abstract. Soy milk is an alternative to cow milk, providing protein in similar amounts. It is considered low in cholesterol and helps strengthen bones, prevent heart disease, and reduce the risk of certain cancers. In this study, we aimed to partially replace cow milk with soy milk to formulate soy yoghurt. Three formulations were prepared by mixing cow milk with soy milk in the following ratios: 70:30% (v/v), 60:40% (v/v), and 50:50% (v/v), labelled as C1, C2, and C3, respectively, with a control sample (C0). These samples were compared for various chemical properties, including moisture, protein, fat, total soluble solids (TSS), calorific value, mineral content, calcium, sodium, and potassium. Sensory evaluation was conducted using the 9-point Hedonic scale. Results showed that the soy yoghurt (C3) made with 50% cow milk and 50% soy milk was the most acceptable in terms of sensory attributes compared to the control. All samples tested were free of aflatoxin. However, the fat content and calorific value per 100 grams were 50% and 60% lower, respectively, compared to the control soy yoghurt, while calcium and potassium content increased by 14% and 50%, respectively. Thus, the C3 soy yoghurt is a low-calorie dairy product with improved mineral content.

1 Introduction

Because of its composition, soy milk is the best alternative to cow's milk and may be classified as a healthy diet. Soy milk, sometimes referred to as soy drink or soy beverage, is a white suspension that resembles cow's milk in composition. [1]. The [2]. Over the last few decades, soymilk has been used in developing food for infants suffering from various malnutrition diseases. In addition to being a great source of protein and minerals, soybeans can be used therapeutically to prevent chronic conditions like osteoporosis, cancer, atherosclerosis, and menopausal problems [3]. Dry soybeans (Glycine max) typically include 40% proteins, 20% oil, 20% carbs, and 5% ash [4].

Soy protein is 100% digestible by the body [5]. For some dairy milk consumers who suffer from lactose intolerance, soymilk is the ideal option because it is lactose-deficient, particularly for newborns. It promotes growth in kids who are allergic to cow's milk. [6]. In addition, soybeans (Glycine max) are known to contain anti-nutritional and flatus factors as well as disagreeable taste, cooking difficulties and beany flavour. The unwanted beany flavour of soymilk can be eliminated by cooking in an aqueous sodium bicarbonate solution at a temperature of about 80°C, followed by the extraction of protein and other water-soluble components [7]. The composition of the soymilk, which is made from soy beans, differs depending on the type of bean and how it is cooked [8]. Depending on the area, different processing methods are used. The most often used method is the Traditional Oriental method, which makes soymilk by soaking soybeans overnight, crushing them wet, and sifting them. Johnson and Snyder proposed two further techniques known as the Illinois and Cornell approaches. [9].

2. Materials and Methodology

Soybean was collected from the local market of Jaipur, and cow milk (mother dairy milk) was collected from the local milk cooperative society of Jaipur city.

Method for preparing soymilk: After cleaning the soybeans to get rid of any stones, they were steeped in water (1:3) containing 0.3% sodium bicarbonate (NaHCO3) for five to eight hours. filtered, dehulled, and chilled [10] at boiling for 30 minutes while stirring continuously. The food's nutritional value was examined.

2.1 Preparation of Soy Yoghurt

Cow’s milk and soy milk were blended in various proportions and then pasteurized, inoculated with starter culture, incubated and refrigerated to prepare soy yoghurt. All of the preparation was done in a laboratory with hygienic conditions. Method of Preparation Cleaned and soaked soybeans were used for the preparation of soy milk using the standard method (Fig 1). The cow milk and soy milk were mixed in the formulation ratios. Sugar was uniformly added as an

ingredient to enhance flavour and acceptability. The mixture was pasteurised and had its texture improved by heating it at 85-90°C for 15-20 minutes. The mixture was cooled down to about 42-45°C. Starter culture of Streptococcus thermophilus and Lactobacillus bulgaricus was applied at the level of 2-3%. Inoculated mixture was poured into sterile container and incubated for 6-8 hrs at 42°C till coagulation and desired acidity was obtained. The soy yoghurt was prepared and kept at 4°C until it was used for analysis and sensory evaluation (Table 1).

