



## Development of Non-Dairy Cream Cheese Using Soy Milk & Cocoa Powder for Lactose Intolerant Population

Shruti Sakpal<sup>1</sup>, Renu Jaisinghani<sup>2</sup>

<sup>1</sup>Department of Foods, Nutrition and Dietetics, College of Home Science, Nirmala Niketan, 49, New Marine Lines, Mumbai, Maharashtra 400020, India.

<sup>2</sup>Department of Microbiology, Smt. Chandibai Himathmal Mansukhani College, Railway Station Road, Ulhasnagar, Maharashtra, 421003, India

Email: [shrutisakpal441@gmail.com](mailto:shrutisakpal441@gmail.com)

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### ABSTRACT

The increasing demand for vegan and non-dairy products has driven the development of alternatives to traditional cream cheese, with soy cream cheese emerging as a promising solution. Therefore this study aimed to develop soy cocoa cream cheese using soy milk, coconut milk, cocoa powder, lemon juice, sucralose, and oil to achieve the desired texture. The formulation underwent several trials to optimize taste, texture, consistency, nutritional composition, microbial safety, sensory attributes, and shelf life. Nutritional analysis revealed high protein content (13g per 100g), low carbohydrate (7.6g per 100g), and moderate fat (32.9g per 100g), making it an appealing option for health-conscious consumers. Microbial analysis demonstrated that vacuum-packed products exhibited lower yeast and mold growth, indicating enhanced preservation and prolonged shelf life. Sensory analysis showed favorable ratings for appearance, aroma, color, taste, texture, and mouthfeel, with an overall acceptability rating of 6 out of 7. In conclusion, soy cocoa cream cheese offers a nutritious, non-dairy alternative with potential benefits for health-conscious consumers, highlighting its suitability for vegan diets and the growing demand for non-dairy products.

**Keywords:** Microbial safety, Non-dairy, Nutritional analysis, Sensory evaluation, Shelf life, Soy cocoa cream cheese, Vegan.

### 1. INTRODUCTION

Non-dairy cream cheese is made from various plant sources such as soy, almond, cashew and other. The rise in consumers that prefer vegan and non-dairy products has led to the increased demand for non-dairy products [39]. Non-dairy cream cheese is also available in various flavours to cater to the varying preferences among consumers [4]. Cream cheese, a versatile and popular dairy product, has been a staple in many cuisines, especially in the Western world. It is commonly used as a spread on bagels, an ingredient in various desserts, and a base for savoury dips [39]. However, the traditional dairy-based cream cheese poses a challenge for lactose intolerant individuals, leading to a growing demand for non-dairy alternatives that can replicate its creamy texture and rich flavour profile [11]. Soy milk, Almond milk, Coconut milk, Oat milk, Rice milk, Cashew milk, Quinoa milk, etc. can be used to make non-dairy products [4].

Soy cream cheese emerged as a promising solution in this context, harnessing the nutritional benefits of soy while maintaining the sensory qualities of conventional cream cheese [4]. The choice of soybeans as the main ingredient in non-dairy cream cheese is not arbitrary but is rooted in their nutritional composition [31]. Soybeans are rich in proteins, essential amino acids, and other nutrients, making them an ideal base for developing non-dairy alternatives [21]. Additionally, soybeans contain compounds known as phytoestrogens, which have been associated with various health benefits, including heart health and hormone balance [5].

Soy milk, derived from soybeans, has gained prominence in the food industry for its versatility and nutritional value. Soy milk is an excellent source of plant-based protein, making it a suitable alternative for individuals seeking protein-rich non-dairy options [31]. The development of soy cream cheese not only addresses the lactose intolerance issue but also aligns with the increasing trend towards plant-based diets and sustainable food choices [4]. The inclusion of cocoa powder in the formulation adds a delightful twist, enhancing the flavour profile of the cream cheese and providing a unique sensory experience for consumers [1]. The incorporation of soy into cream cheese not only caters to lactose intolerant individuals but also aligns with broader health and environmental considerations. Along with cocoa, other different types of flavour additives can also be added in the soy cream cheese [4].

Cream cheese falls under the category of 'Unripened Cheese including fresh cheese' which means cheese which is ready for consumption shortly after manufacture. 'Cream Cheese' (*Rahmfrischkase*, German term that translates to "cream cheese") means soft, unripened cheese obtained by coagulation of pasteurised milk and pasteurised cream with cultures of harmless lactic acid producing bacteria with or without the addition of suitable enzymes of non-animal origin or other suitable coagulating enzymes. It shall have a soft smooth texture with a white to light cream colour. It may contain spices, condiments, seasonings and fruit pulp as additives. Aspartame, Canthaxanthin, Caramel III - ammonia caramel, Indigotine (Indigo carmine), Lauric

arginate ethyl ester, Natamycin (Pimaricin), Riboflavins, Nisin, Propionic acid, sodium propionate, calcium propionate, etc. can also be added in cream cheese within permissible limit [13].

