



## Effects of Coconut Milk Powder on The Characteristics of Tongka Langit Banana Ice cream

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### ABSTRACT

The objective of this study was to determine the effects of coconut milk powder on the characteristics of Tongka Langit Banana ice cream. A completely randomized experimental design was applied in this research with coconut milk powder concentrations based on the weight of full cream milk used as a control. Hence, the levels of treatment were as follows: control (full cream milk), 25%, 50%, 75%, and 100% coconut milk powder. The results showed that Using coconut milk as a milk substitute in the preparation of Tongka Langit banana ice cream has affected its physicochemical and sensory properties but has no effect on vitamin C. With a fat content of 4.93%, a protein content of 0.77%, vitamin C content of 0.67%, total solids of 30.10%, and a melting time of 54'33', coconut milk at 100% by weight of milk was the appropriate concentration for producing ice cream with the best physicochemical and sensory properties.

### Introduction

The tongka langit banana (*Musa troglodytarum*) is an essential endemic banana species in eastern Indonesia, mainly Maluku. Its bunches face upwards, which is rare for bananas, which often face downwards. The yellow to orange flesh of Tongka Langit bananas shows that this banana has a high beta carotene content. Beta carotene is a precursor to vitamin A, the human body's primary supply of vitamin A, and an antioxidant in food-based carotenoids (Gul et al., 2015).

Several studies on the beta carotene content of Tongka Langit bananas indicate that these bananas contain a high level of beta carotene. Long, cone-shaped Tongka Langit bananas have 52.76–55.33 mg/100g of beta carotene, whereas shorter, round-shaped bananas contain 22.31–37.12 mg/100g (Hiariej et al., 2021; Letelay et al., 2020). The high beta carotene content and health benefits of Tongka Langit banana make it a valuable ingredient for processed food products, including ice cream, which can increase the shelf life and diversify processed Tongka Langit banana products.

*Ice cream* is a dairy-based frozen dessert containing at least 10% milk fat before adding flavourings and sugars (De Castro & Arenillo, 2016). Frozen dairy ice cream is loved by people of all ages for its rich flavour and refreshing coolness, making it a popular choice for desserts worldwide (Karthikeyan et al., 2014). Ice cream is made with milk, cream, sugar, natural flavourings, and additional optional components like eggs, nuts, fruits, chocolate, candies, and other ingredients. Many flavours, colours, textures, and ingredients are available in ice creams on the market today. The ice cream is sweetened by flavourings and sweeteners (Perera & Perera, 2021).

Tongka Langit Banana puree has been used as one of the ingredients in ice cream and is regarded as a good ingredient (Tuhumury et al., 2016), with milk as a source of fat. Traditionally, ice cream has been made with dairy; however, non-dairy milk like soy, almond, and coconut have become increasingly popular. Lactose-intolerant people may find coconut milk ice cream an excellent substitute, but it may also benefit others. Extraction of fresh coconut (*Cocos nucifera* L) kernels with or without the addition of water yields a milky fluid known as coconut milk. As an island nation, Indonesia relies heavily on coconut milk in its diet. In addition to its distinctive nutty flavour, it is highly regarded for its nutritional value. 33.4% fat, 4.1% protein, 1.2% minerals, and 5.0% carbohydrates are found in coconut milk (Perera & Perera, 2021).

Ice cream made with coconut milk has been developed and tested for quality (Beegum et al., 2021; Góral et al., 2018). It is yet to be determined how to make Tongka Langit banana ice cream with coconut milk and how to evaluate its physicochemical and sensory properties. Therefore, the objective of this study was to determine the effects of coconut milk powder on the characteristics of Tongka Langit Banana ice cream.

## Materials and Methods

### Materials

The very ripe, long, cone-shaped Tongka Langit bananas were purchased from the local market in Ambon. Other ingredients, including coconut milk powder (Sun Kara), whole cream milk powder (Dancow), whipped cream, CMC, and sugar, were also used in this study. Chemicals (analytical grades) such as NaOH, K<sub>2</sub>SO<sub>4</sub> and HCl were used for chemical analyses.