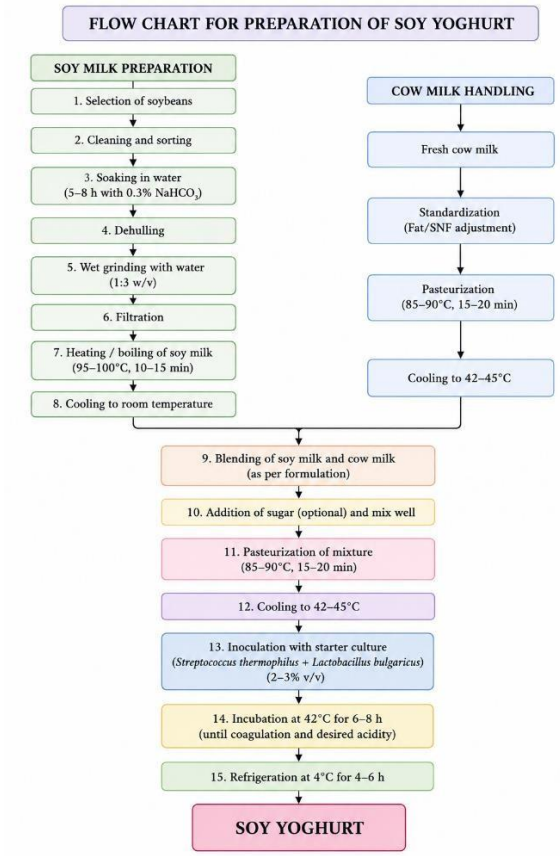

Fig. 1. Flow chart for preparation of soy yoghurt

2.2 Analysis of nutritional content

The protein content in the Milk was estimated as per the standard method [11]. Bomb calorimeter is used to estimate the energy of the given samples. The mineral content was estimated by using the Flame photometer, and the detection of Aflatoxin was carried out by using HPLC [12].

2.3 Sensory Evaluation

Ten semi-trained panelists evaluated the soy yoghurt's sensory qualities using a 9-point hedonic scale. The samples' general acceptability, colour, texture, flavor, and taste were assessed. On the sample, each panelist rates their likes and dislikes on a scale of 9 (very like) to 1 (extremely detest).

3. Results and Discussions

Table 1. Soy yogurt was prepared using Bhattarai's recipe.[13].

Sample/Raw material	Control	Soy yoghurt (C1)	Soy yoghurt (C2)	Soy yoghurt (C3)
Cow milk	100%	70%	60%	50%
Soy milk	---------	30%	40%	50%
Starter culture (1:1) S.thermophilus L. bulgaricus	3%	3%	3%	3%
Acid coagulation	4%	4%	4%	4%
Salting (g/100)	5g/100	5g/100	5g/100	5g/100

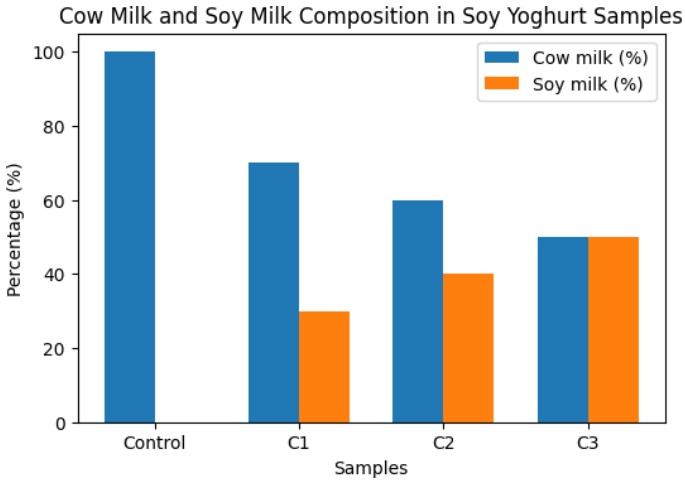

Fig. 2. Cow Milk and Soymilk Composition in Soy Yoghurt Samples

3.1 Sensory Evaluation of Soy yoghurt

When we compare the C3 sample with other soy yoghurts, the sample C3 has good taste, as shown in Figure 3 from the sensory evaluation of the soy soy yoghurt. As the concentration of soy milk was decreased the soy yoghurt had the highest sensory score and had a slightly improved flavor. The colour scores of C3 soy yoghurt were much better compared to other soy yoghurts and also the control soy yoghurt. The texture of C3 soy yoghurt was superior to that of the other soy yoghurts. Reducing the amount of soy milk in C1 soy

yoghurt had an impact on the flavor. The soy yogurt with the highest flavor score is C3.

