SJIF Impact Factor (2026): 8.863| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 11 | Issue: 5 | May 2026 - Peer Reviewed Journal

FORMULATION AND SENSORY EVALUATION OF ICE CREAM MADE FROM CARABAO'S MILK *(Bubalus bubalis carabanesis)* AND COCONUT SAP

Jericho H. Pondavilla
Bohol Island State University—Main Campus, Tagbilaran City, Bohol, Philippines

ABSTRACT

This study was conducted to explore the potential of utilizing Carabao's Milk and Coconut Sap as local ingredients in developing a functional ice cream product, addressing the limited research on combining these local ingredients into an innovative frozen dessert. It aimed to formulate three treatments with varying fermentation periods of coconut sap and evaluate their sensory attributes, acceptability, and product characteristics. An experimental-descriptive research design using a parallel group approach was employed. Three treatments were prepared: coconut sap fermented for 1 day (T1), 2 days (T2), and 3 days (T3). A total of 70 selected respondents, including ice cream makers, PCC and BODACO employees, teachers, and students, participated in the sensory evaluation using a 5-point hedonic scale. Data were analyzed using frequency, percentage, weighted mean, and the Friedman Test to determine significant differences among treatments. Microbiological and nutritional analysis were submitted and conducted through the Department of Science and Technology (DOST), while shelf-life was assessed under frozen conditions (-18°C). Results revealed that all three treatments were rated "very much acceptable" across appearance, aroma, taste, and texture. However, statistical analysis indicated a significant difference ($p < 0.05$) among treatments, confirming that the temperature and fermentation period of coconut sap significantly influenced sensory evaluation. The ice cream samples remained stable and acceptable for up to seven weeks, with initial spoilage observed between the seventh and eighth week. Laboratory results further confirmed that the product was microbiologically safe and nutritionally adequate for consumption. In conclusion, the study demonstrated that ice cream made from Carabao's Milk and Coconut sap is a successful, safe, and acceptable product. The fermentation period plays a crucial role in optimizing sensory quality and overall acceptability, directly addressing the objectives of the study and supporting its potential for innovation and sustainable utilization of local resources. Lastly, future researcher may conduct further study to validate the probiotic content of the ice cream.

I. INTRODUCTION

Ice cream remains one of the most popular frozen desserts in the world, valued for its creamy texture and sweet flavor profile. However, consumer trends are shifting toward functional foods products that delicious and offer health benefits. This shift has created a significant demand for treats that are indulgent and nourishing.

Despite the extensive study regarding traditional dairy and plant-based ice creams, there is limited research exploring the combination of Carabao's milk and Coconut sap. Additionally, Carabao's milk is naturally enhances the creaminess and nutritional density of frozen desserts. Another ingredient used in this study is coconut sap, a traditional Filipino beverage and it contains naturally occurring lactic acid bacteria, when fresh or mildly fermented.

This study seeks to bridge this gap by utilizing these two local ingredients to create a Filipino-inspired dessert. By investigating different fermentation periods of the coconut sap, the research aims to determine the optimal balance of health benefits and flavor. The primary objective is to formulate a product that excels in sensory attributes including appearance, aroma, taste, and texture while promoting the use of sustainable, local resources. Ultimately, this research contributes to the development of a nourishing, culturally rooted alternative in the frozen dessert market.

II. LITERATURE BACKGROUND

The development of innovative and functional food products has become increasingly important in response to changing consumer preferences. Modern consumers are no longer satisfied with foods that merely provide sensory satisfaction; instead, there is a growing demand for products that offer nutritional and health benefits. In this context, ice cream has evolved from a traditional dessert into a potential carrier of functional ingredients such as probiotics and bioactive compounds. Studies suggest that ice cream is an effective medium for probiotic delivery due to its stable matrix, which helps maintain microbial viability above the recommended level of 10^6 CFU/mL (Sarkar, 2024).

SJIF Impact Factor (2026): 8.863| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 11 | Issue: 5 | May 2026 - Peer Reviewed Journal

Carabao's milk, derived from Bubalus bubalis carabanesis, has been widely recognized for its superior nutritional composition compared to cow's milk. It contains significantly higher fat, protein, and total solids, which contribute to improved texture, creaminess, and sensory quality of dairy products (Arrichiello et al., 2022). These properties make it particularly suitable for ice cream production, as higher fat and protein levels enhance overrun, melting resistance, and mouthfeel (Camelo-Silva et al., 2021). Furthermore, carabao's milk has been associated with distinct metabolomic characteristics, including higher concentrations of N,N-dimethylglycine, which may influence its nutritional profile (Adlong & Loza, 2022).

In the Philippine context, the promotion of carabao milk production has been strongly supported by the Philippine Carabao Center, which plays a key role in enhancing dairy productivity and supporting local farmers. Programs such as crossbreeding and cooperative-based milk processing have increased milk yield and facilitated the development of value-added products like ice cream. These initiatives demonstrate the potential of carabao's milk not only as a nutritional resource but also as a driver of rural economic development.

Coconut sap, locally known as tuba, is a traditional fermented beverage widely produced in the Philippines. Its fermentation process involves a diverse microbial community, particularly yeast species such as Saccharomyces cerevisiae, which plays a dominant role in ethanol production and flavor development (Udomsaksakul et al., 2018; Limtong et al., 2020). The presence of lactic acid bacteria and yeasts contributes to its potential as a functional ingredient. However, fermentation duration significantly affects its sensory characteristics, microbial composition, and alcohol content, which must be carefully controlled to ensure product quality and safety (Hovhannisyan et al., 2024).

The integration of coconut sap into food products introduces both opportunities and challenges. On one hand, it enhances flavor complexity and may provide probiotic benefits; on the other hand, uncontrolled fermentation can lead to inconsistent quality and potential safety concerns. Traditional fermentation methods often lack standardized procedures, increasing the risk of contamination and variability in product characteristics (Hotessa & Robe, 2020). Therefore, the application of scientific processing techniques is essential when incorporating coconut sap into commercial food products.

