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Consumer perception and market potential of banana (Musa acuminata)-stabilized leche flan

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ABSTRACT

The study aimed to determine the sensory characteristics and acceptability of banana-stabilized leche flan. To determine also the consumers' perception and market potential of the formulation that is an alternative to the traditional dessert. This product addresses dietary restrictions and allergen concerns while promoting the use of local agricultural produce. The quantitative sensory analysis revealed a significant difference in appearance among the three formulations (test statistic = 10.4, p = 0.006), leading to the rejection of the null hypothesis. Pairwise comparisons indicated that Formulation 1 differed significantly from Formulation 2 (p = 0.003) and Formulation 3 (p = 0.010), while no significant difference was observed between Formulation 2 and 3 (p =0.660). It is suggesting that the variation in appearance was primarily influenced by Formulation 1. In contrast, there is no significant differences were found among the formulation in terms of aroma (test statistic =1.35, p=0.509), taste (test statistic = 2.27, p =0.321), and texture (test statistic = 0.747, p = 0.688), indicating comparable sensory qualities across all formulations in these attributes. Therefore, among the three formulations, Pilko emerged as the most favorable stabilizer due to its highest general acceptability rating, despite having slightly lower appearance scores compared to latundan and Lakatan. Since no significant differences were observed in aroma, taste and texture, all formulations can be considered comparable; however, Pilko variety is recommended based on overall consumer preferences. Using the thematic analysis, the four themes are perceived health benefits, dietary inclusivity, consumer interest, and high purchase intention. The respondents viewed the product as nutritious and suitable for those with dietary restrictions such as egg allergies and plant-based preferences. Despite of the minor flavor concerns, most of the participants expressed willingness to try and purchase the product due to its uniqueness and perceived health value. Overall, the findings suggest that banana-based stabilization is a viable alternative to eggs in leche flan production, with strong consumer acceptance and promising market potential. This research contributes valuable insights for food innovators and entrepreneurs for developing sustainable, inclusive dessert options.

Keywords: Banana-stabilized leche flan, consumer acceptability, market potential.

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INTRODUCTION

Traditional Filipino leche flan is a culturally significant dessert that has long been valued for its rich flavor, smooth texture, and presence in celebrations and social gatherings. Traditionally prepared using eggs, milk, sugar, and flavorings, leche flan relies heavily on eggs to provide structure, firmness, stability, and sensory appeal (Fernandez, 2024). Its popularity extends beyond the Philippines, as evidenced by its recognition as the third best custard dessert in the world by TasteAtlas, highlighting its international appeal and culinary significance (Basina, 2023). Despite its widespread popularity, the traditional formulation presents challenges for consumers with dietary restrictions, including individuals with egg allergies, vegetarians, vegans, and health-conscious consumers seeking lower cholesterol food options. Eggs remain among the most common food allergens globally, affecting millions of individuals and limiting access to egg-based products such as leche flan (Food Allergy Research & Education, 2022; USDA, 2020). Concerns regarding cholesterol intake and cardiovascular health further reinforce the need for alternative formulations that can preserve the desirable qualities of traditional desserts while accommodating evolving consumer needs.

The increasing demand for plant based and allergen free food products has stimulated interest in identifying suitable alternatives to animal derived ingredients. This trend reflects broader shifts in consumer behavior characterized by heightened awareness of health, sustainability, ethical consumption, and dietary inclusivity (Ibsen & Dahm, 2022; Ellis, 2024). Although numerous studies have investigated plant-based substitutes in baked goods and confectionery products, relatively little attention has been devoted to culturally significant Filipino desserts such as leche flan. This gap presents an opportunity for food innovation that simultaneously preserves culinary heritage and addresses contemporary dietary concerns. Guided by Food Product Development Theory, which emphasizes systematic processes of ideation, formulation, and product evaluation, the present study explores the potential of transforming a traditional dessert into a healthier and more accessible alternative through ingredient substitution.

