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FORMULATION, ANALYSES AND ACCEPTABILITY OF SABA (*Musa balbisiana*) ICE CREAM

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Abstract: The growing demand for healthier and more sustainable alternatives in food production has led to an increased interest in utilizing locally available ingredients, such as fruits, as functional additives. The potential of ripe banana (saba) as a natural thickening ingredient in the making of ice cream was examined in this study. The 10 semi-trained panelists evaluated the sensory qualities in terms of appearance, aroma, consistency, and taste and the final process for consumers' preference evaluation by the 100 evaluators. Score cards with the 9-Point Hedonic Scale were used to obtain the data. The different treatment proportions using the banana as a thickening agent were Treatment A 100g, Treatment B 200g, and Treatment C 300g. Score cards with the Nine (9) Points Hedonic Scale was used to obtain the data. The mean and Analysis of Variance (ANOVA) were used to analyze the data into alpha level set at 0.01 alpha. The result from the sensory evaluation among the three treatments in terms of appearance, aroma, consistency, and taste revealed that Treatment A was extremely appealing, extremely pleasant, extremely smooth, and extremely delicious. Treatment B and Treatment C were very much appealing, very much pleasant, very much smooth, and very much delicious. Furthermore, in terms of consumer acceptability of banana as a thickening agent in making ice cream revealed that among the three treatments in terms of appearance, aroma, texture, and taste, Treatment A100g was liked extremely, while Treatment B 200g and Treatment C 300g were liked very much. Therefore, Treatment A 100g was generally acceptable to the consumers with banana as a thickening agent in making ice cream in terms of appearance, aroma, consistency, and taste. There was no significant difference in the sensory qualities of banana as a thickening agent in making ice cream in terms of appearance, aroma, texture, and taste, as evaluated by the experts and consumers. Therefore, banana as a thickening agent in making ice cream in terms of appearance, aroma, consistency and taste was accepted. The result also revealed that there was a significant difference in terms of appearance, aroma, consistency, and taste on the general acceptability of banana as a thickening agent in terms of appearance, aroma, consistency and taste among the three treatments. Based on microbial and proximate analyses, the product passed the minimum safety guidelines based on the Bureau of Food and Drug standards, indicating it is safe to consume, belonging to frozen goods category.

Keywords: Dessert, Banana, Ice Cream, Frozen, Thickening Agent, Treatments, Acceptability

I. INTRODUCTION

The growing demand for healthier and more sustainable alternatives in food production has led to an increased interest in utilizing locally available ingredients, such as fruits, as functional additives. One such fruit, the ripe banana (*Musa saba*), widely cultivated in the Philippines, has gained attention for its potential applications in various food products. Traditionally, bananas are used as primary food source or in processed forms like chips and puree, but recent studies have shown that ripe bananas, especially the saba variety, could serve as a viable thickening agent in different culinary applications (Florendo & Ruiz, 2020). In particular, its use in ice cream production offers a unique opportunity to enhance the texture and nutritional value of this popular dessert.

Bananas, especially saba, are rich in nutrients, such as potassium, carbohydrates, and dietary fiber, and they are also low in fat, making them a promising ingredient for producing low-fat, high-nutrient ice cream (Mendoza et al., 2021). By incorporating banana as a thickening agent, ice cream manufacturers could reduce the reliance on artificial thickeners, thus offering a more natural and wholesome alternative.

This study investigated the acceptability and sensory properties of banana when used as a thickening agent in ice cream production. Specifically, the study assessed the sensory qualities of the ice cream in terms of appearance, aroma, taste, and consistency, as well as determining its general acceptability across different treatments. In addition, the study examined the microbial and proximate analysis of the ice cream samples to ensure safety and nutritional quality.

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The result of this study could provide insights into the potential use of ripe saba banana as a functional ingredient in the food industry, particularly in the production of healthier ice cream alternatives. The study of Natividad et al. (2019) on the use of banana varieties in dairy products have shown promise in improving texture, flavor, and nutritional content.

The Philippines has 2 distinct seasons, dry (from late March to mid-June, and December to February) and rainy (the rest of the year). But recently, those distinctions seem to blur into something more like hot and hotter, especially as climate change seems to make summers a lot more sweltering. Right now, summer is in full swing, with schools closed and children playing on the street, gravitating towards the delightful sound of the *sorbetes* cart once it comes near. Like the rest of the world, Filipinos like to treat themselves to something cool to keep away the heat, which to some extent one can get hardly used to. Whether it is something deliciously crafted from scratch, grabbed from the neighborhood corner store, or store-bought, there is a variety of tasty ways to keep self cool in the Philippines. Filipinos are also huge fans of ice cream, a characteristic of the country's profound American and Spanish influence. The local variant goes by the name of *sorbetes*, not to be mistaken with the similarly named sorbet. Commonly peddled by street vendors in their colorful carts, *sorbetes*, is often made with coconut or dairy milk, and traditionally served in small wafer cones, and more recently, bread buns. *Sorbetes* often comes in several flavors, such as the favorite ube, keso (cheese), strawberry, and buko pandan.

According to popular legend, ice cream was invented by the ancient Chinese, brought to Italy by Marco Polo, to France by Catherine de Medici, and thence to America by Thomas Jefferson. The truth, however, about summer's favorite chilled dairy treat is a bit more difficult to pin down. Iced drinks and desserts have been around since at least 4000 B.C., when nobles along the Euphrates River built ice houses to take the edge off the Mesopotamian summer heat. Snow, likely used to cool wine, was sold in the streets of Athens in the fifth century B.C., while the Roman emperor Nero (A.D. 37–67) enjoyed iced refreshments laced with honey. Sources from the Tang dynasty in China describe a sweet drink made from iced, camphor-laced water buffalo milk.

However, the specific application of ripe saba as a thickening agent for ice cream has not been extensively explored. Therefore, this research aimed to fill the gap in literature by evaluating the feasibility and consumer acceptability of ripe saba banana as an alternative thickener in ice cream.