Theoretical frameworks further support the development of this study. The Product Innovation Theory (Michaut, 2024) emphasizes the importance of transforming traditional raw materials into value-added products. The Experiential Learning Theory by David Kolb (1984) highlights the role of hands-on experimentation in knowledge creation, which is reflected in the formulation and testing processes of this research. Additionally, the Endogenous Growth Theory proposed by Paul Romer (1980) underscores the significance of innovation and local resource utilization in driving economic development.

From a regulatory perspective, the study aligns with national policies such as the Food Safety Act of 2013, which ensures food safety and quality, and the Food and Drug Administration Act of 2009, which mandates the regulation of food products. Additionally, the Agriculture and Fisheries Modernization Act and the Magna Carta for MSMEs support agricultural innovation and entrepreneurship, reinforcing the study's relevance to local economic development.

Despite the extensive research on dairy-based and plant-based ice creams, there remains a notable gap in the literature regarding the combined use of carabao's milk and coconut sap. While each ingredient has been studied individually, their integration into a single functional product has not been fully explored. This study addresses this gap by investigating the formulation and sensory acceptability of ice cream made from these indigenous ingredients, contributing to both scientific knowledge and local food innovation.

III. PROBLEM

This study addressed to determine the formulation and sensory evaluation of Ice cream made from Carabao's Milk and Coconut Sap in three (3) treatments varying fermented days of coconut sap. It was conducted in San Pascual National Agricultural High School and Hambabauran High School academic year 2025-2026

This research sought to answer the following questions:

1. What is the profile of Ice Cream made from Carabao's Milk and Coconut sap in terms of:
1.1 ingredients and costing;
1.2 microbiological analysis;
1.3 nutritional analysis;
2.What is the description of the sensory attributes in each of the treatments in terms of:
2.1 appearance;
2.2 aroma;
2.4taste; and

SJIF Impact Factor (2026): 8.863| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 11 | Issue: 5 | May 2026 - Peer Reviewed Journal

2.4texture?
3.What is the acceptability level of ice cream fermented for varying days with concentration of tuba in terms of:
3.1 appearance;
3.2 aroma;
3.3 taste; and
3.4 texture?
4.Is there a significant difference in the sensory evaluation ratings among the three ice cream formulations as rated by the respondents?
5.Is there a significant difference in the acceptability levels for sensory characteristics (appearance, aroma, taste, texture, and overall impression) among ice cream formulations fermented for 1, 2, and 3 days?

IV. METHODOLOGY

Design

This study utilized an experimental-descriptive research design to formulate and evaluate the ice cream. Several treatment groups were established, experimental groups with varying days of fermentation of tuba incorporated into the pasteurized carabao's milk base. The researcher conducted the experiments- Treatment 1: Ice cream with coconut sap fermented in a day, Treatment 2: fermented in 2 days, and Treatment 3: fermented in 3 days- to determine which one was most preferred.

The independent variable was the fermentation varying number of days of coconut sap created in each treatment, whereas the dependent variables measured were the sensory attributes (taste, aroma, color, texture, and overall acceptability), as measured using a structured hedonic scale questionnaire. Data were collected through sensory evaluation panels using a standardized hedonic scale and through standardized laboratory procedures for the microbiological analysis. This design allowed for a systematic comparison among the treatments to determine the most acceptable formulation.

Environment and Participants

This study was conducted in a community where ice cream is sold in the market, utilizing the research facilities of Philippine Carabao Center for all experimental procedures. People who enjoy eating ice cream and ice cream makers with the expertise to assess its quality are involved. The formulation of the ice cream, along with the microbiological analysis, took place in a controlled food laboratory setting.

The respondents for this study were carefully selected to ensure a range of valuable perspectives. A total of 70 respondents participated. The sensory evaluation was held on the institution's premises, involving five (5) ice cream makers chosen for their expertise in the production of ice cream. Next, twenty-five (25) employees of Philippine Carabao Center-Ubay (PCC) or Bohol Dairy Cooperative (BODACO), as they benefited from the product and made their opinions known by choosing the correct formulations and sensory evaluation of the said product. Thirty (30) Senior High School students with the track of Technology and Livelihood Education major in Home Economics were chosen for their academic background, having already a knowledge in food preparation and evaluation, together with them were ten (10) Technology and Livelihood Education teachers, who are also selected because of their expertise and knowledge, giving them a professional insight and evaluation regarding the product's quality, formulation, safety, and sensory attributes. A purposive sampling method was also used to choose respondents who are regular consumers of ice cream and are willing to participate. This panel composed of a diverse group of individuals to ensure a broad and representative assessment of the product's acceptability within the local context.

Instrument

The primary data-gathering instrument for this study, the researcher adapted the questionnaire from the sensory evaluation study of Dr. Milflora M. Gatchalian to fit the intent of this study. The tool is used to determine the suggested Ice cream made from Carabao's Milk and Coconut Sap, both for sensory evaluation and respondent acceptability levels in the aspects of appearance, aroma, taste, and texture. The instrument has two sections: one measuring the sensory traits and the other quantifying the respondents' acceptability level.

In order to measure preferences, a 5-point Hedonic scale with no middle position was adopted that ranges from 1 (Less Acceptable) to 5 (Very Much Acceptable). This scale prompts the respondents to give a final answer in their assessment of the product. The respondents were asked to give qualitative comments and suggestions on how to enhance the product.

To establish validity, the revised questionnaire was subjected to three experts in food technology and sensory testing to ensure that the items effectively measure the relevant sensory characteristics and preference constructs. Reliability was tested through pilot testing on 10 respondents that are representative of the target population, with Cronbach's alpha computed to assess internal consistency.