3.2 Proximate analysis

When we go for the proximate analysis of the soy yoghurt formulations, the result shows that the pH of C3 soy yoghurt decreases from 4.57 to 4.3 when compared to the controlled soy yoghurt (Fig 2). This is because of the ripening and storage process after making soy yoghurt [14]. They made their soft-ripened soy yoghurt by incorporating bambaranut milk. In this study it was found that the pH of the yoghurt samples falls in the range of 5.8-6.1. The moisture content of C3 soy yoghurt increased (62.26%) compared to the control soy yoghurt (45.36%). The ash content of C3 soy yoghurt is decreased (3.54%) compared to the control soy yoghurt (4.18%). The amount of carbohydrates in C3 soy yoghurt has gone down. (7.32%) as compared to the control soy yoghurt (27.30%). C3 soy yogurt has a higher protein content (20.50%) than control soy yogurt (20.10%). It can be because soybeans have a high protein content and high protein consumption, which results in higher protein intake. C3's fat composition soy yoghurt decreased (5.83%) compared to the control soy yoghurt (16.49%) (Fig 4). The increase in the proportion of soy milk could be the explanation; cow milk determines the fat content. The outcome presented by [15] is comparable. They used soy and coconut milk to make soy yoghurt. When compared to the control soy yogurt, the fat level of soy-coconut soy yoghurt (50:50) is higher by 9.8%.

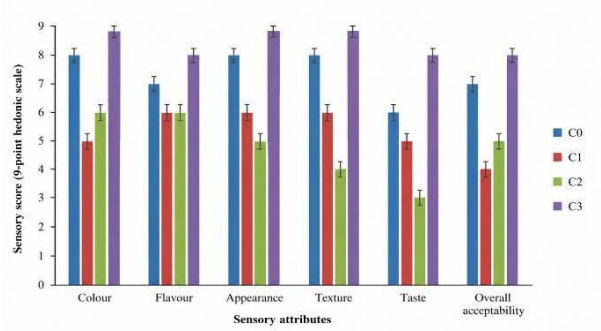

Fig. 3. Sensory evaluation of yoghurt samples

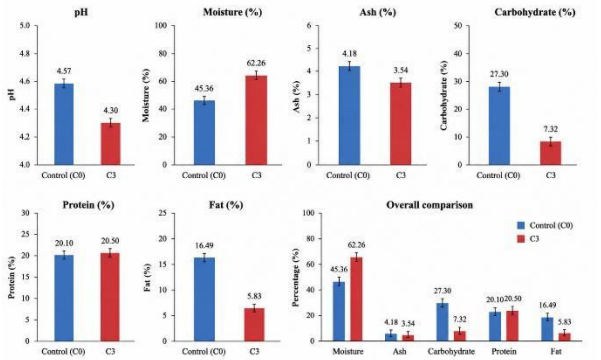

Fig. 4. Proximate analysis of control soy yoghurt

From Figure 5, the calcium content of C3 soy yoghurt increased to 570.30 mg per 100 g compared to the control soy yoghurt, which had 235.6 mg per 100 g. The potassium content of C3 soy yoghurt rose to 673.2 mg per 100 g, while the control soy yoghurt contained 1236.2 mg per 100 g. The energy value of C3 soy yoghurt is lower at 140 kcal per 100 g compared to the control soy yoghurt, which has 283.83 kcal per 100 g. This may be due to the lower amounts of fat and carbohydrate.

