Formulation and Quality Evaluation of Trimilka Pudding Incorporated with Plant-Based Milks: Coconut, Oat and Soybean

Mohite Priyadarshani Ramrao[1], Zalte Pratibha Tatya[2], Kathe Vaishnavi Sujit[3], Khatekar Shravani Mahesh[4], Sonawane Akshata Paresh[5], Wagh Rohit Suresh[6], Bodake Ishwari Ramnath[7], Dhepale Pratik Anil[8], Dhone Dipali Dilip[9], Gaikwad Sanket Tulshiram[10]

[1,2]*Assistant Professor, Department of Food Microbiology and Safety, K. K. Wagh College of Food Technology, Nashik Affiliated to MPKV Rahuri, 422003, Maharashtra, India*

[3, 4, 5,6,7,8,9,10] *Student, Department of Food Microbiology and Safety, K. K. Wagh College of Food Technology, Nashik Affiliated to MPKV Rahuri, 422003, Maharashtra, India.*

***Abstract*—The present investigation focused on the development and characterization of a "Trimilka Pudding Incorporated with Plant-Based Milks: Coconut, Oat, and Soybean" formulated from non-dairy milk alternatives, aimed at providing a functional dessert option for lactose-intolerant, vegan, and health-conscious consumers. Coconut, oat, and soybean milks were extracted and standardized, and subsequently incorporated into pudding formulation at optimized proportions (coconut milk: 49 ml; oat milk: 15 ml; Soybean milk: 10 ml; sugar: 20 g; corn flour: 6 g). Proximate composition analysis indicated moisture content (63.77%), fat (7.30%), protein (6.87%), carbohydrate (20.56%), and ash (0.30%), reflecting a nutritionally balanced profile. Sensory evaluation, carried out using a hedonic scale, identified Treatment 3 as the most acceptable in terms of flavor, texture, and overall palatability. Microbial quality assessment, including total plate count and yeast–mold enumeration, demonstrated that the product remained within acceptable microbiological limits throughout the storage period. Shelf-life studies under ambient and refrigerated conditions further suggested enhanced stability when stored in airtight containers under refrigeration. The study concludes that the standardized formulation of plant-based pudding not only meets desirable sensory and nutritional standards but also ensures microbiological safety, thereby validating its potential as a viable dairy-free functional food product.**

***Index Terms*—Non-Dairy Milk, Plant-Based Pudding, Nutritional Evaluation, Sensory Evaluation, Microbial Quality, Shelf-Life Stability.**

1. INTRODUCTION

Significant research in food product development over the last ten years has concentrated on developing innovative, health-conscious substitutes to meet changing consumer demands. The creation of milk substitutes is a crucial area of functional interest since it helps address problems with lactose intolerance, cow's milk allergy, calorie concerns, and the incidence of hypercholesterolemia (Valencia-Flores et al., 2013). Ethnic background affects the prevalence of lactose intolerance (Lomer et al., 2008). Coconut milk is one of the most significant plant-based milk substitutes in Southeast Asian cooking, where it is used as a beverage and as a component of numerous savory and sweet meals (Seow & Gwee, 1997).

Because of its great nutritional content and adaptability, soybeans are regarded as one of the most significant agricultural crops in the world. Today, soybeans are used to make a variety of human foods and drinks, such as soymilk, tofu, and ice cream. Worldwide, soybeans are regarded as a valuable source of edible oil and a dietary supplement due to their high protein and oil content. An important source of monounsaturated and polyunsaturated fatty acids that are good for the heart

is soymilk, a creamy extract of whole soybeans (Afroz et al., 2016).

Similar to this, oat milk, which is made from whole-grain oats, is naturally lactose-free and packed with minerals and phytochemicals that are bioactive. Food processing innovations and the creation of milk substitutes have greatly increased the production of plant-based milks, including cereal-based milk substitutes, increasing the variety of dairy-free and functional options that consumers may choose from (Yu et al., 2023).