### Research Methods

A completely randomized experimental design was applied in this research with coconut milk powder concentrations based on the weight of whole cream milk used as a control. Hence, the levels of treatment were as follows: control (whole cream milk), 25%, 50%, 75%, and 100% coconut milk powder. The formulation can be seen in Table 1.

**Table 1.** Formulation of coconut milk-based tongka langit banana ice cream

Treatments	Full Cream Milk (g)	Whipped Cream (g)	Sugar(g)	Water (mL)	CMC (g)	Coconut milk powder (g)	Tongka Langit banana puree (g)
Control	75	50	60	175	5	-	135
25%	-	50	60	175	5	18,75	135
50%	-	50	60	175	5	37,50	135
75%	-	50	60	175	5	56,25	135
100%	-	50	60	175	5	75,00	135

### Ice Cream Production

Tuhumury et al. (2018) described methods to prepare the Tongka Langit banana puree. Tongka Langit bananas with their peels were grilled for 5 minutes and then placed in an ice bath for another 5 minutes. Afterwards, the banana was peeled and mashed above the aluminium sieve to obtain the puree. Tongka Langit banana ice cream was made according to the modified method of Tuhumury et al. (2016). As per treatments, coconut milk and whole cream milk (control) were added to the water, stirred and brought to a boil while stirring, not to break the emulsion. The ingredients were added and mixed well: sugar, CMC, Tongka Langit banana puree, and whipped cream. The mixture was mixed using a mixer for 3 minutes until the volume expanded.

The ice cream mixture was then stored in the refrigerator for 4 hours. After 4 hours, it was removed, re-mixed for 3 minutes, and stored in the freezer for 45 minutes. After 45 minutes in the freezer, the mixture was taken out and mixed for another 3 minutes. Then it was aged in the freezer for 24 hours to produce Tongka Langit banana ice cream for further analysis.

### **Physicochemical analysis**

The protein and fat content of the coconut milk-based ice cream and full cream milk ice cream (control) was measured according to the method in AOAC (AOAC, 2005). *Protein-content* dried ice cream samples weighing 0.5 and 1.0 g were placed in a clean and dry digestion flask. A sulfuric acid solution (25mL) and a Kjeldahl tablet (Kjeldahl tablet) were added to the digestion flask. A mini Kjeldahl unit was used to run the digestion for three hours. An automated distillation unit was used to cool the digestion flask and perform the distillation process (BUCHI, USA). Finally, a 0.25N HCl solution was used to titrate the sample and determine the crude protein content ( $N \times 6.25$ ). Titration of a 0.25 N sodium carbonate solution was used to standardize 0.25 N HCl.

### ***Fat content.***

An oven was used to dry off the thimble. Filter paper and fat-free cotton were used to wrap up the sample, weighing 5 grams. A Soxhlet extraction equipment with a condenser was used to remove the sample from the filter paper. Hexane was added to a fat flask and then refluxed until the sample turned pale in color. The residual solvent in the fat flask is removed by heating the flask in an oven and then weighing it. To determine the amount of fat in a given sample, the following formula is used:

$$Fat\ content = \frac{weight\ of\ fat}{sample\ weight} \times 100\%$$

### ***Total solids***

Using material droppers, samples were dripped onto the glass hand refractometer N-2e (Atago, Japan) and viewed for light and dark points. The total solids are represented by the numbers on this equipment (°Brix).

### **Vitamin C**

Samples were prepared for as much as 25 mL. in a dry and clean erlemeyer The filtrate was dripped with some 1% starch indicator and then titrated with 0.01 N iodine solution until a blue color was formed. Calculation of vitamin C levels was carried out based on a standard curve. The formula calculates vitamin C per 100 g of ingredients:

$$\text{Vitamin C (\%)} = \frac{\text{mL titre} \times \text{N iodium} \times \frac{0.88}{0.01} \times Fp}{\text{sample weight}} \times 100 \%$$

### **Melting time**

10 g of ice cream is taken and placed in a container. This is done at room temperature (25°C). The melting speed of ice cream is the time it takes the ice cream to melt completely.