II. METHODOLOGY

This chapter presents the methods of research, experimental design and treatments, tools and equipment, experimental procedure, data collection, statistical tool and analysis and cost analysis.

Methods of Research

This study used experimental research. The experimental method of research is a systematic and scientific approach to research in which the researchers manipulate one or more variable. This experimental research aimed to determine the acceptability of banana as a thickening agent in making ice cream.

The experimental method is a systematic and scientific approached to research, which the researcher manipulates one or more variables, and controls and measures any change in other variables. This method was particularly effective for studies requiring objective evaluation and comparison, as it allows for the isolation of specific factors and the observation of their direct effects (McLeod (2019). According to Gravetter and Forzano (2018), the experimental method is highly valued in research for its ability to establish cause-and-effect relationships. It involves a controlled environment, where independent variables are manipulated to observe their impact on dependent variables. This approach is ideal for sensory evaluation studies, as it enables precise measurement of participants' response to different sensory attributes of food products. Applying this method to this study, the banana as a thickening agent in making ice cream was evaluated by the evaluators. By controlling the preparation and presentation conditions, and systematically collecting sensory data, it reliably assessed its acceptability.

Experimental Design

The objective of this study was to formulate a ripe banana (saba) as a thickening agent in making ice cream and evaluate its sensory qualities, general acceptability, and microbial and proximate properties. The study employed a Completely Randomized Design (CRD) with three treatments, each varying in the amount of ripe banana (saba) as a thickening agent. The treatments were evaluated for their sensory characteristics, such as appearance, aroma, taste, and consistency, along with general acceptability and microbial analysis. The study tested three different treatments with varying amounts of ripe banana (saba) as a thickening agent. Treatment A included a low concentration of banana with 100 grams, Treatment B used moderate concentration with 200 grams, and Treatment C had a high concentration with 300 grams.

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Each treatment used the same base ingredients (milk, cream, sugar, stabilizers, etc.), varying only on the concentration of ripe banana. The banana was pureed and mixed with the other ingredients before being churned and frozen.

For each treatment, a blender was used to puree the banana, which was then incorporated into the ice cream mixture, which was then churned using an ice cream maker, frozen, and prepared for sensory evaluation. A panel of 10 trained judges evaluated the ice cream on various sensory attributes, such as appearance, aroma, taste, and consistency. A 9-Point Hedonic Scale was employed for the ratings. The panel also assessed the general acceptability of the treatments by evaluating the overall sensory experience, combining all aspects into a single score. Microbial testing was conducted on the ice cream samples to assess their safety and ensure that no harmful bacteria, yeast, or molds were present. Test like Total Plate Count (TPC) was used to assess the microbial load. Additionally, proximate analysis was performed to determine the ice cream's nutritional composition, such as moisture, fat, protein, carbohydrate, and fiber content. These analyses helped to evaluate the health and nutritional impact of the ice cream made with ripe banana (saba) as a thickening agent. The data for the sensory evaluations were recorded on sensory evaluation forms filled out by the trained judges for each treatment. Statistical software such as Statistical Package for the Social Sciences (SPSS) was used for data entry, organization, and analysis. The results from the sensory evaluations, general acceptability ratings, and microbial and proximate analysis were used to draw conclusions regarding the effectiveness of banana (saba) as a thickening agent in ice cream.

Tools, Equipment and Treatments

A. Tools and Equipment

The materials used in this study were the following: one mixing bowl, one casserole, one spatula, one spoon, one measuring cup, one knife, one plastic cup, and one working table. As for the equipment, one hand mixer, one blender, and one freezer.

B. Treatments

There were three treatments used in this study. Treatment A used 100g of banana puree, 400 ml of coconut, 250g of skimmed milk, and 100ml of condensed milk. Treatment B used 200g of banana puree, 400 ml of coconut, 250g of skimmed milk, and 100ml of condensed milk. Treatment C used 300g of banana puree, 400 ml of coconut, 250g of skimmed milk, and 100ml of condensed milk. In making the ice cream, banana puree as a thickener was used as the main ingredient.

Table 1. Treatments used in the study.

Ingredients	Treatments		
	A	**B**	**C**
Banana Puree	100g	200g	300g
Coconut milk	400ml	400ml	400ml
Skimmed Milk	250g	250g	250g
Condensed Milk	100ml	100ml	100ml

Experimental Procedure

The experimental procedure for this study involved a systematic and standardized approach in preparing, cooking, and presenting the ice cream with banana as thickening agent. The step-by-step process ensured consistency across all treatments and minimized potential variations that could impact the results.

A. Preparation of Ingredients

In preparing the ingredients, the researcher collected the banana saba in Milibili, Roxas City. On the other hand, some ingredients were marketed in BLTS, Barangay 8 Roxas City, Teodoro Arcenas Trade Center, and brought to Capiz State

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University, Main Campus for experiment. The ingredients were then gathered and prepared in the laboratory to make ice cream with banana saba as thickening agent.

B. Procedure in Making Banana Puree as a Thinking Agent in Making Ice Cream

First, bananas (saba) were gathered and selected, ensuring that they were fully ripe and free from blemishes. Next, the gathered bananas were washed under running water. Then, they were steamed and set aside to cool. Afterwards, they were peeled and blended using a blender, ensuring a fine consistency of the banana puree. Then, the banana puree was measured according to the treatment requirements, with Treatment A using 100g, Treatment B using 200g, and Treatment C using 300g. Finally, the prepared banana puree was set aside for use in the subsequent steps.