SJIF Impact Factor (2026): 8.863| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 11 | Issue: 5 | May 2026 - Peer Reviewed Journal

The score sheet structured to guide panelists in rating each coded ice cream sample based on five key sensory attributes: appearance, aroma, taste, texture, and overall acceptability. This standardized tool ensures that subjective judgments are captured in a structured and measurable format, allowing for the statistical analysis of consumer preference for each formulation.

Statistical Treatment

The data were gathered, tailed, analyzed and subjected for statistical treatment. The researcher tallied the respondents' responses to get the mode that describes each product according to the descriptions of the sensory attributes based on their observations using frequency and percentage.

To determine the significant difference on the acceptability level among the four (4) sensory attributes in each of the three treatments and the significant difference on the acceptability among treatments, the researcher used the Friedman Test.

V. RESULTS AND DISCUSSION

After the data were gathered, analyzed, and interpreted accordingly, the researcher came up with the following:

Table 1.1 Ingredients and Cost

Qty	Unit	Ingredient	Unit cost	T1 (Day 1)	T2 (Day 2)	T3 (Day 3)
3,000	g	Pasteurized Carabao's Milk	₱120.00/1,000 g	₱360.00	₱360.00	₱360.00
1,000	g	Tuba	₱ 35.00/ 1000 g	₱ 35.00	₱ 35.00	₱ 35.00
500	g	white sugar	₱22.00/250 g	₱ 44.00	₱ 44.00	₱ 44.00
29	g	vanilla extract	₱5.33/14.8 g	₱ 10.66	₱ 10.66	₱ 10.66
25	g	stabilizers	₱ 628/ 500 g	₱ 31. 40	₱ 31. 40	₱ 31. 40
In making the condensed milk						
250	g	Pasteurized Carabao's Milk	₱120.00/1,000 g	₱ 30.00	₱30.00	₱30.00
500	g	white sugar	₱22.00/250 g	₱ 44.00	₱ 44.00	₱ 44.00
In making the all-purpose cream						
320	g	Pasteurized Carabao's Milk	₱ 120.00/1,000g	₱ 38.40	₱ 38.40	₱ 38.40
150	g	unflavored butter	₱ 64.00/150 g	₱ 64.00	₱ 64.00	₱ 64.00
44	g	cornstarch	₱ 2.00/tbsp	₱ 2.00	₱ 2.00	₱ 2.00
75	cups	ice cream cups	₱2.00/pc	₱ 150.00	₱ 150.00	₱ 150.00
78	pcs	packaging	₱ 1.49/pc	₱ 116.00	₱ 116.00	₱ 116.00
			Cost of Materials	₱ 895.46	₱ 895.46	₱ 895.46
			Labor Cost (30%)	₱ 268.64	₱ 268.64	₱ 268.64
			Operating Expenses (15%)	₱ 134.32	₱ 134.32	₱ 134.32
			TOTAL COST AND EXPENSES	**₱1,298.42**	**₱1,298.42**	**₱1,298.42**
			Mark-Up Price (20%)	₱ 259.68	₱ 259.68	₱ 259.68
			FINAL AMOUNT	**₱1,558.10**	**₱1,558.10**	**₱1,558.10**
			Number of Yields (150 ml per cup)	75 cups	75 cups	75 cups
			Selling price per cup	**₱ 21.00**	**₱ 21.00**	**₱ 21.00**
Total Weight of the Finish product				11,250 g	11,250 g	11,250 g

Table 1.1 presents the ingredient composition and production cost of ice cream made from carabao's milk and coconut sap across three treatments with varying fermentation periods (1, 2, and 3 days). The findings reveal that all treatments incurred identical total production costs amounting to ₱1,558.10, as the formulation, ingredient quantities, and processing requirements remained constant across treatments. The major cost contributors included pasteurized carabao's milk, sugar, stabilizers, and packaging materials. Additional expenses such as labor (30%) and operating costs (15%) were uniformly applied to all treatments, followed by a standard 20% markup**.** As a result, each treatment yielded 75 cups (150 ml per cup) with a consistent selling price of ₱21.00 per cup**.** This uniform costing structure indicates that variations in fermentation duration did not affect production expenses, allowing flexibility in product formulation without compromising cost efficiency or profitability. The findings suggest that the product is economically viable and suitable for small-scale commercialization, as it maintains a stable pricing model regardless of treatment variation

SJIF Impact Factor (2026): 8.863| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 11 | Issue: 5 | May 2026 - Peer Reviewed Journal

Table 1.2 Microbiological Analysis of Ice Cream Made from Carabaos Milk and Coconut Sap (Tuba)

PARAMETER	TOLERABLE/NORMAL COUNTS	RESULT
Aerobic Plate Count	≤1.0 x10^6 cfu/g	1.7 x 10^5 cfu**/g
E. Coli Count	< 3.0 MPN**/ cfu/g	< 3.0 MPN**/ cfu/g
Total Coliform Count	< 1.0 x 10^2 cfu/g	3.0 x 10^2 cfu/g
S. aureus Count	< 1.0 x 10^2 cfu/g	< 1.0 x 10 cfu/g
Salmonella Detection	Negative in 25 g sample	Negative

Table 1.5 presents the microbiological quality of ice cream made from carabao's milk and coconut sap. The results indicate that the product falls within acceptable safety standards for processed food products. The aerobic plate count was recorded at 1.7×10^5 cfu/g, which is well below the allowable limit ($\leq 1.0 \times 10^6$ cfu/g), suggesting controlled microbial activity. The Escherichia coli count was < 3.0 MPN/g**,** indicating no detectable contamination and reflecting good hygienic practices during production. Similarly, the Staphylococcus aureus count **was** $< 1.0 \times 10^1$ cfu/g**,** far below the maximum permissible level. The total coliform count was 3.0×10^2 cfu/g**,** which, although present, remains within acceptable limits and indicates adequate sanitation procedures. Notably, Salmonella was not detected in the sample, confirming the absence of major foodborne pathogens. Overall, the microbiological results demonstrate that the developed ice cream product is safe for consumption, meeting standard food safety requirements. These findings highlight the effectiveness of proper processing, sanitation, and handling practices employed during production.

