

## DEVELOPMENT AND QUALITY EVALUATION OF CANISTEL (*POUTERIA CAMPECHIANA*) FRUIT PULP IN ICE CREAM

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### ABSTRACT

Desserts are commonly served after the main course and provide quick energy and satiation after meals around the world. Seven formulations of ice cream were prepared with varying levels of canistel pulp (0% to 30%) and sensory evaluation was conducted by a panel of 20 trained judges. The results indicated that the ice cream with 10% canistel pulp was the most preferred, receiving the highest scores for appearance, flavour, texture, taste, and overall acceptability. The selected formulation with 10 percent canistel fruit was further analysed, revealing a moisture content of 56.19%, total soluble solids (TSS) of 36.17%, protein content of 4.21%, fat content of 6.20%, acidity of 0.18% and a pH of 6.46. When compared to the control sample, the incorporation of canistel pulp enhanced the nutritional profile of the ice cream. The production cost for the canistel pulp ice cream was Rs. 60 per 100g, which is comparable to the cost of commercially available premium ice creams. The findings demonstrate that adding canistel pulp to ice cream not only enhances its sensory appeal but also offers a cost-effective, nutritious alternative for functional food products.

**Keywords:** Canistel, Ice cream, Organoleptic evaluation, Physico-chemical properties.

### INTRODUCTION

India, known for its diverse climate is the second-largest producer of fruits, with about 107.10 million metric tonnes of total fruit production, including 5.53 million metric tonnes of minor fruits. Canistel (*Pouteria campechiana*), a nutritionally important minor fruit, belongs to the Sapotaceae family and is locally known as “egg fruit” due to its firm, dense pulp with a texture likened to a hard-boiled egg yolk (Hanamanal *et al.*, 2025). It has numerous medicinal benefits and is a valuable source of protein, carbohydrates, vitamins and micronutrients, contributing to food security.

Native to India, particularly Maharashtra, Kerala and Tamil Nadu, Canistel has a unique taste and boasts of strong antioxidant activity. Morphologically, ripe fruits are oval to ovoid in shape with smooth yellow-orange skin, typically weighing 150–400 g, and have a high edible pulp content of about 65–80 % of the total fruit weight, usually containing 1–3 large glossy brown seeds (Hanamanal *et al.*, 2025). The pulp is characterized by low moisture and a mealy, sweet texture which supports its use in value-added food products.

Recent nutritional analyses indicate that canistel fruit is a valuable source of

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macronutrients and micronutrients. Standard proximate analysis shows approximately 41.44 g carbohydrates, 1.02 g protein, 4.00 g fat, and 5.60 mg vitamin C per 100 g pulp, with an energy value of about 205.68 kcal/100 g, underscoring its high caloric density and carbohydrate richness (Hanamandal *et al.*, 2025). Other studies report significant contents of vitamin A (51.15 mg/100 g), vitamin C (105.82 mg/100 g), iron, calcium, and phosphorus, along with abundant phenolics and flavonoids that contribute to strong antioxidant activity, supporting potential health benefits such as immune enhancement and possible roles in preventing conditions including diabetes and cataracts (Islam *et al.*, 2022).

In addition to its nutrient density, canistel exhibits bioactive properties that are believed to support traditional uses in managing coronary artery disease, liver disorders, and other health conditions, likely due to its antioxidant compounds and micronutrient composition (Jyothish *et al.*, 2025). Economically, although comprehensive nationwide pricing and production statistics for canistel are limited, market data from retail platforms indicate that fresh canistel can be priced at around Rs.480 per kg in some outlets, reflecting its current niche status in Indian fruit markets.

Canistel's adaptability to tropical environments, combined with its high edible pulp yield, functional nutrient and health-promoting compounds, positions it as a valuable fruit for enhancing food security, supporting sustainable fruit systems, and enabling the development of value-added products such as fortified dairy desserts. This study, therefore aims to standardize the integration of canistel pulp into ice cream production, tapping into consumer demand for natural, fruit-based ingredients and reducing reliance on artificial flavors in dairy desserts.

## MATERIAL AND METHODS

### Collection of ingredients

The experiment was carried out at the Department of Community Science, College of Agriculture, Kerala Agricultural University, Vellanikkara, Kerala, in 2024. Fresh cow's milk used for the study was sourced from the College of Dairy Science and Technology, Kerala Veterinary and Animal Sciences University, Mannuthy. The canistel fruits were obtained from the Department of Fruit Science and the Central Nursery of Kerala Agricultural University, Vellanikkara. Other ingredients for making the ice cream, including skimmed milk powder, sugar, vanilla flavour, cream and stabilisers, such as guar gum, xanthan gum, carrageenan, sodium alginate and dextrose, were acquired from the local market.