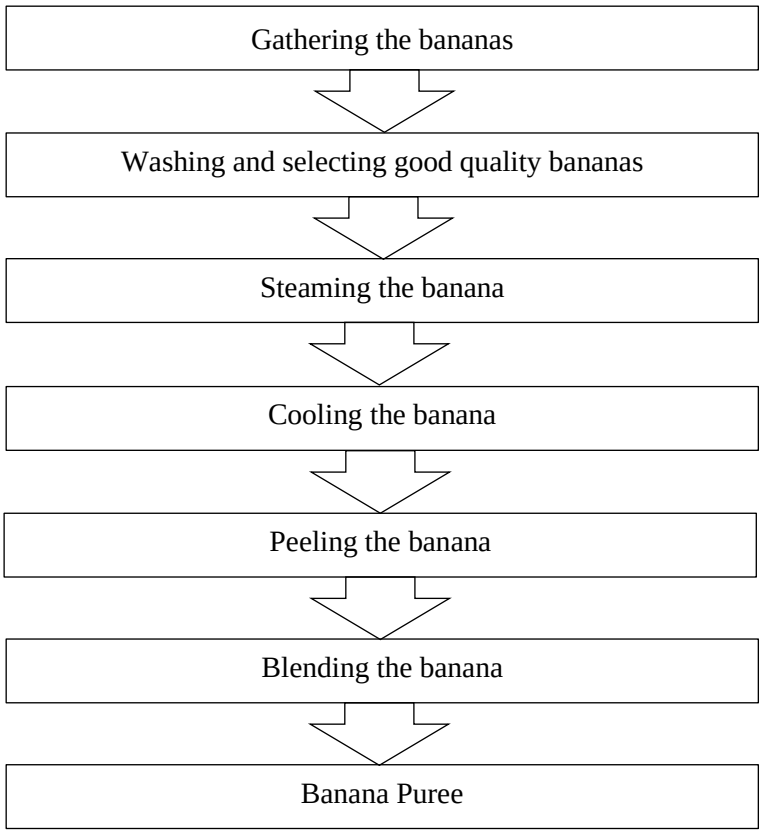

Figure 1. Flow chart in preparing banana puree as a thickener in ice cream.

C. Procedure in Making Ice Cream with Banana as a Thickening Agent

First, the materials and ingredients needed were prepared. Second, the ingredients were measured. Third, the process of double broiling with the coconut milk, banana puree and skimmed milk was done. Fourth, the condensed milk was added and mixed well until the ingredients were well combined. Fifth, the mixture was chilled for 5 to 10 minutes. Sixth, the chilled mixture was mixed until it doubled the size. Seventh, the mixture was transferred to the ice cream cups. Eight, the filled cups were transferred in a freezer for freezing. Lastly, the ice cream with banana as a thickening agent was served.

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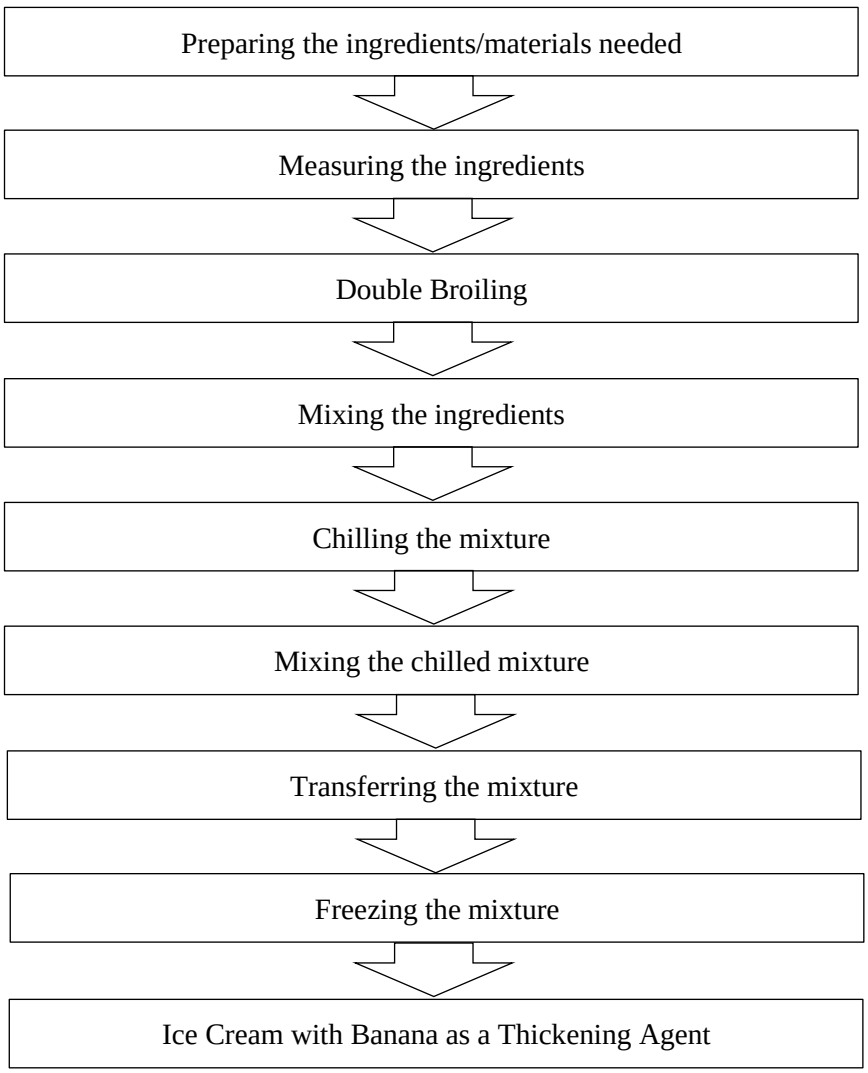

Figure 2. Flow chart in making ice cream with banana as a thickening agent.

Research Instrument

This study used an evaluation sheet for evaluation as a research instrument. This was also used to evaluate the treatments that were undertaken to determine whether the criteria for evaluation would be added for more concrete analysis and result. The experiment considered factors, such as appearance, aroma, taste, and consistency of banana (saba) as a thickening agent in making ice cream.