Among potential plant-based substitutes, banana (Musa acuminata) emerges as a particularly promising candidate due to its nutritional composition, functional properties, local availability, and economic value. Bananas are among the most widely cultivated and consumed fruits globally and constitute one of the Philippines' most important agricultural commodities. According to the Food and Agriculture Organization of the United Nations (FAOSTAT, 2024), the Philippines ranks as the fifth largest banana producer worldwide. The banana industry receives active support from the Philippine government because of its importance in meeting the nutritional needs of millions of people (Marta et al., 2022). Beyond its agricultural significance, banana possesses physicochemical characteristics that make it suitable for food processing applications. Ripe bananas contain starch, pectin, cellulose, natural sugars, and dietary fiber, all of which contribute to moisture retention, binding, thickening, and gelling functions within food systems (Sharma et al., 2021; Ahmed, 2025). These properties suggest that bananas may effectively perform some of the stabilizing functions traditionally provided by eggs.

The nutritional advantages of bananas further strengthen their suitability as an alternative ingredient. Bananas provide essential nutrients including potassium, magnesium, phosphorus, iron, calcium, vitamin B6, vitamin C, fiber, antioxidants, and phytonutrients (Criollo Feijoo, 2020). A medium sized banana contains approximately 105 calories, 1.29 grams of protein, 26.9 grams of carbohydrates, 14.4 grams of sugars, and 3.07 grams of fiber, while containing virtually no cholesterol and minimal fat. Regular consumption has been associated with improved digestive and cardiovascular health. Compared with eggs, bananas offer a lighter, plant-based alternative that can contribute both functional and nutritional

benefits to food products. Moreover, bananas are cost effective, widely accessible throughout the Philippines, and contain significant starch content that can contribute to product stability and texture development (Anarson, 2023; Marta et al., 2022). Recent research also highlights the broader potential of banana derived products as sustainable sources of macro and micronutrients as well as natural fibers suitable for food innovation (Ahmed, 2025).

The present study specifically investigates three dessert banana varieties commonly found in the Philippines: Lakatan, Latundan, and Bungulan, locally known as Pilko. Each variety offers unique characteristics that may influence product quality and consumer acceptance. Lakatan is widely regarded as the most popular dessert banana in the country and is recognized for its exceptional flavor and strong market demand (Stuart, 2022). Beyond its sensory qualities, Lakatan banana proteins have demonstrated antioxidant and antihypertensive activities, suggesting potential cardiovascular health benefits (Mangussad et al., 2021). Latundan, scientifically classified as Musa acuminata x M. balbisiana, is valued for its sweet tart flavor, creamy texture, thin yellow peel, and nutritional richness in vitamin C, potassium, and dietary fiber. Bungulan or Pilko, in contrast, is characterized by its green peel that remains green even at ripeness, its sweet aromatic flesh, and its creamy texture. The distinct properties of these banana varieties provide an opportunity to evaluate their effectiveness as natural stabilizers and egg substitutes in leche flan production.

The rationale for employing bananas as egg substitutes is further supported by Food Substitution Theory, which conceptualizes the replacement of one food ingredient with another to satisfy nutritional, functional, or personal dietary objectives (Ibsen et al., 2021; Ławrynowicz et al., 2022). Clifford (2025) specifically notes that one quarter cup of mashed ripe banana can substitute for one egg in food formulations. However, successful substitution requires consideration of both nutritional equivalence and functional performance, particularly regarding texture, flavor, structure, and consumer acceptability (Ibsen & Dahm, 2022). Existing research provides encouraging evidence regarding the feasibility of banana-based substitutions. Bananda and colleagues reported that banana substitutes in pudding type custards achieved texture and binding characteristics comparable to traditional egg-based formulations. Similarly, Rani et al. (2021) demonstrated the effectiveness of bananas as binding and moistening agents in cakes and muffins. These findings suggest that bananas possess functional capabilities suitable for custard style desserts and support their application in egg free leche flan formulations.