### Standardisation of canistel pulp (CP) incorporated icecream

A series of ice cream formulations were developed by incorporating canistel fruit pulp at varying levels, ranging from 0% to 30% ( $T_0$ - $T_6$ ). A sensory evaluation was conducted to assess the impact of canistel fruit pulp on the ice cream's overall acceptability. Based on the sensory results, the optimal level of canistel fruit pulp addition was identified. The selected formulation was then subjected to a comprehensive proximate analysis to determine its physico-chemical properties.

### Preparation of canistel fruit incorporated icecream

The ice cream was prepared using the procedure recommended by Akin *et al.* (2007). As shown in Figure 1, the milk, skim milk powder, sugar, and water were combined and pasteurised at 85°C for 1 minute. The mixture was then homogenised and allowed to cool, after which pasteurised cream was added. The mixture was thoroughly blended and left to ripen at 4°C for 24 hours. Following the

**Table 1. Composition of ice cream**

Sl.No.	Ingredient	Quantity
1	Cow'smilk(ml)	45
2	Cream(ml)	15
3	Skimmedmilk powder (g)	7.4
4	Sugar(g)	15
5	Stabiliser (g)	0.5(0.1each)
6	Vanillin(ml)	0.1
7	Water(ml)	10

**Table2.Treatments for the standardisation of canistel fruit incorporated icecream**

Sl.No.	Treatment	Composition
1	T <sub>0</sub>	Icecream
2	T <sub>1</sub>	Icecream+5%CP
3	T <sub>2</sub>	Icecream+10%CP
4	T <sub>3</sub>	Icecream+15%CP
5	T <sub>4</sub>	Icecream+20%CP
6	T <sub>5</sub>	Icecream+25%CP
7	T <sub>6</sub>	Icecream+30%CP

### CP- Canistel Pulp

ripening process, the canistel pulp was added at varying concentrations (5-30%) and mixed thoroughly. The finished ice cream was stored in food grade polypropylene containers in the freezer at -18°C.

The ice cream made with these formulations was assessed for sensory attributes, and the optimal level of addition was standardised based on the sensory evaluation of the ice cream, conducted with three replications. The proximate analysis of the best-performing treatment was then carried out and compared to the control.