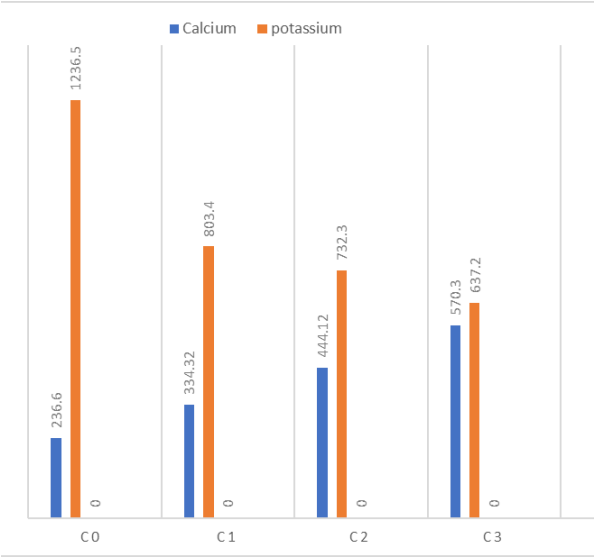

Fig. 5. Calcium Content of the Soy Yoghurt Samples

3.3 Detection of Aflatoxin in Soy yoghurt

In the figures (6a-6d), HPLC chromatograms of standard and soy yogurt samples are shown. These graphs display the typical peaks of Aflatoxin G1, B1, G2, and B2. Figure 6 depicts the HPLC chromatogram for the standard peaks of Aflatoxin G1, B1, G2, and B2, detected at retention times of 6.627, 7.781, 11.738, and 15.151 minutes. Figures (6a) to (6d) illustrate the HPLC chromatogram of soy yogurt C1, C2, and C3. Absorbance occurs at retention times of 2.3500, 2.5667, 3.000, 3.6500, 4.5500, 4.9567, 7.333, 11.1167, and 12.6500, and 15.151 minutes. The chromatograms for soy yogurt C1, C2, and C3 indicate that no retention time or peak matches the retention times of Aflatoxins shown in the figure. The level of Aflatoxin in this product was below the maximum limit set by the European Union (2 ng/g) and the U.S. Food and Drug Administration (20 ng/g). Therefore, the results indicate that Aflatoxins G1, G2, B1, and B2 were absent in soy yogurt samples C1, C2, and C3, confirming it is safe to substitute soy milk for cow milk in soy yogurt.

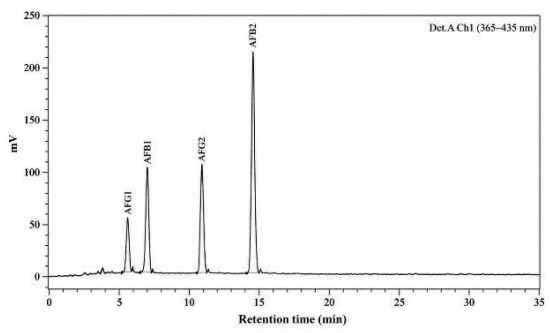

Fig. 6a

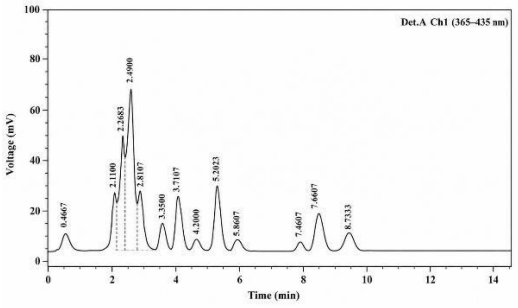

Fig. 6b

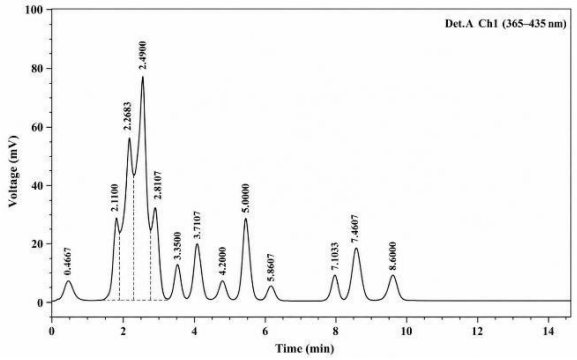

Fig. 6c

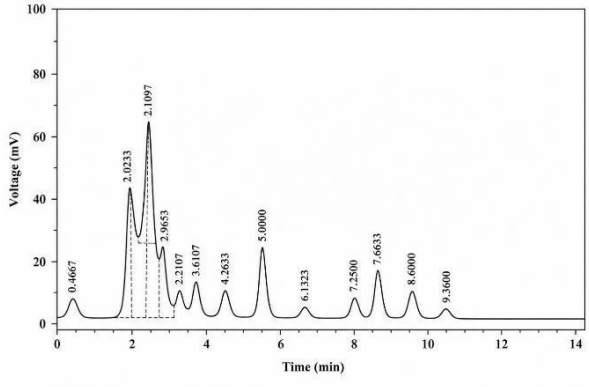

Fig. 6d

Fig. 6. Detection of Aflatoxin in Soy yoghurt

4. Conclusions

This study shows that the sensory acceptable soy yoghurt C3 can be made from 50% soy milk and 50% cow milk. The soy yoghurt has an energy value of 142 kcal per 100g, with 5.40% fat, 14% calcium, and 44% potassium. These values are lower than those of cow milk soy yoghurt. We can conclude that this soy yoghurt may be seen as a functional food. It provides better minerals and nutrients than regular soy yoghurt and is suitable for low-fat diets. Aflatoxin B1, B2, G1, and G2 were not found in the soy yoghurt, indicating that it is a safe food product.

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