The emerging body of literature on alternative dessert formulations reveals both opportunities and challenges associated with ingredient substitution. Mendoza (2020) found that chia based leche flan alternatives offered enhanced nutritional benefits but failed to replicate the expected creaminess of traditional flan. Rivera (2022) reported that tofu-based flans achieved satisfactory firmness yet lacked desirable flavor characteristics. In contrast, Lopez (2021) found high consumer acceptability for banana-based custards due to their rich taste and soft texture. Other researchers have explored flavor innovations involving banana, ube, and mango in modified leche flan products (Sagenes, 2024; Spillet, 2022; Quirino, 2022). Collectively, these studies suggest that while alternative ingredients can address nutritional and dietary concerns, achieving a balance between functionality and sensory appeal remains a critical challenge. Bananas appear particularly promising because they combine nutritional value, functional performance, and favorable sensory characteristics, thereby addressing limitations observed in other substitutes.

Consumer trends further reinforce the relevance of developing fruit based and plant-based dessert alternatives. Increasing numbers of consumers are adopting diets that emphasize natural ingredients, reduced reliance on animal products, and enhanced health benefits (Ellis,

2024). Fruitarian and plant-based desserts align with broader movements toward sustainable consumption and health-conscious lifestyles. Gherasim et al. (2020) emphasize the importance of dietary patterns in promoting overall health, while Deslippe et al. (2023) note the challenges many individuals face in adhering to healthy lifestyle recommendations. Consequently, food innovations that provide healthier yet enjoyable alternatives may facilitate more sustainable dietary choices. Samarakoon et al. (2025) further demonstrate that consumer attitudes toward food products are influenced by lifestyle factors, knowledge, and sensory experiences, underscoring the need to evaluate both product quality and consumer perceptions.

The success of any food innovation ultimately depends on consumer acceptance, making sensory evaluation an essential component of food product development. The Sensory and Consumer Approach emphasizes the assessment of appearance, aroma, taste, texture, and overall acceptability as determinants of product quality and market viability. Drake (2023) highlights the role of human senses in evaluating food quality and safety, while Porretta (2021) argues that sensory properties largely determine product acceptability. Similarly, Mihafu et al. (2020) stress the importance of objective sensory evaluation and consumer testing in assessing the quality and acceptance of new food products. These perspectives suggest that sensory evaluation serves not only as a measure of product quality but also as a predictor of commercial success. Accordingly, assessing consumer responses to banana stabilized leche flan is essential for determining whether the product can satisfy expectations traditionally associated with leche flan while offering additional health and dietary benefits.

The study is also grounded in Rogers' Diffusion of Innovation Theory, which explains how new ideas, products, and practices gain acceptance and spread among consumers (Rogers, 1962, as cited in Halton, 2023). This framework is particularly relevant in evaluating the market potential of banana stabilized leche flan because consumer willingness to adopt innovative food products often depends on perceived advantages, compatibility with existing preferences, and observable benefits. Understanding how consumers perceive plant-based modifications of traditional desserts can provide valuable insights into the likelihood of market acceptance and commercial viability.

Complementing the quantitative sensory evaluation, the study incorporates the six-step thematic analysis framework of Braun and Clarke (2006) to explore consumer perceptions and market potential. This method involves familiarization with the data, initial coding, theme development, theme review, theme definition, and report production. By systematically organizing consumer responses into themes, thematic analysis enables researchers to identify the underlying motivations, attitudes, and beliefs that influence product acceptance or rejection. The approach is particularly useful for examining perceptions related to health benefits, sustainability, dietary inclusivity, and innovation. Previous research indicates that positive perceptions of plant-based foods are often linked to beliefs regarding improved health and well-being (Michel et al., 2021). Through thematic analysis, the study seeks to establish meaningful connections between sensory acceptance and broader consumer trends, thereby providing a more comprehensive assessment of market potential and product positioning.

The development of banana stabilized leche flan is further supported by legal and policy frameworks that encourage food innovation, consumer protection, and food safety. The 1987 Philippine Constitution recognizes science and technology as essential drivers of national development and encourages research, innovation, and the utilization of indigenous resources. This constitutional mandate supports the use of locally available banana varieties as natural stabilizers and promotes the development of self-reliant food technologies. Republic Act No. 10611, or the Food Safety Act of 2013, establishes standards for ensuring food safety throughout production and distribution processes, while Republic Act No. 7394, or the Consumer Act of the Philippines, protects consumers through requirements related to product safety, labeling accuracy, and informed choice. These legal frameworks provide a foundation

for developing safe, transparent, and innovative food products that address diverse dietary needs while maintaining compliance with national standards.