### **Sensory Analysis**

A sensory analysis (hedonic rating) of ice cream was carried out on color, taste, aroma, texture, and overall. A four-point hedonic scale was used in this testing. Decimal numbers greater than 5 of the average score were rounded up according to the scale category above. A moderately trained panel of 20 people was used in this test. The method of calculating the degree of acceptance (acceptance index; AI) was used to determine the level of panelists' acceptance of the sensory characteristics of ice cream (da Silva et al., 2010).

$$AI (\%) = Y \times 100/Z$$

Y : the average hedonic score obtained by the product.

Z : the maximum hedonic score of the product.

## **Results and Discussion**

### **Physicochemical characteristics**

#### **Protein content**

The protein content of Tongka Langit banana ice cream varies significantly depending on the concentration of coconut milk used. Tongka Langit banana ice cream with various concentrations of coconut milk had a protein content of 0.54-0.77% (Table 2). The highest protein content (0.77%) was found in ice cream made with 100% coconut milk and was not significantly

different when made with 75 % coconut milk. The lowest protein content in control ice cream with milk without coconut milk was 0.54 %, which was not statistically different from ice cream with coconut milk concentrations of 25% and 50% of the weight of milk. When comparing ice cream made with whole cream milk to ice cream made with coconut milk, the protein content of the ice cream was much higher. The higher the protein content of coconut milk, the higher its concentration. On the other hand, the protein content was lower than the minimum of 2.7% protein required by the Indonesian quality standard for ice cream.

**Table 2.** Physicochemical properties of coconut milk-based Tongka Langit banana ice cream

Treatments	Protein content (%)	Fat content (%)	Total soluble solids (°Brix)	Vitamin C (%)	Melting time (min)
Control	0.54 ± 0.02 <sup>b</sup>	3.75 ± 0,10 <sup>c</sup>	42.90 ± 1.27 <sup>a</sup>	0.68 ± 0.03 <sup>a</sup>	58'30" ± 1'03" <sup>a</sup>
25%	0.62 ± 0.00 <sup>b</sup>	3.59 ± 0,03 <sup>c</sup>	25.00 ± 0.01 <sup>c</sup>	0.68 ± 0.03 <sup>a</sup>	25'40" ± 6'55" <sup>c</sup>
50%	0.62 ± 0.04 <sup>b</sup>	3.75 ± 0,09 <sup>c</sup>	27.90 ± 0.14 <sup>b</sup>	0.65 ± 0.02 <sup>a</sup>	35'06" ± 3'10" <sup>bc</sup>
75%	0.73 ± 0.04 <sup>a</sup>	4.62 ± 0,05 <sup>b</sup>	29.40 ± 0.57 <sup>b</sup>	0.63 ± 0.02 <sup>a</sup>	48'37" ± 1'22" <sup>ab</sup>
100%	0.77 ± 0.01 <sup>a</sup>	4.93 ± 0,07 <sup>a</sup>	30.10 ± 0.14 <sup>b</sup>	0.67 ± 0.02 <sup>a</sup>	54'33" ± 4'26" <sup>a</sup>

The increased protein level of coconut milk-based tongka langit ice cream could be attributed to the higher protein content of coconut milk compared to milk, which was estimated to be 6.79% and 3%, respectively (Pereira, 2014). The more significant proportion of Tongka Langit banana puree in the formulation may explain the lower protein level than the quality standard for ice cream. As a result, increasing the quantity of coconut milk in the formulation is required to meet the requirement.

### Fat content

The ice cream's fat content ranged from 3.59 to 4.93 % (Table 2). Tongka Langit banana ice cream's fat content increased following the coconut milk concentration. Except for 25% coconut milk, ice cream made with coconut milk had a higher fat content than milk. Using 100%, coconut milk yielded the highest fat content (4.93%), significantly higher than all other treatments. This result was consistent with the findings of Beegum et al. (2021), which indicated that non-dairy ice cream contained more fat than dairy ice cream. However, this Tongka Langit banana ice cream formulation's fat content was significantly lower than the mentioned previous results and the Indonesian quality requirement (minimum 5%). The ice cream with 100% coconut milk in the formulation had the highest fat content and almost reached the minimum standard for ice cream. The fat content of coconut milk ranges between 27.69% (Beegum et al., 2021) and 30–35% (Rethinam & Bosco, 2006), which is significantly higher than the fat content of milk (3–4%)

(Pereira, 2014). This has contributed to the higher fat content of coconut milk ice cream. Furthermore, the fat content of the whole cream milk powder used in the formulation was 26 g/7100g, whereas the fat content of the coconut milk powder was 45 g/100g, resulting in a higher fat content of the ice cream with coconut milk.