Collection of Data

For sensory evaluation, the instrument used was a score card. It looked into the quality attributes of the product, such as appearance, aroma, taste and consistency. These four sensory qualities included in determining the general acceptability of banana saba as a thickening agent in making ice cream.

The evaluators were invited and given instructions on how to evaluate the product. The evaluation sheet was given to the participants, experts, teachers, students, and outside consumers with their honest opinions solicited. The evaluators were instructed to evaluate the product using a 9-Point Hedonic Scale as to appearance, aroma, taste, and consistency. The 100 consumer respondents, comprised of 15 Technical-Vocational-Livelihood (TVL) teachers, 45 cookery students in Grade 12 at Capiz National High School, and 30 potential consumers, evaluated the acceptability of the product prepared in three treatments.

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After the evaluation of the product, the evaluation sheets were gathered, tallied, analyzed, and interpreted using a Statistical Package for Social Sciences (SPSS) software. The mean was used to determine the sensory qualities of banana as thickening agent in making ice cream in terms of appearance, aroma, color, taste, and consistency and its general acceptability as a whole. The Analysis of Variance (ANOVA) was used to analyze and interpret the significant difference among three treatments of the product set at 0.01 level of significance.

Scoring of Variables

In scoring the variables, the researchers use the 9-Point Hedonic Rating Scale in evaluating the product. To have a better understanding of the result, the researcher also gave the equivalent interpretation for each scale that corresponds to the rating scale in determining the level of acceptability of the product.

1. Appearance of the Product

Score	Mean Score	Adjectival Description
9	8.12-9.00	Extremely Appealing
8	7.238.11	Very Much Appealing
7	6.34-7.22	Moderately Appealing
6	5.45-6.33	Slightly Appealing
5	4.56-5.44	Neither Appealing Nor Unappealing
4	3.67-4.55	Slightly Unappealing
3	2.78-3.66	Not Moderately Unappealing
2	1.89-2.77	Not Very Much Unappealing
1	1.00-1.88	Not Extremely Appealing

2. Aroma of the Product

Score	Mean Score	Adjectival Description
9	8.12-9.00	Extremely Pleasant
8	7.23-8.11	Very Much Pleasant
7	6.34-7.22	Moderately Pleasant
6	5.45-6.33	Slightly Pleasant
5	4.56-5.44	Neither pleasant Nor Unpleasant
4	3.67-4.55	Slightly Unpleasant
3	2.78-3.66	Not Moderately Unpleasant
2	1.89-2.77	Not Very Much Unpleasant
1	1.00-1.88	Not Extremely Pleasant

3. Taste of the Product

Score	Mean Score	Adjectival Description
9	8.12-9.00	Extremely Delicious
8	7.238.11	Very Much Delicious
7	6.34-7.22	Moderately Delicious
6	5.45-6.33	Slightly Delicious
5	4.56-5.44	Neither Delicious Nor Delicious
4	3.67-4.55	Slightly Delicious
3	2.78-3.66	Not Moderately Delicious
2	1.89-2.77	Not Very Much Delicious
1	1.00-1,88	Not Extremely Delicious

4. Consistency of the Product

Score	Mean Score	Adjectival Description
9	8.12-9.00	Extremely Smooth
8	7.238.11	Very Much Smooth
7	6.34-7.22.	Moderately Smooth
6	5.45-6.33	Slightly Smooth
5	4.565.44	Neither Smooth Nor Smooth
4	3.67-4.55	Slightly Smooth
3	2.78-3.66	Not Moderately Smooth
2	1.89-2.77	Not Very Much Smooth
1	1.00-1.88	Not Extremely Smooth

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To determine the general acceptability of ice cream with banana as a thickening agent in terms of appearance, aroma, consistency and taste,, the following score intervals with their corresponding qualitative description were used.

Consumer Summary of Acceptability

Score	Mean Score	Adjectival Description
9	8.12 - 9.00	Liked Extremely
8	7.238.11	Liked Very Much
7	6.34-7.22	Liked Moderately
6	5.45-6.33	Liked Slightly
5	4.56 - 5.44	Liked or Disliked
4	3.67-4.55	Disliked Slightly
3	2.783.66	Disliked Moderately
2	1.89-2.77	Disliked Very Much
1	1.00-1.88	Disliked Extremely

Statistical Tools and Analysis

The data gathered were analyzed using the Statistical Package for Social Sciences (SPSS) software. The statistical tools used in the analysis of the data gathered were the mean, which was employed to determine sensory qualities and general acceptability of banana (saba) as a thickening agent in making ice cream in terms of appearance, aroma, taste, and consistency and the Analysis of Variance (ANOVA) was used in analyzing and interpreting the significant difference in ice cream in three treatments, set at 0.01 level of significance.

III. RESULTS AND DISCUSSION

This chapter contains the presentation, analysis, and interpretation of data. Tables and textual descriptions of gathered data from the acceptability of banana (saba) as a thickening agent in making ice cream are the focus of discussions and analysis. The data presented at each table are preceded by a textual discussion. The acceptability of the product is also reflected in the table for quality attributes, which are further categorized into appearance, aroma, taste, and consistency.

Sensory Qualities of Banana as a Thickening Agent in Making Ice Cream in terms of Four (4) Sensory Qualities

Table 2 presents the description of appearance, aroma, consistency, and taste, of banana (saba) as a thickening agent in making ice cream.

The result showed that in terms of appearance, Treatment A100g got the highest mean score of 8.30, described as “extremely appealing,” followed by Treatment B 200g with the mean score of 7.90, described as “very much appealing,” and Treatment C 300g with the mean score of 7.70, described as “very much appealing,” as evaluated by the evaluators. This implies that Treatment A 100g was preferred most in terms of appearance.