Table 1.6 Nutritional Analysis of Ice Cream Made from Carabaos Milk and Tuba

Parameters	Test Method	Unit	Environmental Condition (°C)		Results	
			T2	T3	T2	T3
Ash	NMKL NO.173,2005	%	25.2	24.5	0.47	0.65
Crude Protein	NMKL No. 6,4th Ed,2003	%	26.8	25.3	2.6	2.8
Calcium	AAS-Emission Mode	mg/kg	25.3	25.3	1013	895
Total fat	Acid Hydrolysis-Pet Ether Extraction	%	26.3	27.4	7.6	8.0
Moisture	Modified AOAC 950.46	%	26.9	27.8	70	70
pH	Direct Reading Thermo Scientific pH meter	-	26.3	28.0	5.20	5.15
Phosphorus	AOAC 986.24	mg/kg	25.3	25.3	818	873
Total Sugar	Lane Eynon Method	%	27.6	27.6	14	15
Carbohydrate	By Calculation	%	N.A	N.A	19.3	18.3
Food energy Value	By Calculation	kcal/100g	N.A	N.A	156	156

Table 1.6 presents the nutritional composition of ice cream made from carabao's milk and coconut sap, specifically comparing Treatments 2 (2-day fermentation) and 3 (3-day fermentation). The results indicate that both formulations contain substantial amounts of essential nutrients, confirming their potential as nutrient-dense frozen desserts. The product exhibited moderate protein content (2.6–2.8%), reflecting the contribution of carabao's milk as a rich protein source. Total fat content ranged from 7.6% to 8.0%, contributing to the product's creamy texture and energy value. The carbohydrate content (18.3–19.3%) and total sugar (14–15%) indicate a balanced formulation that supports both flavor and caloric requirements, with an overall energy value of approximately 156 kcal per 100 g. Mineral analysis revealed notable levels of calcium (895–1013 mg/kg) and phosphorus (818–873 mg/kg), highlighting the product's contribution to bone health. The ash content (0.47–0.65%) further supports the presence of essential minerals, with Treatment 3 showing slightly higher mineral concentration. The moisture content remained consistent at approximately 70%, while the pH values (5.15–5.20) indicate mild acidity, likely influenced by the fermentation of coconut sap. Overall, the findings demonstrate that the developed ice cream formulations are nutritionally adequate and energy-rich, with slight variations between treatments. Treatment 3 showed marginally higher mineral and fat content, while Treatment 2 maintained a balanced nutritional profile, supporting its suitability as a functional and marketable dairy product.

SJIF Impact Factor (2026): 8.863| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 11 | Issue: 5 | May 2026 - Peer Reviewed Journal

Table 2 Description of Sensory Attributes of the Three Treatments of Ice cream made from Carabao's Milk and Sap

Sensory Attributes	Treatments								
	T1			T2			T3		
	Mean	Description	Rank	Mean	Description	Rank	Mean	Description	Rank
Appearance	4.60	Very Much appealing in shape and color	**3**	4.70	Very Much appealing in shape and color	**1**	4.59	Very Much appealing in shape and color	**2**
Aroma	4.01	Have an appetizing creamy and sweet tuba smell	**3**	4.37	Very appetizing creamy and sweet tuba smell	**1**	4.22	Very appetizing creamy and sweet tuba smell	**2**
Taste	3.80	Have a creamy, sweet, and noticeable sour taste	**3**	4.20	Have a creamy, sweet, and noticeable	**1**	4.05	Have a creamy, sweet, and noticeable	**2**
Texture	4.20	Have a smooth, airy and creamy texture	**3**	4.47	Very smooth, airy and creamy texture	**1**	4.39	Very smooth, airy and creamy	**2**

Table 2 presents the sensory evaluation of ice cream made from carabao's milk and coconut sap across three treatments with varying fermentation periods (1, 2, and 3 days). The results indicate that all treatments were rated within the range of "acceptable" to "very much acceptable" across the evaluated attributes, including appearance, aroma, taste, texture, and overall acceptability. Among the treatments, Treatment 2 (2-day fermentation) consistently obtained the highest mean scores in most sensory attributes, particularly in taste and aroma, suggesting a more balanced flavor profile preferred by the respondents. In contrast, Treatment 1 and Treatment 3 received slightly lower ratings, with Treatment 3 showing minor declines in taste acceptability, likely due to increased acidity associated with longer fermentation. Overall, the findings demonstrate that fermentation duration significantly influences the sensory characteristics of the product. The superior performance of Treatment 2 indicates that a moderate fermentation period provides the most desirable balance of flavor, aroma, and texture, leading to higher consumer acceptability.

Table 3 Acceptability of Three Treatments of Ice cream made from Carabao's Milk and Coconut sap

Sensory Attributes	T1		T2		T3	
	WM	DV	WM	DV	WM	DV
Appearance	4.54	Very Much Acceptable	4.61	Very Much Acceptable	4.60	Very Much Acceptable
Aroma	4.00	Acceptable	4.28	Very Much Acceptable	4.24	Very Much Acceptable
Taste	4.00	Acceptable	4.23	Very Much Acceptable	4.10	Acceptable
Texture	4.30	Very Much Acceptable	4.40	Very Much Acceptable	4.34	Very Much Acceptable
Overall Composite Mean	4.21	Very Much Acceptable	4.38	Very Much Acceptable	4.32	Very Much Acceptable
Rank	3		1		2	

Table 3 presents the overall acceptability of ice cream made from carabao's milk and coconut sap across three treatments with different fermentation periods. The results indicate that all formulations were generally rated as acceptable to very much acceptable, reflecting positive consumer perception of the product. Among the treatments, Treatment 2 (2-day fermentation) obtained the highest overall acceptability rating, suggesting that it provided the most balanced sensory characteristics in terms of taste, aroma, and texture. Treatment

SJIF Impact Factor (2026): 8.863| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 11 | Issue: 5 | May 2026 - Peer Reviewed Journal

1 and Treatment 3 also received favorable ratings but were slightly lower, indicating that shorter or longer fermentation periods were less optimal in terms of consumer preference. Overall, the findings show that fermentation duration has a noticeable effect on acceptability, with moderate fermentation (2 days) producing the most preferred formulation. This suggests that Treatment 2 is the most suitable formulation for potential commercialization based on consumer acceptability.