Taken together, the literature highlights the convergence of several important developments, including increasing demand for plant-based foods, the search for effective egg alternatives, the nutritional and functional potential of bananas, and the importance of consumer driven food innovation. Although prior studies have explored various substitutes for eggs in dessert products, limited research has focused specifically on the use of banana varieties as stabilizers in traditional Filipino leche flan. Existing evidence suggests that bananas possess the functional properties necessary to replicate many of the roles performed by eggs while offering nutritional, economic, and sustainability advantages. However, further investigation is needed to determine the sensory acceptability, consumer perception, and market potential of banana stabilized leche flan. Addressing this gap, the present study seeks to evaluate the effectiveness of ripe Lakatan, Latundan, and Pilko bananas as natural stabilizers and egg substitutes in leche flan production, thereby contributing to the development of healthier, more inclusive, and commercially viable dessert alternatives rooted in local agricultural resources and contemporary consumer preferences.

Statement of the problem

The study aimed to determine the sensory characteristics and acceptability of an innovative traditional leche flan compared to banana stabilized leche flan. This study was conducted at the Bohol Island State University campuses and secondary high schools of Congressional District I of Bohol, focusing on TLE teachers and Food Technology students in line with the food related field of specialization for the school year 2025 to 2026.

Specifically, the study sought to answer the following research questions:

1. What is the profile of banana stabilized leche flan in terms of ingredients and cost, materials, tools and equipment, procedure, shelf life, microbiology, proximate composition and nutritional value analysis, packaging, and marketability?
2. What is the level of acceptability of the three formulations of banana stabilized leche flan?
3. Is there a significant difference in the level of acceptability of the sensory characteristics of banana stabilized leche flan among the three formulations in terms of appearance, aroma, taste, and texture?
4. What is the perception of consumers toward banana stabilized leche flan?
5. What is the perceived market potential of banana stabilized leche flan in terms of purchase intent and target market segment?
6. What commercialization plan could be proposed based on the results of the study?

METHODOLOGY

This study utilized a mixed-method research design for data collection and analysis in an effort to meet the flow and thus meet the objectives of the study. Quantitative methods collected measurable data, such as sensory evaluations and survey results, that were quantified to provide numerical results with regard to taste, texture, and appearance of the banana-stabilized leche flan, thus determining the quality of the banana variety rated most highly by respondents to the study and how acceptable the banana-stabilized leche flan was to them. On a qualitative basis, the actionable results of the surveys were evaluated to provide additional insight into the participants' opinions, suggestions, and personal preferences about their

experiences with the study and to gather in-depth knowledge of the reasons behind what the participant chose.

The researcher conducted the study in Bohol, predominantly at Bohol Island State University Campuses, among TLE Teachers and Food Technology students in secondary high schools of Congressional District I of Bohol offering the food-related field of specialization for school year 2025-2026. There were also two separate ways to identify participants for this study, using both quantitative and qualitative approaches. Quantitative participants were selected in order to be representative of the general consumer population; hence, statistics could be performed on the type of preference and acceptability for this group. Conversely, qualitative participants were made available for the purpose of providing greater depth with respect to sensory perceptions, which served as a means of enhancing data interpretation provided in numerical format.

The respondents of the study were drawn from five distinct groups, yielding a total of 103 respondents. Specifically, the respondent matrix is as follows: Food Technology Teachers and Experts comprised 18 respondents; Local Entrepreneurs comprised 5 respondents; Consumers comprised 11 respondents; Canteen Managers comprised 4 respondents; and SHS Food Technology Students comprised 65 respondents, bringing the total to 103 respondents. In total, these 103 respondents provided a robust dataset related to the sensory attributes associated with the eggless flan produced using a banana stabilizer and consumer acceptance of it compared to that of a traditional leche flan. Another benefit of conducting surveys and taste tests is that they provide a more accurate representation of real-world consumer behavior and preferences and therefore increase the utility and applicability of the study's results. In terms of gathering qualitative data, the participants are qualified to answer due to their wider knowledge of foods, and the thoughts and ideas of the participants would strengthen the study.