In terms of aroma, Treatment A 100g got the highest mean score of 8.30, which described as “extremely pleasant”. This was followed by Treatment B 200g with the mean score of 8.10, described as “very much pleasant,” and Treatment C 300g with the mean score of 8.00, described as “very much pleasant,” as evaluated by the evaluators. This implies that Treatment A 100g was preferred in terms of aroma.

In terms of consistency, Treatment A 100g got the highest mean score of 8.50, described as “extremely smooth,” followed by Treatment B 200g with the mean score of 8.10, described as “very much smooth,” and Treatment C300g with the mean score of 8.00, described as “very much smooth,” as evaluated by the evaluators. This implies that Treatment A was preferred most in terms of consistency.

In terms of taste, Treatment A 100g got the highest mean score of 8.50, described as “extremely delicious,” followed by Treatment B 200g with the mean score of 8.00, described as “very much delicious,” and Treatment C 300g with the mean score of 7.70, described as “very much delicious,” as evaluated by the evaluators. This implies that Treatment A 100g stood out and preferred most in terms of taste.

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Sensory studies on banana-enriched food products revealed superior attributes in terms of aroma, taste, and mouthfeel. The result of this study supported Sharma et al. (2020), Li et al. (2022), and Balmurugan et al. (2022) on the idea of banana as a thickening agent due to its sensory attributes. These studies demonstrated that banana can enhance the sensory qualities of the ice cream. A study by Kumar et al. (2020) found that ripe banana pulp enhanced the sensory qualities of ice cream, particularly in creaminess and texture, due to its natural emulsifying properties. Similarly, a study by Santos et al. (2019) revealed that bananas improved the texture and sensory acceptability of desserts, making them a sustainable alternative to synthetic stabilizers.

Table 2. Sensory qualities of banana as a thickening in making ice cream in terms of four sensory qualities.

Sensory Attributes	**Treatment A (100g)**		**Treatment A (200g)**		**Treatment C (300g)**	
	Mean	**AD**	**Mean**	**AD**	**Mean**	**AD**
Appearance	8.30	Ea	7.90	VMa	7.70	VMa
Aroma	8.30	Ep	8.10	VMp	8.00	VMp
Consistency	8.50	Es	8.10	VMs	8.00	VMs
Taste	8.50	Ed	8.00	VMd	7.70	VMd

Legend: ***Adjectival Description (AD)***

Score	***Appearance***	***Aroma***	***Taste***
8.12 – 9.00	*Extremely appealing (Ea)*	*Extremely pleasant (Ep)*	*Extremely delicious (Ed)*
7.23 – 8.11	*Very Much appealing (VMa)*	*Very Much pleasant (VMp)*	*Very Much delicious (VMd)*
6.34 – 7.22	*Moderately appealing (Ma)*	*Moderately pleasant (Mp)*	*Moderately delicious (Md)*
5.45 – 6.33	*Slightly appealing (Sa)*	*Slightly pleasant (Sp)*	*Slightly delicious (Sd)*

Score	***Consistency***
8.12 – 9.00	*Extremely smooth (Es)*
7.23 – 8.11	*Very much smooth (VMs)*
6.34 – 7.22	*Moderately smooth (Ms)*
5.45 – 6.33	*Slightly smooth (Sm)*

Furthermore, Sarker and Haque (2019) found that ripe bananas, when used as a thickening agent, enhanced the sensory qualities of the products, such as aroma, taste, and texture, while reducing food waste. According to Lim et al. (2019), different banana varieties have varying impacts on the sensory and textural properties of ice cream. Their study found that ripe saba bananas were particularly effective due to their high starch and sugar content, making them suitable for frozen desserts.

General Acceptability of Banana as a Thickening Agent in Making Ice Cream of Three Treatments Based on the Four Sensory Qualities

Table 3 presents the general acceptability of banana (saba) as a thickening agent in making ice cream in three treatments. In terms of appearance, the result revealed that Treatment A 100g obtained the highest acceptability mean score of 8.22, described as “extremely appealing”. This was followed by Treatment B 200g with the acceptability mean score of 7.85, described as “very much appealing”. Treatment C 300g got the acceptability mean score of 7.67, described as “very much appealing”. This implies that Treatment A 100g was preferred most in terms of appearance.

The acceptability of banana (saba) as a thickening agent in making ice cream in three treatments in terms of aroma with the highest mean score of 8.22, described as “extremely pleasant” was Treatment A 100g and Treatment B 200g with the mean score of 7.97, described as “very much pleasant,” while Treatment C 300g got the mean score of 7.74, described as “very much pleasant”. This implies that Treatment A 100g was preferred most in terms of aroma.

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The acceptability of banana (saba) as a thickening in making ice cream in terms of consistency with the highest mean score of 8.65, described as "extremely smooth" was Treatment A 100g. This was followed by Treatment B 200g with the score of 8.22, described as "extremely smooth". Treatment C 300g got the mean score of 8.01, described as "very much smooth". This implies that Treatment A 100g was preferred most in terms of consistency. Moreover, the acceptability of banana (saba) as a thickening agent in making ice cream in three treatments in terms of taste with the highest mean score of 8.60, described as "extremely delicious" was Treatment A 100g. This was followed by Treatment B 200g with the mean score of 8.19, described as "extremely delicious," and Treatment C 300g with the mean score 7.86, described as "very much delicious". This implies that Treatment A 100g was preferred most in terms of taste.

The general acceptability of banana (saba) as a thickening agent in making ice cream in three treatments showed that Treatment A 100g got the highest mean score of 8.42, described as "liked extremely". This was followed by Treatment B 200g with the mean score of 8.06, described as "liked very much". Treatment C 300g got the mean score of 7.82, described as "liked very much. This implies that the product with 100g of banana as the thickening agent in ice cream is highly acceptable in all aspects. Treatment B with 200g and Treatment C with 300g of banana as a thickening agent in ice cream were also acceptable in all aspect.