2. MATERIALS AND METHODS

This section describes the raw materials, equipment, chemicals, glassware, packaging material, and methodologies used for the preparation and analysis of "Trimilka Pudding Incorporated with Plant-Based Milks: Coconut, Oat, and Soybean"

2.1 Materials

2.1.1 Raw Materials

Fresh mature coconuts, whole soybeans, rolled oats, refined sugar, and corn flour were procured from the local market. All raw materials were cleaned and sorted prior to use.

2.1.2 Chemicals and Glassware

Analytical-grade chemicals were used for microbiological and chemical analysis. Standard laboratory glassware was employed for sample preparation and analysis.

2.1.3 Equipment

The major equipment used included a laboratory blender, bench-top pasteurizer, water bath, muslin cloth, precision weighing balance (±0.001 g), and refrigerator (4 ± 1 °C).

2.1.4 Packaging Material

Low-density polyethylene (LDPE) pouches (70 µm thickness, food-grade) were used for the storage and packaging of "Trimilka Pudding Incorporated with Plant-Based Milks: Coconut, Oat, and Soybean"

2.2 Production of Plant-Based Milk

The plant-based milks (coconut, soybean, and oat) were extracted following standardized protocols with slight modifications to ensure microbial safety and nutritional retention.

2.2.1 Extraction of Coconut Milk

- The coconut was dehusked, cracked, and the endosperm (white flesh) was manually separated.
- The coconut flesh was chopped into uniform pieces and blanched at 95 °C for 3 min, followed by immediate cooling in water at 25 °C for 5 min.
- The blanched pieces were blended with potable water in a 1:1 ratio (w/v), and the slurry was filtered through a muslin cloth.
- The extraction was repeated to maximize yield.
- The filtrate was pasteurized at 75 °C for 5 min and stored at 4 °C until use.

2.2.2 Extraction of Soybean Milk

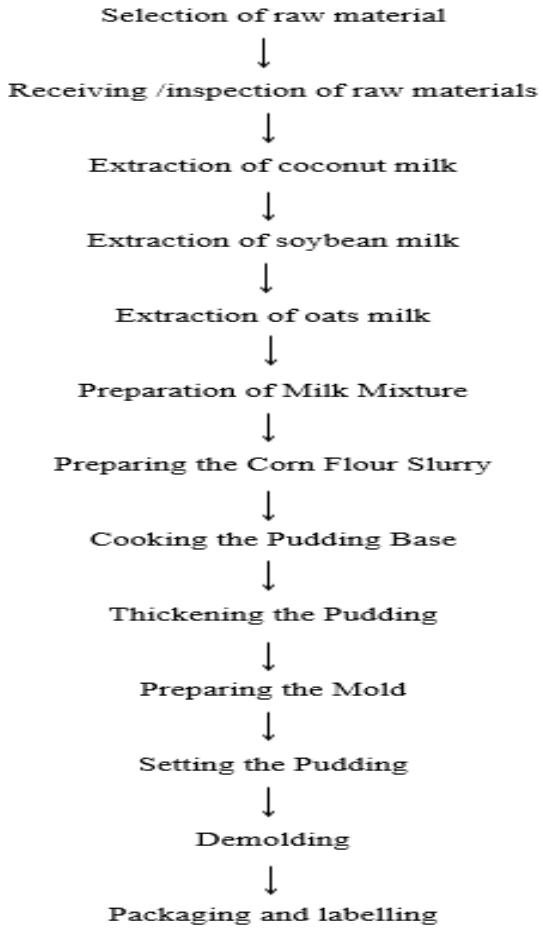
- Soybeans were soaked in potable water for 8–12 h at ambient temperature (25–30 °C).
- The seed coats were removed manually after soaking.
- The dehulled soybeans were blended with potable water in a 1:4 ratio (w/v), and the slurry was filtered through muslin cloth.
- The filtrate was pasteurized at 91 °C for 1 min, cooled rapidly to room temperature (25 ± 2 °C), and stored at 4 °C until further use.

2.2.3 Extraction of Oat Milk

- Rolled oats were washed thoroughly with potable water and drained.
- The cleaned oats were blended with potable water in a 1:4 ratio (w/v).
- The mixture was filtered through muslin cloth to obtain oat milk.
- The milk was stored at 4 °C prior to formulation.