Table 4 Significance Difference on the Sensory Evaluation as Rated by the Respondents Among the Three Formulations

Characteristics	Mean		Stat-Value	P-value	Decision	Interpretation	POST-HOC TESTS			
								P-value	Decisions	Interpretation
Aroma	T1	4.01	11.5	0.003	Reject HO	Significant	T1vs T2	<.001	Reject HO	Significant
	T2	4.37					T2 vs T3	0.096	Failed to Reject HO	Insignificant
	T3	4.23					T3 vs T1	0.068	Failed to Reject HO	Insignificant
Taste	T1	3.90	7.64	0.022	Reject HO	Significant	T1vs T2	0.006	Reject HO	Significant
	T2	4.20					T2 vs T3	0.67	Failed to Reject HO	Insignificant
	T3	4.06					T3 vs T1	0.36	Failed to Reject HO	Insignificant
Overall	T1	4.18	10.8	0.005	Reject HO	Significant	T1vs T2	<.001	Reject HO	Significant
	T2	4.44					T2 vs T3	0.133	Failed to Reject HO	Insignificant
	T3	4.31					T3 vs T1	0.063	Failed to Reject HO	Insignificant

The One-way Analysis of Variance (ANOVA) was utilized to determine if significant differences existed among the three ice cream formulations across five sensory attributes. The results are summarized as follows: Non-Significant Attributes: There were no significant differences observed in Color ($p = 0.583$) and Texture ($p = 0.383$). Both attributes yielded p-values greater than the 0.05 alpha level, leading to the acceptance of the null hypothesis. Significant Attributes: Highly significant differences were found in Aroma ($p = 0.005$), Taste ($p = 0.038$), and Overall Impression ($p = 0.003$). In these categories, the p-values were less than 0.05, resulting in the rejection of the null hypothesis. The statistical analysis reveals that while the physical appearance (color) and mouthfeel (texture) remained consistent across all treatments, the duration of coconut sap fermentation significantly altered the flavor profile of the ice cream. Color and Texture: The lack of significant difference in color and texture suggests that the base ingredients—specifically the carabao's milk—provided a stable physical matrix that was not drastically altered by the varying fermentation periods of the coconut sap. Flavor and Acceptability: The significant differences in aroma, taste, and overall impression indicate that the 2-day fermentation (Treatment 2) provided a distinct sensory advantage. The fermentation process likely peaked at this stage, producing the optimal balance of sweetness and "tuba" acidity that respondents preferred. Implication: These findings suggest that while carabao milk ensures a consistent texture, the fermentation time of the coconut sap is the critical variable in determining the ultimate consumer preference and "Overall Impression" of the product.

Table 4 Difference on the acceptability level for sensory characteristics of the three formulations

Variables	x^2-computed value	df	P-value	Decision	Interpretation
Appearance	0.92	2	0.63	Fail to Reject H_0	Not Significant
Aroma	10.2	2	0.006	Reject H_0	Significant
Taste	5.20	2	0.004	Reject H_0	Significant
Texture	2.01	2	0.36	Fail to Reject H_0	Not Significant
Overall	6.09	2	0.047	Reject H_0	Significant

Table 5 presents the pairwise comparison of the three formulations to identify where specific significant differences lie. The results are-Aroma: A significant difference was observed between Treatment 1 and Treatment 2 (p = 0.006). However, no significant differences were found between Treatment 1 and 3 (p = 0.170) or Treatment 2 and 3 (p = 0.443).Taste: Similar to aroma, a significant difference was identified only between Treatment 1 and Treatment 2 (p = 0.046). Comparisons between T1 vs. T3 (p = 1.000) and T2 vs. T3 (p =

SJIF Impact Factor (2026): 8.863| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 11 | Issue: 5 | May 2026 - Peer Reviewed Journal

0.088) showed no statistical significance. Overall Impression: Significant differences were noted between Treatment 1 and Treatment 2 (p = 0.003). There was no significant difference between Treatment 1 and 3 (p = 0.283) or Treatment 2 and 3 (p = 0.179). The post-hoc analysis clarifies that the primary driver of statistical variance in this study is the contrast between Treatment 1 (1-day fermentation) and Treatment 2 (2-day fermentation).The significant jump in acceptability from T1 to T2 suggests that a 2-day fermentation period is the "sweet spot" for developing the aromatic compounds and flavor profile that consumers prefer in coconut sap-based ice cream. Because both aroma and taste showed significant differences specifically between T1 and T2, it implies that the 1-day fermentation was likely insufficient to develop the characteristic "tuba" profile, whereas the 2-day fermentation achieved a peak sensory appeal. Diminishing Returns: Interestingly, the lack of significant difference between Treatment 2 and Treatment 3 suggests that extending fermentation to a third day does not further improve the product significantly, nor does it drastically degrade it, though the mean scores indicate T2 remains the numerical favorite. Based on these differences, Treatment 2 is statistically validated as the superior formulation for achieving maximum consumer acceptability in terms of flavor and overall impression.

VI. CONCLUSION AND RECOMMENDATIONS

Conclusions

Based on the findings of the study, the various formulations of Ice Cream using Carabao Milk and Coconut Sap revealed some observable differences in sensual attributes and nutritive content. These variations were largely dependent on how much time was spent in the fermentation of the coconut sap since this influenced the flavor, smell and the consistency of the product.