The result aligned to that of Martínez et al.'s (2020), who found that ripe bananas contributed positively to the creaminess and taste of the products, with high acceptability ratings among consumers. It highlighted the role of bananas in enhancing texture and natural sweetness in ice cream formulations.

Table 3. General acceptability of banana as a thickening agent in making ice cream of three treatments in terms of four sensory qualities.

Quality Attributes	**Treatment A (100g)**		**Treatment B (200g)**		**Treatment C (300g)**	
	Mean	AD	Mean	AD	Mean	AD
Appearance	8.22	LE	7.85	LVM	7.67	LVM
Aroma	8.22	LE	7.97	LVM	7.74	LVM
Consistency	8.65	LE	8.22	LE	8.01	LVM
Taste	8.60	LE	8.19	LE	7.86	LVM
General Acceptability	**8.42**	**LE**	**8.06**	**LVM**	**7.82**	**LVM**

Legend: ***Adjectival Description (AD)***

Score	***General Acceptability***
8.12 – 9.00	*Liked Extremely (LE)*
7.23 – 8.11	*Liked Very Much (LVM)*
6.34 – 7.22	*Liked Moderately (LM)*
5.45 – 6.33	*Liked Slightly (LS)*

Likewise, Alcantara et al. (2019) found that saba bananas enhanced the texture, aroma, and overall acceptability of desserts, including ice cream, due to their unique flavor profile and thickening properties. Additionally, Gonzalez et al. (2022) studied the effects of various banana varieties, including saba, in ice cream production. Their research highlighted that saba bananas yielded superior texture and flavor, making them particularly suitable for thickening applications.

Difference in the Sensory Qualities of Banana as a Thickening Agent Ice Cream in terms of Appearance, Aroma, Consistency, and Taste among Three Treatments

Table 4 shows the difference in the sensory qualities of banana as a thickening agent ice cream in terms of appearance, aroma, consistency, and taste among three treatments.

The result revealed that in terms of appearance, (p value .126>0.01alpha) there was no significance difference among the three treatments. This implies that, regardless of the amount of banana as a thickening agent in making ice cream, the three treatments did not differ in the appearance. Therefore, the null hypothesis of the study that no significant different

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exists in the appearance of the three treatments is accepted. This implies that regardless of the proportion per treatments, the appearance of the ice cream with banana as a thickener appeared almost the same.

In terms of aroma (p value .460 > 0.01 alpha), there was no significance difference among the three treatments. This implies that, regardless of the amount of banana as a thickening agent in making ice cream, they did not differ in aroma. Result therefore, accepts the non-existence of a significant different among treatments. This indicates that regardless of the proportion per treatments in ice cream with banana as a thickener, the aromatic quality of the three treatments appeared to be similar.

In terms of consistency (p value .357>0.01 alpha), there was no significance difference found among the three treatments. This implies that, regardless of the amount of banana as a thickening agent in making ice cream, they did not differ in consistency. Therefore, the non-existence of a significant difference in the consistency of the three treatments is accepted. In terms of taste (p value .017>0.01 alpha), there was no significance difference among the three treatments. This implies that, regardless of the amount of banana as a thickening agent in making ice cream, they did not differ in taste. Therefore, the result accepts the null hypothesis of the study. Hence, the taste qualities of the three treatments are not significantly different from each other.

The result disclosed that all the treatments had no significant differences in the variable tested. Given these results, the lack of statistically significant differences among treatments implies that all formulations of banana as a thickening agent in ice cream are similarly acceptable to the panelists in terms of sensory quality. While there may be slight variations in sensory ratings, they are not large enough to influence the overall perception of the product.
The result supported Smith et al. (2019), who focused on consumer acceptance of ice cream formulations enriched with fruit-based thickeners. The result indicated that banana-enriched ice creams received high scores for aroma and creaminess, demonstrating their market potential as a natural additive.

Table 4. Difference in the sensory qualities of banana as a thickening agent ice cream in terms of appearance, aroma, consistency and taste among three treatments.

Sensory Attributes	z	p value	Remarks
Appearance	4.15	0.126	ns
Aroma	1.551	0.460	ns
Consistency	2.062	0.357	ns
Taste	8.161	0.017	ns

Legend: F-value – 2.410 > 0.01, ns = not significant; level of significance = 0.01 alpha

According to Raj et al. (2020), ripe bananas can positively impact these sensory parameters by contributing to a natural sweetness and smooth consistency, thereby improving overall product perception. Also, Morales et al. (2019) evaluated the sensory and textural qualities of ice creams made with fruit-based thickeners, including bananas. The study found that bananas provided superior creaminess and a naturally appealing aroma compared to other fruits.

Difference in the General Acceptability of Banana as a Thickening Agent in Making Ice Cream in terms of Appearance, Aroma, Consistency, and Taste among Three (3) Treatments

Table 5 shows the result of the statistical test (ANOVA), checking whether there were significant differences in the general acceptability of ice cream using banana as a thickening agent based on appearance, aroma, consistency, and taste among the three treatments.

The result revealed that there was a significant difference in the appearance of ice cream with banana as a thickening agent among treatments with F-value=11.345, p-value-.000. This implies that consumers perceived a difference in the appearance of the ice cream made with banana as a thickener among the three treatments. Therefore, the null hypothesis is rejected in terms of its appearance.

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The result also showed that there was a significant difference in the aroma of ice cream with banana as a thickening agent among treatments with F-value=8.507, p-value-.000. This implies that the aroma of ice cream was significantly affected by the banana as thickener. A significant difference implies that consumers could distinctly perceive the aroma of the ice cream made with banana as a thickening agent among the three treatments. Therefore, the null hypothesis is rejected in terms of its aroma.

The result further showed that there was a significant difference in the consistency of banana as a thickening agent in ice cream with F-value=19.012, p-value=.000. This implies that the consistency of bananas as a thickening agent affected how the ice cream was felt in terms of texture, possibly making it smoother, creamier, or thicker among treatments. Therefore, the null hypothesis is rejected in terms of its consistency.