2.3 Procedure of "Trimilka Pudding Incorporated with Plant-Based Milks: Coconut, Oat, and Soybean"

2.3.1 Process Flowchart



Flowchart: Preparation of "Trimilka Pudding Incorporated with Plant-Based Milks: Coconut, Oat, and Soybean"
Chaiyasit Punfujinda et al., (2024)

2.3.2 Process Explanation

Coconut milk, oat milk, and soybean milk were mixed in a pre-sterilized stainless-steel container. Refined sugar was added and vigorously blended until fully dissolved. Corn flour was mixed in a little amount of coconut milk to create homogenous slurry, reducing lump formation while heating. To achieve homogeneous thickening, the milk mixture was progressively heated to boiling while being stirred constantly. The corn flour slurry was then slowly incorporated. The resulting pudding mixture was constantly agitated until it reached the desired consistency.

The heated mixture was then cooled to room temperature (25 ± 2 °C) in lightly greased food-grade molds. The samples were then kept in the refrigerator at 4 ± 1 °C until they completely gelled. Following the setting process, the puddings were meticulously demolded, placed in sterile LDPE bags, suitably labeled with product information, and refrigerated (4 ± 1 °C) until additional examination.

Table: Formulation of "Trimilka Pudding Incorporated with Plant-Based Milks: Coconut, Oat, and Soybean"

Sr.No	Ingredient	T_1	T_2	T_3
1	Coconut milk	38ml	55ml	49ml
2	Soybean milk	-	20ml	10ml
3	Oats milk	50ml	-	15ml
4	Sugar	10gm	15gm	20gm
5	Corn flour	2gm	10gm	6gm

*Each value represents the average of three determinations.

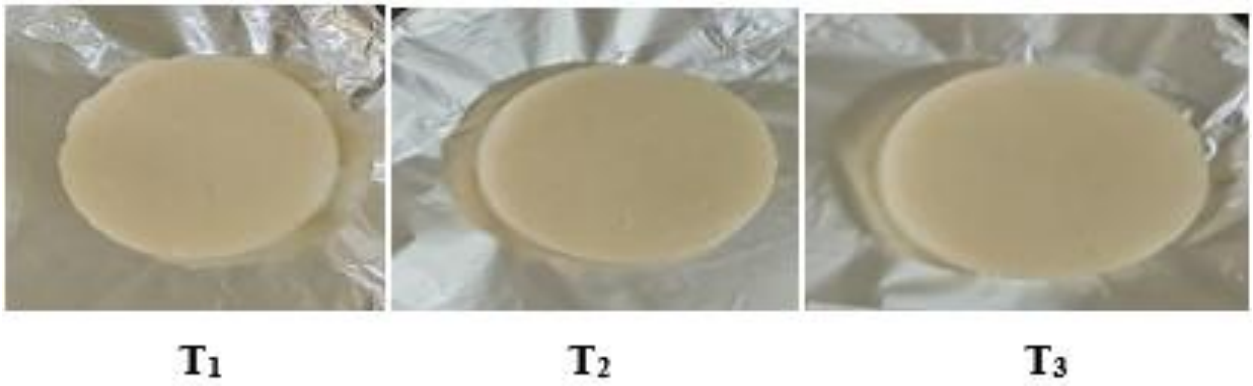


Fig : Formulation of "Trimilka Pudding Incorporated with Plant-Based Milks: Coconut, Oat, and Soybean"