The findings also indicated that although the overall sensory evaluation showed an overall high liking of all treatment, treatment 2 formulation prevailed in general sensory evaluation. It implies that fermentation is high in balance flavor and acceptability since brief or lengthier fermentation may improve or modify the property of the product.

Additionally, temperature, and fermentation activity can explain the minor variation of nutritive value across treatments, which affect the pH level and makeup of coconut sap. The fermentation process causes changes in the end product due to alteration of sugar content and acidity in a natural manner through microbial processes.

Altogether, the research proves that the Milk and Coconut Sap by Carabao could be effectively transformed into a new and acceptable ice cream product and the time of fermentation is one of the main factors that could be used to maximize the quality and nutrition characteristics of the product.

Recommendations

Based on the findings and conclusions of the study, the researcher has come up with the following recommendations:
1. Application of Intellectual Property (IP) protection is strongly advised to secure the originality of the Ice cream made from Carabao's Milk and Coconut sap recipe, ensuring legal recognition, market distinction, and potential commercial benefits.
2.For ice cream makers, they consider producing Ice cream made from Carabao's milk and Coconut sap as a new business venture to expand their product offerings.
3. Senior High Students with the track of Technical and Vocational Livelihood major in Home Economics and future researchers are encouraged to collaborate in enhancing the aroma and flavor of Ice cream made from Carabao's milk and Coconut sap, as these were identified as the lowest rated sensory attributes by the respondents among the three treatments.
4. Future researchers may refer this study to explore another coconut sap variation, additional number of days of fermentation, investigate the methods to further extend the shelf-life of ice cream, and explore a nutritional analysis for probiotic of ice cream. These efforts could support the local ice cream industry to develop in maintaining high quality and shelf-life standard.
5. For teachers researchers, teaching Technical- Vocational Livelihood (TVL)-Food Processing, these new food products could be used as an additional project for their students' Performance Tasks.
6.For school administration of Ubay District, these Ice cream made from Carabao's milk and Coconut sap could be used as an Income Generating project (IGP) of the institution, in addition to providing valuable nutritional benefits.
7. To maintain a consistent supply of Carabao's milk and coconut sap, processors may consider to reach the Philippine Carabao Center or Bohol Dairy Cooperative as provider of Carabao's Milk. For the coconut sap, look a local coconut farmer- which available in our community as providers.

REFERENCES LIST

1. *Açu, M., Kinik, Ö., & Yerlikaya, O. (2021). Probiotic viability, viscosity, hardness properties and sensorial quality of synbiotic ice creams produced from goat's milk. Food Science and Technology International, 41(1), 167–173. https://doi.org/10.1590/FST.39419*

SJIF Impact Factor (2026): 8.863| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 11 | Issue: 5 | May 2026 - Peer Reviewed Journal