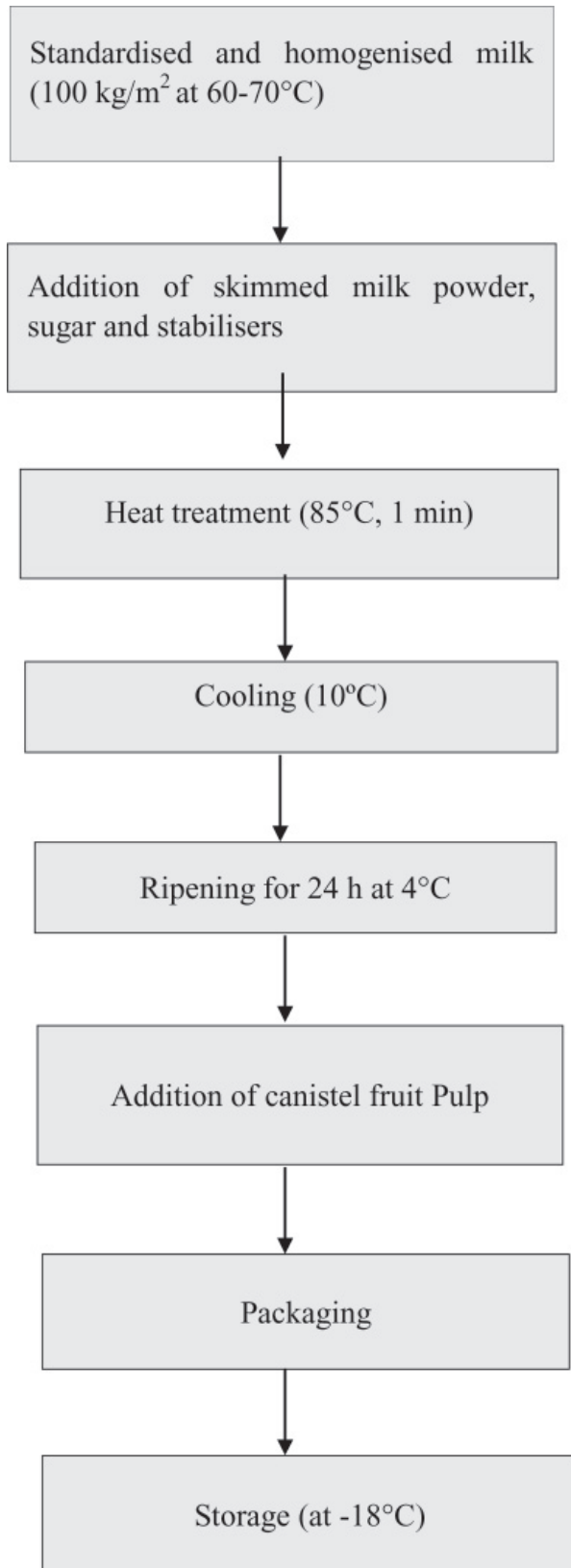
### Organoleptic evaluation

The organoleptic evaluation was carried out in the KAU laboratory using the triangle test proposed by Jellinek (1985). A panel of twenty judges, aged 18 to 35 was selected

based on the results of a triangle test. The acceptability tests for all developed ice creams were conducted by elected panel using a nine-point hedonic scale. 9-point hedonic scale to express their liking or disliking as giving score like: 1 - Disliked extremely, 2 - Disliked very much, 3 - Disliked moderately, 4 - Disliked slightly, 5 - Neither liked nor disliked, 6 - Liked slightly, 7 - Liked moderately, 8 - Liked very much and 9 - Liked extremely; in terms of appearance, colour, flavour, taste, texture and overall acceptability. The ice creams with the best quality characteristics were chosen for further investigation based on organoleptic scores.

### Physico-chemical properties

The proximate analysis of the ice creams focused on evaluating the physico-chemical properties such as moisture, protein,



**Fig. 1. Flow diagram for the preparation of the canistel fruit ice cream**

and fat, which were determined using the standard methods outlined by AOAC (2016). The Total Soluble Solids (TSS), sucrose and acidity of canistel incorporated ice cream and the control were measured using the procedure described by Ranganna (1986). The pH of the ice cream was measured with a digital pH meter.

### Statistical analysis

The data collected during the organoleptic evaluation were organised into tables and analysed using a Completely Randomized Design (CRD). The results were further statistically analysed using Kendall's coefficient of concordance and Duncan's Multiple Range Test (DMRT).

### RESULTS AND DISCUSSION

Sensory evaluation is a tool used to measure, analyse and understand how consumers experience a product's characteristics. By utilising the human senses of sight, hearing, taste, smell, and touch, sensory evaluation assesses various attributes that collectively create a sensory experience, including appearance, texture, taste, colour and flavour. This study employed sensory analysis to evaluate the acceptability of canistel fruit incorporated ice creams developed using different combination of ingredients. The mean score obtained for the organoleptic qualities of each treatment were statistically analysed using Kendall's coefficient of concordance and are presented in Table 3.

The sensory evaluation study showed that treatment T<sub>2</sub>, with 10% canistel fruit pulp, was the most preferred combination, scoring highest in all sensory attributes including appearance, color, flavor, taste, texture, and overall acceptability.

The results in Table 3 indicate that incorporating canistel fruit pulp into ice cream substantially improved its sensory scores,

similar to the control ice cream. The ranking of the developed icecreams, from highest to lowest score was :  $T_2$  (52.21),  $T_1$  (49.56),  $T_3$  (49.11),  $T_4$ (46.52),  $T_5$  (46.29) and  $T_6$ (44.96). Additionally, Kendall's analysis confirmed a high level of agreement among the judges' scores with a significance level of 1%.

The sensory evaluation revealed that the ice cream containing 10% CP ( $T_2$ ) found the highest scores for appearance (8.90), color (8.90), flavor (8.52), taste (8.54), texture (8.64) and overall acceptability (8.71). In contrast, the ice cream prepared with 30% CP ( $T_6$ ) received the lowest scores for both attributes. The results showed that increasing the CP level up to 10% improved the appearance score, but further increase led to a decline in scores. This can be attributed to the impact of CP concentration on the ice cream's color, with lower concentrations resulting in a lighter color and higher concentrations producing a darker, less appealing colour.