Lastly, the result showed that there was a significant difference in the taste of ice cream using banana as its thickener with F-value=20.329, p-value=.000. This implies that banana likely imparted a distinct flavor to the ice cream that consumers could taste, and influenced their overall enjoyment. Since taste is one of the most crucial factors in food acceptability, this is an essential finding. The positive impact on taste implies that banana was not only a good thickener in ice cream but also an enhancer on the overall flavor profile, making it more desirable. Therefore, the null hypothesis is rejected in terms of its taste.

Therefore, significant differences in terms of appearance, aroma, consistency, and taste among the three treatments indicated that consumer evaluations varied significantly between samples. This implies that the amount or method of incorporating banana puree had a measurable impact on how consumers perceived these sensory qualities. Therefore, the null hypothesis in the general acceptability of banana as a thickening agent in making ice cream is rejected. The result aligned to that of Amoah's (2016), who found significant sensory differences when using ripe banana as a thickening agent in ice cream. Similarly, Garcia and Perez (2020) reported positive effects on the texture and creaminess of the ice cream, with consumers rating the product higher in terms of mouthfeel compared to conventional formulations. Likewise, Silva et al. (2021) investigated the general acceptability of banana-flavored ice creams, with particular emphasis on sensory qualities like taste, texture, and aroma. The study found that banana-flavored ice cream had higher acceptability scores compared to other fruit-based ice creams. It was concluded that ripe bananas could serve as an effective flavor and texture enhancer in ice cream products. Furthermore, a study by Yadav and Sharma (2020) compared natural and artificial stabilizers in ice cream production. Bananas were found to perform comparably to commercial stabilizers in terms of texture, creaminess, and consumer acceptability, while also providing additional nutritional benefits. Additionally, the study of Gupta and Mehra (2020) revealed that bananas contributed to a smoother consistency and better melting resistance in frozen desserts.

Table 5. Difference in the general acceptability of banana as a thickening agent in making ice cream in terms of appearance, aroma, consistency, and taste among three treatments.

Sensory Attributes	Sources of Variance	Sum of Square	df	Mean Square	F-Value	P-Value	Remarks
Appearance	Between	15.886	2	7.943	11.345	0.000	s
	Within	205.838	294	0.700			
	Total	221.724	296				
Aroma	Between	11.643	2	5.822	8.507	0.000	s
	Within	201.192	294	0.684			
	Total	145.770	299				
Consistency	Between	20.788	2	10.394	19.012	0.000	s
	Within	160.727	294	0.547			
	Total	181.515	296				
Taste	Between	26.997	2	13.498	20.329	0.000	s
	Within	195.212	294	0.664			
	Total	222.209	296				

Legend: *Ns = Not Significant; S = Significant*
F-value – 2.410 > .01, ns @ .01 alpha

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Microbial Analysis of Banana as a Thickening Agent in Making Ice Cream

Table 6 shows the microbial report analysis of ice cream with banana (saba) as a thickening agent sample conducted by the DOST Regional Standard and Testing Laboratory, Iloilo City. Test service request R6-032025-MlC-0122-0185 was submitted on March 5, 2025, and was analyzed from March 5, 2025-March 7, 2025, see Appendix J.

The ice cream with banana (saba) as a thickening agent with one pack at 250grams manufactured on March 4, 2025, was subjected to Aerobic Plate Count and Salmonella spp at freezing point of 32℃ and pack in a cream molder.

The result showed that ice cream with banana (saba) as a thickening agent obtained the Aerobic Plate Count of 7800 cfu/g sample although the APC result was relatively higher, still the product was acceptable to the standard range of the Bureau of Food and Drugs, which ranged from 50,000 to 100,000 CFU/g. The result for Salmonella spp. was excellent since no Salmonella was detected. This was a critical finding, as Salmonella is a major food safety concern. The results given in this report were those obtained at the time of examination and referred only to the sample submitted.

The result supported Chen and Wang (2021), who found that ripe bananas could serve as a sustainable alternative to synthetic thickeners, especially in frozen desserts, while maintaining microbial safety and extending shelf life. Likewise, Martinez and Santos (2020) found that bananas acted as a natural preservative, reducing ice crystal formation and improving the stability of the product during storage. A research by Ahmad et al. (2021) reported significant improvements in sensory attributes like creaminess and texture, with no adverse effects on microbial safety. Kumar and Singh (2022) assessed the microbial safety of ice creams formulated with natural fruit thickeners, including bananas. The results confirmed that banana-enriched ice creams met safety standards while exhibiting high sensory acceptability. Additionally, Das et al. (2021) confirmed that banana-based ice creams were microbiologically safe, meeting industry standards, and had no adverse effects on shelf stability.

Table 6. Microbial analysis of banana as a thickening agent in making ice cream.

Sample Description	Parameter	Result	FDA
Ice Cream (Ripe Banana as Thickening Agent, 250g	Aerobic Plate Count	78 000 CFIJ/g sample	50,000 to 100,000 CFU/g
(1 pack @ 250g/pk MFD: 03/05/2025	Salmonella spp	Not Detected in 25 g sample	

Furthermore, Gutierrez and Lopez (2021) evaluated the microbiological and sensory quality of banana-enriched ice cream. Their findings showed that banana puree did not negatively affect the shelf life or safety of the ice cream, and it contributed to a smooth texture and appealing flavor. The microbiological tests revealed that banana-enriched ice cream had acceptable levels of microbial safety, indicating its potential for commercial production storage stability.