### **Total solids**

The total solids of Tongka Langit banana ice cream were significantly affected by the concentration of coconut milk. The total solids value of ice cream ranged from 25.00 to 42.90 °Brix. The highest total solids concentration was 42.90 °Brix in the control ice cream with milk, significantly different from all treatments with coconut concentration. The treatment with 100% coconut milk concentration resulted in the lowest total solids in ice cream (Table 2). These results are by the previous results, which showed that the total solids in the coconut-based ice cream formulation were comparably lower than those in the dairy-based formulation (Beegum et al., 2021).

The total solids content of ice cream is typically the sum of all solid ingredients; fat sugar, milk solids non-fat (MSNF), stabilizers and emulsifiers all contribute to total solids (Syed et al., 2018). The content of the above ingredients is more in milk than in coconut milk, so, with the same amount of milk, coconut milk contributes fewer total solids to ice cream

### **Vitamin C**

The vitamin C content of Tongka Langit banana ice cream was unaffected by varying the amount of coconut milk used to make it. Tongka Langit banana ice cream had a vitamin C concentration between 0.63% and 0.68%. (Table 2). The Vitamin C concentration in the Tongka Langit bananas determines the level of Vitamin C in Tongka Langit banana ice cream, as the amount of Tongka Langit banana puree stayed the same in all formulations. This is in line with Tuhumury et al. (2016), who found that the amount of vitamin C in ice cream made with varying quantities of Tongka Langit bananas was different.

### **Melting time**

The ice cream with the highest resistance and the longest melting time was found in the control treatment with milk, as shown in Table 2. It took 58'30" to melt completely, and there was no significant difference in 100% coconut milk, which took 54'55". Meanwhile, ice cream with a 25% coconut milk concentration had the fastest melting time of 26'06", much faster than the other treatments. This data shows that the higher the percentage of coconut milk, the more resistant it

is to melting or the longer it takes for the ice cream to melt, but that the melting time is still comparatively short compared to milk. A low freezing point is the primary cause of rapid melting, whereas incorporating air and fat tends to slow it down (Sofjan & Hartel, 2004). This is also consistent with ice cream's total solids yield. The more total solids, the slower the ice cream will melt and the more excellent its resistance. Quality ice cream resists melting when served at room temperature. The preference is not for ice cream that melts quickly because it will immediately melt at room temperature.

### **Sensory characteristics**

The composition of the ingredients influences the flavour of ice cream. Taste significantly impacts consumer preference for ice cream; it can be considered the deciding element. Currently, the variety of ice cream flavours on the market is wide. Therefore it requires forethought and ingenuity to mix consumer-preferred flavours. Several factors also affect the flavour of ice cream, including thickeners that can lessen the sweetness of sugar and variations in texture that can alter the flavour.

Table 3 displays the results of the panellists' evaluation of tongka Langit banana ice cream with varying concentrations of coconut milk. Tongka Langit banana ice cream with concentrations of 25%, 50% and 100% was primarily liked for its flavour (2.60, 2.55, and 2.70). The panellists somewhat preferred the taste of the control and 75% coconut milk. For a product to be well received, the acceptance or acceptability index (AI) level must be greater than **or equal to 70%** (da Silva et al., 2010). The highest acceptance rate (AI) was 67.50% for the ice cream made with 100% coconut milk. The ice cream was made with 75% coconut milk; the control had the lowest AI, 62.00%. The fat content of coconut milk is supposed to contribute to the high acceptability of the ice cream flavor for 100% coconut milk. The majority of flavor components are fat soluble. The intensity of the ice cream's flavor is affected by changes in the amount and kind of fat.