The ice cream samples prepared with 0%, 5%, and 10% CP received flavour scores of 8.42 ( $T_0$ ), 8.38 ( $T_1$ ), and 8.52 ( $T_2$ ), respectively. The maximum flavour score of 8.52 was achieved by the sample containing 10% CP ( $T_2$ ). However, as CP concentration increased beyond 10%, the flavor scores decreased, with the lowest score of 7.16 recorded for the 30% CP sample ( $T_6$ ). A similar trend was observed for taste, where the addition of CP up to 10% improved the scores, but higher concentrations led to a decline in the sensory attributes. The strong, pungent flavor of the canistel fruit pulp was the primary reason for this trend observation. The strong, characteristic flavor of *canistel* pulp has been shown to produce pronounced sensory attributes when incorporated into food products, with panelists reporting dominant aroma and taste profiles that increase with higher proportions of fruit powder (Retna Pertiwi *et al.*, 2021).

**Table 3. Mean scores for organoleptic evaluation of canistel fruit pulp incorporated icecream**

(n=20)							
Sensory attributes							
Treat-ments	Appearance	Colour	Flavour	Taste	Texture	Overall acceptability	Total score
$T_0$	8.54(5.04)	8.23(5.32)	8.42(4.86)	8.47(5.07)	8.33(5.43)	8.47(5.32)	50.46
$T_1$	7.88(4.96)	8.19(4.25)	8.38(4.86)	8.45(4.86)	8.28(5.18)	8.38(5.32)	49.56
$T_2$	8.90(6.25)	8.90(6.79)	8.52(6.32)	8.54(5.57)	8.64(5.93)	<b>8.71(6.04)</b>	<b>52.21</b>
$T_3$	8.30(4.39)	8.14(3.86)	7.97(4.61)	8.21(4.68)	8.23(4.57)	8.26(4.50)	49.11
$T_4$	7.69(3.21)	7.59(2.82)	7.61(2.96)	7.98(2.74)	7.83(2.84)	7.82(3.00)	46.52
$T_5$	7.97(2.46)	7.80(2.75)	7.47(2.39)	7.80(2.64)	7.59(2.36)	7.66(2.61)	46.29
$T_6$	7.57(1.68)	7.83(2.21)	7.16(2.00)	7.70(2.46)	7.30(1.64)	7.40(1.79)	44.96
<b>Kendall's Wvalue</b>	<b>0.629**</b>	<b>0.642**</b>	<b>0.602**</b>	<b>0.472**</b>	<b>0.655**</b>	<b>0.583**</b>	

Values in parentheses are mean rank scores based on Kendall's W (\*\*significant at 1% level)

**Table 4. Physico-chemical analysis of ice creams (Mean  $\pm$  SD, n = 3)**

S.No.	Quality Parameters	Control Ice Cream (Mean $\pm$ SD)	Canistel Fruit Ice Cream (Mean $\pm$ SD)
1	Moisture (%)	59.70 $\pm$ 0.45	56.19 $\pm$ 0.38
2	TSS (%)	37.10 $\pm$ 0.52	36.17 $\pm$ 0.41
3	Protein (%)	3.49 $\pm$ 0.12	4.21 $\pm$ 0.15
4	Fat (%)	4.63 $\pm$ 0.18	6.20 $\pm$ 0.22
5	Acidity (%)	0.12 $\pm$ 0.01	0.18 $\pm$ 0.02
6	pH	6.55 $\pm$ 0.04	6.46 $\pm$ 0.05
7	Sucrose (%)	18.73 $\pm$ 0.36	17.27 $\pm$ 0.29

The texture scores of the ice cream samples ranged from 7.30 to 8.64 (Table 3). Treatment T<sub>2</sub> showed the highest texture score (8.64), while T<sub>6</sub> received the lowest score (7.30). The decrease in texture score with increased CP incorporation may be attributed to the boiled egg-like texture of canistel fruit, which is soft and pulpy, as previously reported by Pertiwi *et al.* (2020). This finding supports the results of the present observations.

The overall acceptability scores for T<sub>0</sub> and T<sub>2</sub> were 8.47 and 8.71, respectively. The ice cream prepared with 10% CP (T<sub>2</sub>) exhibited a desirable yellow color, optimal firmness, and a pleasing sweet and sour canistel fruit flavor. In contrast, the ice cream with 5% CP had a light yellow color, a slightly hard texture, and lacked flavor. Ice creams with more than 10% CP were dark yellow, lacked firmness, and had a pungent flavor and taste. Based on these results, T<sub>2</sub> (10% CP) was selected as the optimal formulation and used for further study. Rajeesha *et al.* (2023) found that the ice cream with 10% jackfruit pulp earned the highest average scores for appearance (8.89), taste (8.82), and overall acceptability (8.81).