Proximate Analysis of Banana as a Thickening Agent in Making Ice Cream

Table 7 shows the result of the proximate analysis of the ice cream sample with banana as a thickening agent. The result revealed a well-rounded nutritional profile. The fat content, assessed using the Soxhlet Extraction Method, was recorded at 10.7%, characteristic of high-quality ice cream, adding to a smooth texture and rich mouthfeel. The carbohydrate content, evaluated through the Phenol Sulfuric Acid Method, was significantly high at 55.1%, largely attributable to the natural sugars from the banana and other sweetening sources, enhancing both sweetness and energy value. With a moisture content of 29.6%, this indicated a dense and stable product that minimized ice crystal formation, an essential aspect for achieving a desirable texture. The protein content, as determined by the Kjeldahl Method, was found to be 3.4%, which contributed to both the nutritional value and the structure of the ice cream. The calculated caloric value for a 66g serving was 218 kcal, reflecting a moderate energy contribution appropriate for a regular dessert portion.

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The result implies that adding bananas as a thickener in ice cream enhances sensory qualities and fosters a nutritionally sound ice cream formulation.

The result supported Kim et al. (2021), who found that banana-based formulations maintained desirable sensory attributes while significantly lowering fat content, aligning with consumer demand for healthier options. Gupta et al. (2020) suggested that ripe bananas improve the nutritional content of desserts while maintaining microbial safety, making them suitable for use in frozen foods. Likewise, the study Ramos and Perez (2022) analyzed the proximate composition of ice creams containing ripe bananas. Their study reported higher levels of carbohydrates and dietary fiber, confirming the nutritional advantages of incorporating bananas into frozen desserts.

Table 7. Proximate analysis of banana as a thickening agent in making ice cream.

Sample Description	Test	Result
Ice Cream (Ripe Banana as Thickening Agent, 250g	% Fat	10.7
	% Carbohydrates	55.1
	% Moisture	29.6
	% Protein	3.4
	Calories	218

Alvarez et al. (2022) studied the effects of using banana puree as a fat replacer in ice cream. The study concluded that bananas could reduce the fat content while maintaining the ice cream's creamy texture. The sensory tests revealed no significant difference in texture and taste compared to full-fat ice cream, making bananas a suitable option for healthier alternatives.

Shelf life of Banana as a Thickening Agent in Making Ice Cream

Table 8 reveals the shelf-life of the sealed ice cream with banana as a thickening agent when stored at 18°C or colder. Storage was made for the period of 30 days . The product was checked daily to record reactions to the storage conditions. The taste, appearance, and consistency change after the sixty-one day of storage, in which the color becomes lighter compared to its original appearance, taste begins to lose its optimal taste as an indicator of risk that the ice cream will spoil, and the smoothness of ice cream becomes airy or has a sandy aftertaste.

Improving shelf-life stability beyond 60 days may require exploring additional preservation techniques, such as improved packaging methods like airtight containers to avoid freezer burn, and oxidation to prevent moisture loss. Cooling Storage Temperature is highly recommended to improve its shelf life, avoid repeated thawing and freezing of ice cream. The results are consistent with Labuza and Dugan (2011), who emphasized that moisture content and exposure to air are primary factors that contribute to spoilage. Ensuring proper packaging and moisture control can significantly extend the shelf life of frozen food products.

Additionally, Saloni, R. et al (2020) he optimized banana ice cream exhibited a higher overrun percentage (48.50%) compared to the control (44.69%), indicating better air incorporation. The banana-enriched ice cream maintained its quality attributes over the 60-day storage period, demonstrating that incorporating banana pulp as a natural thickener does not adversely affect shelf life.

Table 8. Shelf Life of Banana as a Thickening Agent in Making Ice Cream

Variant	Two days (Mold Formation, unpleasant odor, discoloration)	Thirty days (Mold Formation, unpleasant odor, discoloration)	Sixty days (Mold Formation, unpleasant odor, discoloration)	Sixty-one days and above (Mold Formation, unpleasant odor, discoloration)
Treatment A (100g)	0	0	0	+

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IV. CONCLUSIONS

Based on the objectives and findings of the study, the following conclusions were formulated.
Among the three treatments of banana as a thickening agent in making ice cream, Treatment A (100g banana puree) has the best sensory quality attributes. Treatment A is liked extremely by the evaluators, in terms of its appearance, aroma, consistency, and taste. Therefore, it is advised that Treatment A with 100g of banana puree were the best formulation for producing banana-flavored ice cream the same time a thickener. This treatment strikes a balance between sensory attractiveness and functional efficiency, making it appropriate for both small-scale and large-scale ice cream production. Furthermore, using banana in this amount encourages a simpler ingredient list and enhances nutritional benefits, which aligns with modern consumer trends toward natural components.

There is no significant difference in the general acceptability of the ice cream with banana as a thickening agent in terms of its appearance, aroma, consistency, and taste. Therefore, banana-based ice cream formulations can meet consumer demands for healthier, more sustainable desserts without sacrificing enjoyment or sensory satisfaction.

There is no significant difference in the in the sensory qualities of ice cream with banana as a thickening agent in terms of its appearance, aroma, consistency, and taste among treatments. Therefore, the lack of statistically significant differences among treatments implies that all formulations of banana as a thickening agent in ice cream are similarly acceptable to the panelists in terms of sensory quality. While there may be slight variations in sensory ratings, they are not large enough to influence the overall perception of the product.

There is a significant difference in the ice cream with banana as a thickening agent in terms of its appearance, aroma, consistency, and taste in their general acceptability among treatments. Therefore, significant differences in terms of appearance, aroma, consistency, and taste among the three treatments indicated that consumer evaluations varied significantly between samples. This implies that the amount or method of incorporating banana puree had a measurable impact on how consumers perceived these sensory qualities.

Based on the Food and Drug Administration (FDA) Standards for Microbial Analysis, the ice cream with banana as a thickening agent results are within the acceptable levels and are safe for consumption. Also, the Proximate Analysis result stated that bananas as a thickener in ice cream enhances sensory qualities and fosters a nutritional, and natural ice cream formulation. Therefore, ice cream with banana as a thickening agent in making ice cream is safe to consumption and fosters a nutritionally sound ice cream formulation.

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