A modified questionnaire was used to determine the level of likeness of the sensory characteristics of banana-stabilized leche flan. The questionnaire was checked by the adviser and a critic for its validity and reliability. Questionnaires were employed as the primary tool to gather the necessary data based on the hedonic parameters of Vagias (2006). The respondents evaluated the product using the 5-point Hedonic Scale for the descriptive test. The questions included in the questionnaire were tailored to assess various sensory aspects of the banana-stabilized leche flan, such as taste, texture, aroma, and overall acceptability. The participants marked the appropriate point according to their evaluation. The highest description range is "very much acceptable" with a scale of 5, and the lowest is "unacceptable" with a scale of 1. The sensorial evaluation survey is based on existing literature in this area, which helped form the survey's content. This relationship ensured that the survey captures meaningful information about both how consumers prefer to eat and feel about the innovative way of using banana as a stabilizer for leche flan. For the qualitative questionnaire, the instrument tool was modified from the research of J Acad Nutri Diet (2022) using thematic analysis. The same statement was used in asking questions for an interview. It is an open-ended question designed to gather details on participants' perspectives, experiences, and emotions.

The data-gathering procedure for studying the transition from traditional leche flan to an eggless version with banana as a stabilizer involved several key steps organized into distinct phases. In the first phase, which constituted pre-data gathering, the researcher sent a permission letter to the Campus Director of Bohol Island State University, the Superintendent of the Division of Bohol, the Dean of the School of Advanced Studies, and the District Supervisor of the Alburquerque District in Bohol to conduct the study. Approval to conduct the study was obtained, ensuring compliance with ethical and institutional guidelines. In the second phase, which constituted the conduct of the experiment, the researcher used a mixed-method research design. A leche flan without eggs, using banana instead, was prepared as a stabilizer. In all treatments, three varieties of bananas, namely pilko, tundan, and lacatan, were used as

substitutes for eggs. A systematic trial-and-error approach was taken to develop the best formulation for an eggless version of leche flan using bananas as stabilizers. The development included making several different batches of the product with different amounts of each banana variety along with varying amounts of other important ingredients to achieve the desired consistency, taste, texture, and other sensory characteristics. All results from the tests were captured in reports which were then incorporated into modifications of the base recipe. The modified product was intended to meet the quality standards established for future assessments.

In the third phase, which involved formulating the recipe of leche flan with banana stabilizer, the researcher prepared and formulated versions of leche flan without eggs using the standard recipe. These were to be tested by the Food and Nutrition Research Institute (FNRI) through laboratory evaluation, including testing for the nutritional value of each version, as well as examining the microbiological properties and generating nutritional facts. In the fourth phase, which involved crafting the research instruments, the instruments were prepared prior to the sensory evaluation techniques, which provided empirical data from the respondents regarding the preference and acceptance of the banana-stabilized leche flan. The questionnaires or surveys were modified to allow for data collection on consumer preferences and perceptions of the eggless and traditional versions. The systematic data collection process allowed for the quantitative evaluation of the taste and texture of both versions, as well as the respondents' preferences on other factors relevant to the evaluation of the eggless leche flan. In the fifth phase, which involved the distribution of research instruments, the respondents were informed of the study's purpose. The data gathered were to be used for the research and treated confidentially. The respondents were given enough time to answer the questionnaire. The researcher explained the items in the questionnaire and responded to any clarification from the respondents. The data were tabulated and interpreted. Ethical considerations, such as the rights of respondents to informed consent and confidentiality, were strictly observed throughout the entire process.

The data gathered from the sensory evaluation of the banana-stabilized egg-free leche flan were analyzed using both descriptive and inferential statistical methods. The mean was used to determine the average scores for each sensory attribute, specifically appearance, aroma, taste, and texture, as rated on a 5-point hedonic scale, which measured the level of acceptability from "unacceptable" to "very much acceptable." To assess significant differences among the samples, particularly in sensory attributes, the Friedman test was employed as a non-parametric alternative to repeated measures ANOVA.