Lactose intolerance, a common digestive disorder affecting a significant portion of the global population, has spurred increased interest in the development of alternative food products that cater to the dietary needs of individuals who cannot comfortably consume dairy-based products [4]. This has led to innovative approaches in the culinary world, focusing on the creation of non-dairy alternatives that not only address the nutritional aspects but also replicate the sensory experience associated with traditional dairy products [11]. This also has given rise to a burgeoning market for non-dairy alternatives, designed to cater to the diverse dietary preferences and requirements of the lactose intolerant demographic [26]. This study aimed to develop non-dairy cream cheese using soy milk and cocoa powder for the lactose intolerant population.

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## 2. MATERIALS AND METHODS

### 2.1 Materials

Soybeans, coconut, lime juice, cocoa powder, sucralose, salt, vegetable oil, and vanilla essence were sourced from a quality-checked supermarket. All equipment and utensils were sanitized following Good Hygienic Practices (GHP) and Good Manufacturing Practices (GMP).

### 2.2 Formulation of the Product

Soy milk was made by soaking soybeans overnight, blending with water (1:2), separating the milk (700 ml) from solids, pasteurizing, and cooling. Coconut milk (250 ml) was prepared by washing, dehusking, grating, blending with water (1:2), filtering, pasteurizing, and cooling. The two milks were mixed, heated, and coagulated with lime juice. Curds (285 g) were blended with 5% cocoa powder, 1% sucralose, salt, 10% vegetable oil, and 1% vanilla essence, then refrigerated at 2°C - 4°C.

### 2.3 Vacuum Packaging

The finished cream cheese was vacuum-sealed in 100-micron polypropylene bags at 0.045 MPa to ensure freshness. Other half of the product was packed in a plastic container with a lid without vacuum packaging procedure.

### 2.4 Physicochemical Analysis

#### 2.4.1 Proximate Analysis

Nutritional composition, including ash, moisture, fat, protein, carbohydrates, fiber, pH, and acidity, was analyzed in triplicates following AOAC 2005 guidelines. Moisture content was assessed by drying a sample in a hot air oven at 105°C and weighing it before and after drying. Protein content was determined through the [Pelican Equipment](#) Kjeldahl instrument, involving digestion with sulfuric acid and Kjeldahl catalyst, followed by distillation and titration. Ash content was measured by igniting a sample in a Sigma Instruments muffle furnace at 550°C until all carbonaceous matter was burned off. Fat content was analyzed using the Soxhlet extraction method with petroleum ether. Crude fiber was determined by sequential extraction and digestion with sulfuric acid and sodium hydroxide, followed by incineration.

Carbohydrates were calculated by subtracting the percentages of moisture, protein, fat, ash, and crude fiber from the total weight. pH was measured in a sample solution prepared with distilled water using a Equiptronic pH meter. Finally, titratable acidity was assessed by titrating the sample with a standard sodium hydroxide solution using phenolphthalein as an indicator. Each method provided critical data on the product's nutritional and chemical properties.

#### 2.4.2 Shelf Life Analysis

Soy cocoa cream cheese was maintained at 2°C to 4°C for a period of 45 days, and regular evaluations were conducted to monitor changes in its quality. A 45-day study assessed the product for yeast, mold, coliforms, and *Staphylococcus aureus* growth, with visual inspections every 7 days at 2°C - 4°C.

#### 2.4.3 Sensory Analysis

A 7-point hedonic scale was used for sensory evaluation of appearance, aroma, color, taste, texture, mouthfeel, and overall acceptability by semi-trained panelists. Data was analyzed and presented on a radar chart.

### 3. RESULTS AND DISCUSSION

#### 3.1 Formulation of the product

The formulation of soy cocoa cream cheese was refined to aim at achieving consistent flavor, texture, and overall quality. The process involved varying proportions of soy milk, coconut milk, lime juice, unsweetened cocoa powder, sucralose, salt, vegetable oil, and vanilla essence to optimize sensory attributes such as sweetness, cocoa flavor intensity, creaminess, and spreadability. These adjustments were guided by both sensory evaluation feedback and analytical testing results to meet predefined quality standards [2]. Similar research was done by Zulkurnain M. *et al.* (2008) where various amounts of blended tofu, oil, salt, carrageenan, pectin and maltodextrin were used as additives to develop soy cream cheese products that were trans fat free, with texture properties similar to those of commercial dairy cream cheese [43]. It was found that carrageenan and salt were useful to impart the desired firmness, while maltodextrin provided body to the product. Pectin introduced viscous behaviour to the final texture but was proven useful in preventing syneresis [43].