Table 3 shows the findings of the panelists' color evaluation of the Tongka Langit banana ice cream. The control, 25%, 50%, and 100% coconut milk colors were all favorites among the panelists (2.83; 2.73; 2.85; and 2.75). While ice cream made with 75% coconut milk was in the "somewhat like" category (2.45). Control and 50% coconut milk ice cream have an AI value of more than 70%, i.e., 70.75% and 71.25%, respectively, and had a high acceptance rate. Because the color of the control milk and coconut milk powder was similar, the panelists preferred the tongka Langit banana ice cream colour despite the difference in the amount used. This demonstrates that the color of the ice cream is still favored and acceptable by the panelists when the milk is replaced with coconut milk.



**Table 3.** Sensory characteristics and acceptance index (AI) of coconut milk-based Tongka Langit banana ice cream

Treatments	Taste		Color		Aroma		Texture		Overall	
	Scale	AI (%)	Scale	AI(%)	Scale	AI(%)	Scale	AI(%)	Scale	AI(%)
Control	2,48	62,00	2,83	70,75	2,60	65,00	2,65	66,25	2,40	60,00
25%	2,60	65,00	2,73	68,25	2,83	70,75	2,85	71,25	2,73	68,25
50%	2,55	63,75	2,85	71,25	2,88	72,00	2,65	66,25	2,85	71,25
75%	2,48	62,00	2,45	61,25	2,48	62,00	2,85	71,25	2,70	67,50
100%	2,70	67,50	2,75	68,75	2,45	61,25	2,83	70,65	2,98	74,50

Table 3 shows the results of the panelists' evaluations of the aroma of Tongka Langit banana ice cream. The panellists preferred the aroma of Tongka Langit banana ice cream with control, 25%, and 50% coconut milk (2.60; 2.83; and 2.88). While ice cream with 75% and 100% coconut milk received moderate acceptance (2.48 and 2.45, respectively), Ice cream with a concentration of 25% and 50% coconut milk has a high level of acceptance of the aroma, with AI values of 70.75% and 72.00%, respectively. The more coconut milk was used to replace milk, the lower the level of acceptance of the ice cream's aroma. This is most likely due to the aromatic compounds found in coconut milk. The compounds identified have six alcohol groups: aldehydes, ketones, acids, esters, and lactones. While tetracotane, 2-hexanol is the most abundant compound (Kokilavani et al., 2017), it is thought that using more coconut milk will change how much panellists like the smell of the ice cream.

Table 3 also shows the texture of Tongka Langit banana ice cream. Panellists preferred Tongka Langit banana ice cream prepared with all treatments (2.65-2.85). The ones with 25%, 50%, and 100% coconut milk had a high acceptance index for the texture of the ice cream (71.25%, 71.25%, and 70.65% ). When coconut milk was used as a substitute for milk, the texture of the ice cream was more acceptable. This also had to do with the total amount of ice cream solids. The higher the total solids content, the less soft the resulting ice cream. Because ice cream with coconut milk had lower total solids than ice cream with milk, the panelists' acceptance of the texture of ice cream was affected.

The panelists' preferences for color, taste, aroma, and texture contribute to the ice cream's overall likeness. Table 3 shows that the panelists preferred all concentrations of coconut milk (2.70–2.98). Meanwhile, in terms of overall likeness, the panellists (2.40) only slightly preferred ice cream with milk as the control. Ice cream containing 25% and 100% coconut milk received good overall acceptance, with AI values of 71.25% and 74.50%, respectively. People preferred ice cream made with 100% coconut milk than other treatments.

## CONCLUSION

Using coconut milk as a milk substitute in the preparation of Tongka Langit banana ice cream has affected its physicochemical and sensory properties but has no effect on vitamin C. With a fat content of 4.93%, a protein content of 0.77%, vitamin C content of 0.67%, total solids of 30.10%, and a melting time of 54'33', coconut milk at 100% by weight of milk was the appropriate concentration for producing ice cream with the best physicochemical and sensory properties.

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