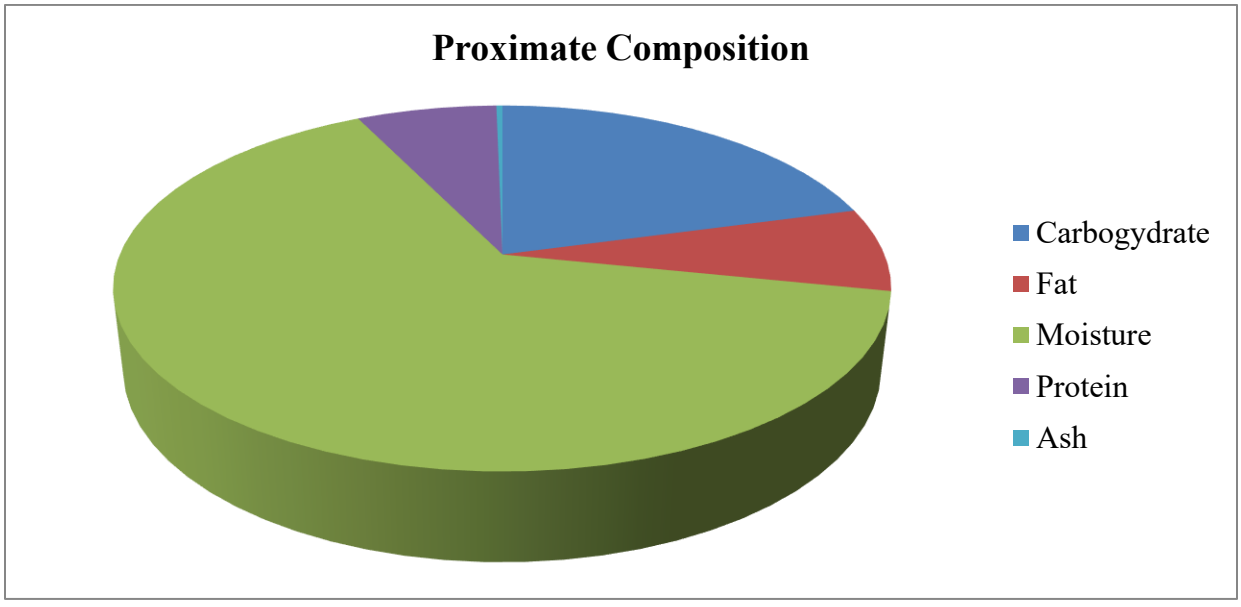
2.4 Proximate composition

Using conventional AOAC (2005) techniques, the sample's proximate composition which includes moisture, fat, protein, crude fiber, ash, and total carbohydrates was examined. Ten grams of the sample were oven-dried at 110 degrees Celsius until its weight remained constant, yielding a moisture content of 63.77%. Using the Soxhlet extraction procedure, which involved extracting 5 g of the dried sample with petroleum ether, the fat content was determined to be 7.3%. The Micro-Kjeldahl method, which includes digesting the sample with concentrated acid to transform protein-bound nitrogen into ammonium ions, then distilling and titrating the result, was used to quantify the protein concentration. With the proper conversion factor, the nitrogen concentration was 1.1%, or 6.87% protein. In order to determine the ash content, which represents the entire mineral fraction, 5 g of the sample was incinerated for 5 hours at 550°C in a muffle furnace, yielding 0.3% ash. The total carbohydrate content was determined by subtracting the sum of moisture, fat, protein, fiber, and ash from 100%, which yielded 20.56% carbs. Crude fiber was measured in accordance with established protocols.

Table: Proximate composition of 'Trimilka Pudding Incorporated with Plant-Based Milks: Coconut, Oat, and Soybean'

Sr. No.	Particulars	Value (%)
1	Energy Value (Kcal)	175.4 kcal
2	Carbohydrate (%)	20.56 g
3	Fat (%)	7.3 g
4	Moisture (%)	63.77 g
5	Protein (%)	6.87 g
6	Ash (%)	0.3 g

*Each value represents the average of three determinations.