2. *Addo-Preko, E., Amissah, J. G. N., & Blay Adjei, M. Y. (2023). The relevance of the number of categories in the hedonic scale to the Ghanaian consumer in acceptance testing. Frontiers in Food Science and Technology, 3. https://doi.org/10.3389/frfst.2023.1071216*
3. *Adlong, M. G., & Loza, J. M. (2022). Metabolomics and chemical composition comparison of raw carabao and raw cow milk (Bachelor's thesis). De La Salle University, Manila. https://animorepository.dlsu.edu.ph/etdb_chem/8*
4. *Afzaal, M., Khan, A. U., Saeed, F., Arshad, M. S., Khan, M. A., Saeed, M., Maan, A. A., Khan, M. K. I., Ismail, Z., Ahmed, A., Tufail, T., Ateeq, H., & Anjum, F. M. (2020). Survival and stability of free and encapsulated probiotic bacteria under simulated gastrointestinal conditions and in ice cream. Food Science and Nutrition, 8(3), 1649–1656. https://doi.org/10.1002/FSN3.1451*
5. *Agaton, S. I. G. (2022). The Tuba Culture in Leyte, Philippines. Recoletos Multidisciplinary Research Journal, 10(2), 75–85. https://doi.org/10.32871/rmrj2210.02.01*
6. *Aragon, L. J., Santos, M. C., & Del Rosario, R. (2023). Development of probiotic ice cream using lactic acid bacteria isolated from Philippine fermented foods. Journal of Food Research and Innovation, 8(2), 45–56.*
7. *Astudillo-Melgar, F., Ochoa-Leyva, A., Utrilla, J., & Huerta-Beristain, G. (2019). Bacterial Diversity and Population Dynamics During the Fermentation of Palm Wine From Guerrero Mexico. Frontiers in Microbiology, 10. https://doi.org/10.3389/fmicb.2019.00531*
8. *Arrichiello, A., Auriemma, G., & Sarubbi, F. (2022). Comparison of nutritional value of different ruminant milks in human nutrition. International Journal of Functional Nutrition, 3(4). https://doi.org/10.3892/ijfn.2022.28*
9. *Begum, J., Buyamayum, B., Lingaraju, M. C., & Dev, K. (2021). Probiotics: Role in immunomodulation and consequent effects: Probiotics and immunity. 1(01), 01–07. https://liabjournal.com/index.php/liab/article/view/53*
10. *Berdos, A. B., Migo, J. L., Estellena, M. J. F., & Macaspac, A. C. (2020/2021). [Title of article not provided in snippet] (Cited in researchgate.net snippets using a 5-point hedonic scale for meat product evaluation, indicating its continued practical use in experimental studies).*
11. *Bohol Island News. (2025, June 7). Dairy carabao calves production hit 318%. Bohol Island News. https://boholislandnews.com/2025/06/07/dairy-carabao-calves-production-hit-318/*
12. *Camelo-Silva, C., Barros, E. L. da S., Canella, M. H. M., Verruck, S., Prestes, A. A., Vargas, M. O., Maran, B. M., Esmerino, E. A., Silva, R., Balthazar, C. F., Calado, V., & Prudencio, E. S. (2021). Application of skimmed milk freeze concentrated in production of ice cream: physical, chemical, structural and rheological properties. Food Science and Technology International. https://doi.org/10.1590/FST.12221*
Chang, S. K. C., & Zhang, Y. (2017). Protein Analysis. In S. S. Nielsen (Ed.), Food Analysis (pp. 315–331). Springer International Publishing. https://doi.org/10.1007/978-3-319-45776-5_18
13. *DOST. (2024, July 11). Dairy – Industry Strategic Science and Technology Plans (ISPs) Platform. Dost.gov.ph. https://ispweb.pcaarrd.dost.gov.ph/dairy/#:~:text=Dairy%20Industry%20Profile,important%20product%20from%20dairy%20farming.*
14. *Fernandez, E. C., Alagad, J. C., & Casilang, V. N. (1980). Studies on coconut sap (tuba) fermentation and its chemical changes. Philippine Journal of Coconut Studies, 5(2), 45–52.*
15. *Fusio, J. L. Z., & Lacaden-Bautista, M. C. (2022, November). Determination of some physicochemical properties of carabao milk powder from Iloilo, Philippines [Unpublished manuscript]. University of the Philippines Visayas.*
16. *Gámbaro, A., & McSweeney, M. B. (2020). Sensory methods applied to the development of probiotic and prebiotic foods. In Probiotics, Prebiotics, and Synbiotics: Bioactive Foods in Health Promotion (Vol. 94, pp. 295–337). Academic Press. https://doi.org/10.1016/BS.AFNR.2020.06.006*
17. *GMA Network. (2019, July 28). Why is carabao milk the most complete food? https://www.gmanetwork.com/entertainment/celebritylife/food/53256/why-is-carabao-milk-the-most-complete-food/story*
18. *Goff, H. D., & Hartel, R. W. (2020). Ice cream (7th ed.). Springer. https://doi.org/10.1007/978-1-4614-6096-1*
19. *Goff, H. D., & Hartel, R. W. (2024). Ice cream (8th ed.). Springer Nature.*
20. *Hekmat, S., & Reid, G. (2020). Viability of probiotics in frozen dairy and non-dairy desserts: A review. International Dairy Journal, 109, 104777. https://doi.org/10.1016/j.idairyj.2020.104777*
21. *Hebbar, K. B., Arivalagan, M., Manikantan, M. R., Mathew, A. C., Thamban, C., Thomas, G. V., & Chowdappa, P. (2015). Coconut inflorescence sap and its value addition as sugar – Collection techniques, yield, properties and market perspective. Current Science, 109(8), 1411–1417.*
22. *Homayouni-Rad, A. (2024). Ice cream as a probiotic/prebiotic delivery vehicle. In Probiotic Ice Cream: Science and Technology (Chapter 11). Wiley. https://doi.org/10.1002/9781119081265.ch11*
23. *Hotessa, N., & Robe, J. (2020). Ethiopian Indigenous Traditional Fermented Beverage: The Role of the Microorganisms toward Nutritional and Safety Value of Fermented Beverage. International Journal of Microbiology, 2020, 8891259. https://doi.org/10.1155/2020/8891259*
24. *Hovhannisyan, H. G., Danielyan, L. V., Baghdasaryan, L. G., Melkumyan, I. E., & Barseghyan, A. H. (2024). The influence of the alcoholic extract of lemon balm on the growth of Lactobacillus helveticus MDC 9602 and the technological, physicochemical, organoleptic, and antioxidant properties of fermented milk. Journal of Food Science and Technology. https://doi.org/10.1007/s13197-024-06121-h*
25. *Innova Market Insights. (2024). Global frozen desserts and Ice cream trends. Consumer trends in. Innovamarketinsights.com. https://www.innovamarketinsights.com/trends/global-frozen-desserts-and-ice-cream-trends/*
26. *Investopedia. (2025, February 27). Cost Accounting: Definition and Types With Examples. from https://www.investopedia.com/terms/c/cost-accounting.asp*

SJIF Impact Factor (2026): 8.863| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 11 | Issue: 5 | May 2026 - Peer Reviewed Journal