Following successful formulation, the soy cocoa cream cheese underwent rigorous packaging procedures to ensure freshness and extend its shelf life, aligning with established industry practices. Research conducted by Ajewole *et al.* (2023) showed an increasing trend which was observed in the mineral content of all the samples as the inclusion level of cocoa powder increased, thus laying credence to the impact of cocoa addition. [2]



Figure 1: Soy cocoa cream cheese non-vacuum packed



Figure 2: Soy cocoa cream cheese vacuum packed

#### 3.2 Physicochemical analysis of soy cocoa cream cheese:

##### 3.2.1 Proximate analysis

Table 1: Proximate analysis value of Soy cocoa cream cheese

Nutrition Facts	For 100 g	For 200 g (Serving size)
Carbohydrate (g)	7.6	15.2
Dietary Fiber (g)	0	0
Protein (g)	13	26
Total Fats (g)	32.9	65.8

Ash	2	2
Moisture (%)	44.5	44.5
Titrateable Acidity	0.12	0.12
pH	5.0	5.0

As indicated in Table 1, the protein content of the product was measured at 13 g per 100 g, signifying a high protein concentration. This finding aligns with the study by Friedman *et al.* (2001), which underscores soybeans as a substantial source of protein, thereby enhancing the nutritional profile of the product.

Proximate analysis results were added into One Way Anova tool to obtain the p-value. After performing One Way ANOVA test, using F distribution df (right tailed), p value found to be 0.9989. p-value equals 0.998898, [ $p(x \leq F) = 0.00110163$ ]. It means that if we reject  $H_0$ , the chance of type1 error (rejecting a correct  $H_0$ ) would be too high: 0.9989 (99.89%).

The test statistic F equals 0.0011023, which is in the 95% region of acceptance: [0 : 3.4668]. The observed effect size f is small (0.01). That indicates that the magnitude of the difference between the averages is small. There is no significant difference between the means of any pair.

### 3.2.2 Shelf life analysis

The shelf life analysis was conducted by visually examining the product for any observable signs of yeast and mould growth over a period of 45 days, with observations made at 7-day intervals. It was observed that samples without vacuum packaging started to deteriorate after day 28 and started losing its structure. Also after the 28th day it showed growth of yeast & mould. Vacuum sealed product showed no sign of spoilage over a period of 45 days and maintains its quality. These results corroborate findings by Bruno *et al.* (2023), who demonstrated that vacuum packaging significantly extends the shelf life of similar dairy products by inhibiting microbial growth. After analysing product for yeast & mould growth for a period of 45 days it was observed that product without vacuum packaging shows signs of spoilage with yeast & mould compared to vacuum packed product. Colony count of the product was found to be less than FSSAI regulatory standards. Simultaneously, coliform and *Staphylococci* count was estimated at day 30 and 45 respectively. No colonies of coliform and *Staphylococci* were obtained on the respective media plates showing the sample is not contaminated with pathogenic bacteria and it was made under hygienic conditions.

### 3.2.3 Sensory analysis

Sensory analysis was conducted using a 7-point hedonic scale to evaluate the product's organoleptic properties with 50 semi trained panellists. The soy cocoa cream cheese received favorable ratings across various parameters such as appearance, aroma, color, taste, texture, and mouthfeel, with an overall acceptability rating of 6 out of 7. This is consistent with research by Qinghui Li *et al.* (2013), who found high sensory scores for similar soy-based cream cheese products, suggesting that our formulation aligns well with consumer preferences.

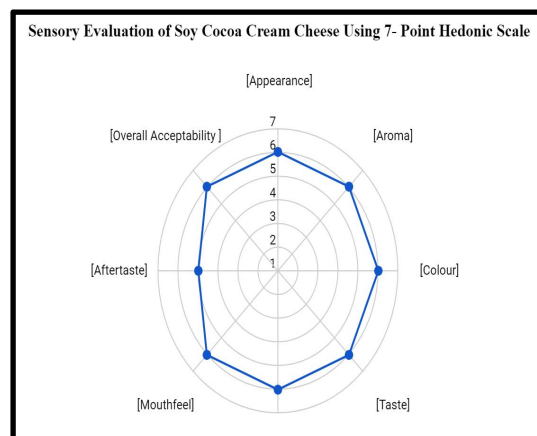


Figure 3: Radar chart of sensory evaluation test soy cocoa cream cheese

## 4. CONCLUSION

Soy cocoa cream cheese emerged as a novel product with significant health benefits, particularly as a high-protein alternative to traditional dairy cream cheeses. Its formulation, optimized through meticulous process focusing on taste, texture, and consistency, underscores its potential appeal to health-conscious consumers seeking nutritious options. Moreover, its designation as a non-dairy cream cheese makes it particularly valuable for individuals with lactose intolerance, offering them a flavorful and satisfying alternative without compromising on taste or quality.

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