The proximate analysis of the most preferred combination of canistel fruit incorporated ice creams selected after the thorough organoleptic evaluation was

analysed along with the control. The results are depicted in Table 4.

The acceptable ice cream sample (T<sub>2</sub>) and the control sample was evaluated for its nutritional composition, and tabulated in the (Table 4). The moisture content of the selected ice cream was 56.19%, while the control sample had 59.70%. The moisture content recommended for ice cream, according to Deosarkar *et al.* (2016), is 61.7%, which is closer to the moisture content found in the control sample.

The total soluble solids (TSS) content of the selected ice cream was 36.17%, which was slightly lower than the control sample, which had a TSS of 37.10%. Shelke *et al.* (2020) studied the use of jamun pomace as a functional ingredient to enhance the physico-chemical and sensory properties of ice cream, reporting TSS values ranging from 29% to 39%. In addition, the milk proteins help stabilize the air interface in ice cream, which is essential for its overall structure and stability. The protein content in the control sample was 3.49%, while the canistel fruit ice cream had a higher protein content of 4.21%.

In conventional ice cream, the fat content plays a crucial role in shaping the microstructure during the ageing, freezing, and aeration processes. The canistel fruit ice cream

developed in this study had a fat content of 6.20%, while the control ice cream contained 4.63%. According to FSSAI (2016), ice cream with a fat content between 2.5% and 10.0% is classified as medium fat ice cream, which makes the developed ice cream fall under this category.

Acidity is an important factor in achieving the optimal pH, as excessive acidity during pasteurisation can cause the mixture to curdle. The acidity of the control ice cream was 0.12% with a pH of 6.55, while the canistel fruit ice cream had a slightly higher acidity of 0.18% and a pH of 6.46, which is within the ideal range. Shinde *et al.* (2021), developed ice cream with jackfruit seed flour, and during a five-week storage period, the acidity increased from 0.21% to 0.24%.

While various sugars, such as glucose, fructose, sucrose, and sugar alcohols, are used in ice cream production, sucrose is the main sweetener responsible for the ice cream's taste. In this study, the sucrose content in the control ice cream was 18.73%, while the canistel fruit ice cream contained 17.27% sucrose, which is slightly lower. This is in comparison to the ice cream developed by Mansour *et al.* (2021), which had a sucrose content of 15% when incorporating date fibre powder.

#### **Cost of the Production**

The production cost of the canistel fruit-incorporated ice cream was Rs. 65 per 100 g, which is slightly higher than some conventional and fruit-based ice cream products. This increased cost may be attributed to the use of fresh canistel fruit pulp, additional processing steps such as pulp extraction and standardization and the incorporation of natural ingredients without artificial flavours and colours. The cost of procuring high-quality raw materials, maintaining hygienic processing conditions, and ensuring product quality and

safety also contributed to the overall production expenses.

Moreover, the developed ice cream falls under the category of value-added functional dairy products due to its enhanced nutritional profile, antioxidant properties and natural fruit content. Such functional foods generally command a higher market price owing to their perceived health benefits and growing consumer demand for natural and nutrient-enriched products.

The price of commercially available premium ice creams typically ranges from Rs. 55 to Rs. 80 per 100 g, indicating that the developed canistel ice cream is competitively priced within the existing market range. Gaikwad *et al.* (2020) reported the average production cost for jamun juice-incorporated ice cream at levels of 5%, 10%, and 15%, along with the control sample, as Rs. 50.91, Rs. 54.06, Rs. 57.09, and Rs. 48.04, respectively. Although the present study recorded a marginally higher cost, the additional expenditure is justified by the superior nutritional quality, unique flavour and functional properties of the product.

#### **CONCLUSION**

The present study demonstrated the successful incorporation of canistel fruit pulp into ice cream, with 10% pulp addition (T2) identified as the most acceptable formulation based on sensory evaluation. This treatment obtained the highest scores for appearance, colour, flavour, taste, texture, and overall acceptability. Increasing the pulp concentration beyond 10% resulted in a decline in sensory quality, particularly in flavour and texture, which may be attributed to the strong characteristic taste and soft texture of canistel fruit. The proximate analysis revealed that the 10% canistel pulp-incorporated ice cream had slightly lower moisture and total soluble solids compared to the control, while exhibiting higher protein and fat contents. The acidity, pH, and

sucrose levels remained within acceptable limits, indicating good product stability and quality. Overall, the findings suggest that canistel fruit pulp can be effectively utilized to enhance the nutritional value and sensory appeal of ice cream.

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