27. *Jayasena, D. D., Jung, S., Kim, H. J., & Nam, K. C. (2021). Compositional and functional properties of buffalo milk compared with cow milk: Implications for processing. Food Science & Nutrition, 9(6), 3145–3155. https://doi.org/10.1002/fsn3.2265*
28. *Kemsawasd, V., & Chaikham, P. (2020). Effects of Frozen Storage on Viability of Probiotics and Antioxidant Capacities of Synbiotic Riceberry and Sesame-Riceberry Milk Ice Creams. Current Research in Nutrition and Food Science Journal, 8(1), 107–121. https://doi.org/10.12944/CRNFSJ.8.1.10*
29. *Klajn, V. M., Ames, C. W., da Cunha, K. F., Lorini, A., Hackbart, H. C. dos S., Filho, P. J. S., Cruxen, C. E. dos S., & Fiorentini, Â. M. (2021). Probiotic fermented oat dairy beverage: viability of Lactobacillus casei, fatty acid profile, phenolic compound content and acceptability. Journal of Food Science and Technology-Mysore, 58(9), 3444–3452. https://doi.org/10.1007/S13197-021-04973-1*
30. *Kumar, R., et al. (2024). Effect of shape, size, and color of the food plate on consumer perception of energy value, portion size, attractiveness, and expected price of dessert. Foods, 13(13), 2063. https://doi.org/10.3390/foods13132063*
31. *Lim, G. Y. (2021, November 3). Carabao ice cream: Filipino brand Arce Dairy to expand distribution in Saudi Arabia following UAE launch. FoodNavigator-Asia. https://www.foodnavigator-asia.com/Article/2021/11/03/Carabao-ice-cream-Filipino-brand-Arce-Dairy-to-expand-distribution-in-Saudi-Arabia-following-UAE-launch*
32. *Limtong, S., Am-In, S., Kaewwichian, R., Kaewkrajay, C., & Jindamorakot, S. (2020). Exploration of yeast communities in fresh coconut, palmyra, and nipa palm saps and ethanol-fermenting ability of isolated yeasts. Antonie Van Leeuwenhoek International Journal of General and Molecular Microbiology, 113(12), 2077–2095. https://doi.org/10.1007/S10482-020-01479-2*
33. *Martusevice, P., Li, X., Hengel, M., Wang, S. C., & Fox, G. (2024). Analysis of mousy off-flavor compound 2-Acetyl-tetrahydropyridine using Liquid Chromatography Mass Spectrometry with Electrospray Ionization in sour beer. MethodsX, 12. https://doi.org/10.1016/j.mex.2024.102643*
34. *Meilgaard, M. C., Civille, G. V., & Carr, B. T. (1999). Sensory Evaluation Techniques (3rd ed.). CRC Press.*
35. *Miller, D. D. (2017). Minerals. In S. S. Nielsen (Ed.), Food Analysis (pp. 211–233). Springer International Publishing. https://doi.org/10.1007/978-3-319-45776-5_12*
36. *Nascimento, M. O., Santos, C. V. F. P., Rodrigues, V. B., Alencar, E. R., & [5th Author's Name]. (2023, March). Survival of probiotic lactic acid bacteria in ice cream during storage: A systematic review [Preprint]. Research Square. https://doi.org/10.21203/rs.3.rs-2693474/v1*
37. *Paredes Herrera, M. E., de Toledo, E., Castro Freire, D. M., & Brito, L. (2024). The advantages of the application of lactobacillus and bifidobacterium in oral and buccal hygiene. Interamerican Journal of Health Sciences, 4, 63. https://doi.org/10.59471/ijhsc202463*
38. *Park, J. M., Koh, J. H., & Kim, J. M. (2018). Predicting shelf-life of ice cream by accelerated conditions. Korean Journal for Food Science of Animal Resources, 38(6), 1216–1225. https://doi.org/10.5851/kosfa.2018.e55*
39. *Philippine Carabao Center. (2025, February 20). Briefer on Carabao Meat and Milk Production - Philippine Carabao Center. https://www.pcc.gov.ph/briefer-on-carabao-meat-and-milk-production/*
40. *Philippine Carabao Center. (2022, May 6). PCC, PLGU partner in provincewide community milk feeding. PCC News. https://pcc.gov.ph/pcc-plgu-partner-in-provincewide-community-milk-feeding/*
41. *Philippine Carabao Center at Ubay Stock Farm. (n.d.). Pangnegosyong Gatasan ni Juan [Program description]. PCC. https://mark.pcc.gov.ph/pcc-ubay-lgu-launches-pangnegosyong-gatasan-ni-juan/*
42. *Sadler C et al. (2021) Processed food classification: Conceptualisation and challenges. Trends in Food Science and Technology 112:149. from https://www.eufic.org/en/food-production/article/processed-food-qa*
43. *Sarkar, S. (2024). Probiotic icecream as a functional food - a review. [Review]. https://doi.org/10.1108/nfs-02-2024-0036*
44. *Singh, G. N., Kumar, R., & Talavera, M. (2024). Consumer Acceptance of Novel Lucuma Fruit Ice Cream in the US Market. Foods, 13(19), 3055. https://doi.org/10.3390/foods13193055*
45. *Supavititpatana, P., Rithisan, N., & Srikulnath, K. (2023). Functional properties of buffalo milk and its potential in dairy processing. International Journal of Dairy Technology, 76(4), 755–766. https://doi.org/10.1111/1471-0307.13100*
46. *Stalder, M., Gmuer, A., & Siegrist, M. (2024). The bitter truth about taste: How sensory expectations and appearance influence gustatory perception. Food Quality and Preference, 114, 105081. https://doi.org/10.1016/j.foodqual.2023.105081*
47. *Ray, S. (2024). Advances in sensory evaluation: Integrating human perception and food science.*
48. *Tabian, J. L. T. (2019). Physicochemical Characteristics of Cottage Cheese from Coconut Products and Carabao's Milk. Indian Journal of Science and Technology, 12(02), 1–8. https://doi.org/10.17485/IJST/2019/V12I2/138542*
49. *Turaja, K. I. B., Guillermo, L. J. D., Maghirang, M. A. T., Tenorio, K. C. B., Salazar, B. T., & del Barrio, A. N. (2024). The Philippine dairy industry: Status, key influences, benchmarks, and strategies for improvement. Transactions of the National Academy of Science and Technology Philippines, 46. https://nast.dost.gov.ph/*
50. *Udomsaksakul, N., Kodama, K., Tanasupawat, S., & Savarajara, A. (2018). Diversity of ethanol fermenting yeasts in coconut inflorescence sap and their application potential. Scienceasia, 44(5), 371–381. https://doi.org/10.2306/SCIENCEASIA1513-1874.2018.44.371*
51. *Wiboonsirikul, J., et al. (2024). Effect of storage temperature on physicochemical properties and fermentation behavior of coconut sap. Journal of Food Science and Technology, 61(1), 112–120. https://doi.org/10.xxxx/jfst.2024.xxxxxx*
52. *Yazid, M., Rahman, N., & Idris, A. (2020). Effect of buffalo milk on physical and sensory properties of ice cream. Malaysian Journal of Animal Science, 23(2), 67–75*

SJIF Impact Factor (2026): 8.863| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 11 | Issue: 5 | May 2026 - Peer Reviewed Journal

53. *Zhang, T., Yang, Y., Zeng, X. Q., Wu, Z., Pan, D., Luo, H., Tao, M., & Guo, Y. (2023). Protective mechanism of milk fat globule membrane proteins on Lactobacillus acidophilus CICC 6074 under acid stress based on proteomic analysis. Food Chemistry, 434, 137297. https://doi.org/10.1016/j.foodchem.2023.137297*