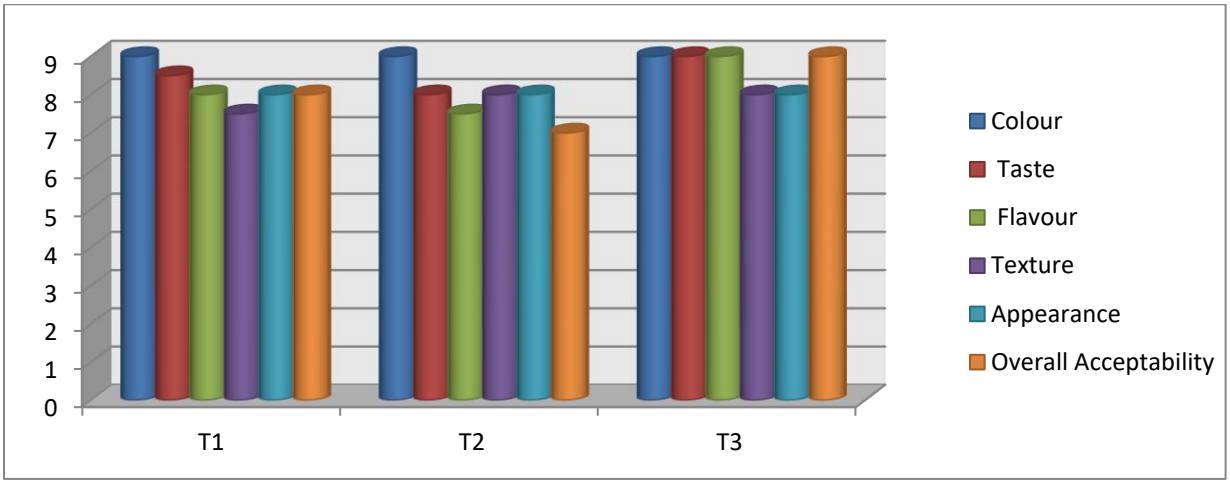


Graph: "Proximate composition of Trimilka Pudding Incorporated with Plant-Based Milks: Coconut, Oat, and Soybean"

2.5 Sensory Analysis

A 9-point hedonic scale was used to assess the puddings' color, look, texture, flavor, taste, and general acceptability. The puddings were made with coconut milk, oat milk, soybean milk, sugar, and corn flour. The T_3 sample showed the highest overall acceptance across the various formulations, suggesting that it was the most favored treatment.

Graph: Sensory Analysis of "Trimilka Pudding Incorporated with Plant-Based Milks: Coconut, Oat, and Soybean"



*Each value represents the average of three determinations.

2.6 Microbial Analysis

The "Trimilka Pudding Incorporated with Plant-Based Milks: Coconut, Oat, and Soybean" remained microbiologically stable and showed no discernible microbial growth ($\leq 1 \times 10^5$ cfu/mL) for up to 15 days when kept in a refrigerator (4 °C), according to microbiological analysis conducted using the Total Plate Count (TPC) method.

Table: Proximate composition of "Trimilka Pudding Incorporated with Plant-Based Milks: Coconut, Oat, and Soybean"

Storage Period (days)	Total Plate Count (cfu/ml)
1	ND
3	ND
5	1.2×10^2
7	2.5×10^2
10	1.5×10^3
12	5.0×10^3
15	8.5×10^4

*Each value represents the average of three determinations.

3. RESULT AND DISCUSSION

The "Trimilka Pudding Incorporated with Plant-Based Milks: Coconut, Oat, and Soybean" had a proximate composition that was balanced, with 63.77% moisture, 6.87% protein, 7.3% fat, and 20.56% carbs. Using a 9-point hedonic scale for sensory evaluation, it was found that Treatment T_3 was the most favored of the three formulations, scoring best for taste, texture, and general acceptance. Using Total Plate Count (TPC) microbiological analysis, the pudding was shown to be microbiologically safe ($\leq 1 \times 10^5$ cfu/mL) for up to 15 days when stored in a refrigerator at 4 °C. However, after day 12, there was a noticeable deterioration in sensory quality.

These findings imply that the product is a safe, tasty, and healthy dessert, and that it is best consumed 10–12 days after preparation. Commercialization of the formulation is highly promising, especially given the expanding market for vegan and lactose-free products. With proper packaging, cold chain control, and shelf-life optimization techniques, this "Trimilka Pudding Incorporated with Plant-Based Milks: Coconut, Oat, and Soybean" can be successfully launched as a dairy-free, nutritious dessert substitute in retail markets.

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