The 5-point hedonic parameter for acceptability level was operationalized as follows. A scale of 5 corresponds to a numerical range of 4.21 to 5.00, a descriptive rating of "Very Much Acceptable," and an interpretation of highly acceptable and very pleasing. A scale of 4 corresponds to a numerical range of 3.41 to 4.20, a descriptive rating of "Acceptable," and an interpretation of acceptable and generally liked. A scale of 3 corresponds to a numerical range of 2.61 to 3.40, a descriptive rating of "Neither acceptable nor unacceptable," and an interpretation of neutral, neither good nor bad. A scale of 2 corresponds to a numerical range of 1.81 to 2.50, a descriptive rating of "Unacceptable," and an interpretation of somewhat unacceptable. A scale of 1 corresponds to a numerical range of 1.00 to 1.80, a descriptive rating of "Very unacceptable," and an interpretation of highly unacceptable and disliked.

The 5-point hedonic parameter for packaging was operationalized as follows. A scale of 5 corresponds to a numerical range of 4.21 to 5.00, a descriptive rating of "Very Much Preferred," with an interpretation that the respondents strongly favor or highly like the option. A scale of 4 corresponds to a numerical range of 3.41 to 4.20, a descriptive rating of "Very Preferred," with an interpretation that the respondents clearly preferred the option. A scale of 3

corresponds to a numerical range of 2.61 to 3.40, a descriptive rating of "Moderately Preferred," with an interpretation that the respondents somewhat prefer the option but not strongly. A scale of 2 corresponds to a numerical range of 1.81 to 2.50, a descriptive rating of "Strongly Preferred," with an interpretation that the respondents have weak or minimal preference. A scale of 1 corresponds to a numerical range of 1.00 to 1.80, a descriptive rating of "Not Preferred at all," with an interpretation that the respondents do not like or favor the option.

Cronbach's Alpha was used to compute and evaluate the internal consistency and reliability of the sensory evaluation scores provided by the respondents. This involved calculating weighted means to determine the overall acceptability or satisfaction scores for each version of the dessert. The impact of the substitution and treatment was evaluated using statistical tests such as the t-test, which allowed the researcher to determine if there are significant differences in taste, texture, or overall acceptability between the egg-free leche flan and the traditional leche flan. For the consumers' respondents, the sample size was computed based on the population size using Cronbach's alpha. Additionally, an analysis of the Friedman test was employed to assess if there are any significant differences in preferences or acceptability levels among these groups. Applying these statistical treatments allowed the researcher to effectively analyze the data and draw meaningful conclusions regarding the study.

The reliability and internal consistency of the sensory evaluations were assessed using Cronbach's alpha, which provided evidence that the rating of attributes such as taste, texture, appearance, and overall acceptability were rated equally amongst the different samples, thereby confirming that reliable evaluations were made on each respective product. To evaluate significant differences in the ranking of the different leche flan formulations, the Friedman test was utilized. A comparison of the sensory values of the different samples provided further insight into the impact of banana as a stabilizer, and the Friedman test assisted in determining the most preferred version of the flan. Where statistically significant differences were identified, the Durbin-Conover post-hoc test was performed to establish which specific pairs of samples were statistically significantly different.

Braun and Clarke (2006) conducted thematic analyses of the qualitative portion, specifically the open-ended responses and comments of participants, evaluating and grouping the response data based on how similar they were to one another. This provided valuable insight regarding the participants' reasoning for liking or disliking the product. The combined use of quantitative data analysis as well as qualitative analyses offered a complete and valid assessment of the acceptability of the product to support this research.

The following terms are defined for a better grasp to ensure clarity and consistency of the study. Appearance refers to the color, physical look, and presentation of the leche flan stabilized with banana. Banana Pulp refers to the edible part of the banana that consists of the soft, mashed inner portion of ripe bananas that has been manually separated from the peel and used as a natural stabilizing agent in the preparation of the egg-free leche flan. Banana Stabilizer refers to the banana's function as an edible fruit in the egg-free leche flan, stipulating that it replaces eggs to give the dessert structure and texture. Dessert Banana refers to sweet banana varieties commonly eaten raw when ripe. Egg-Free Leche Flan refers to a modified version of leche flan where eggs are substituted with banana as a stabilizer, specifying that no eggs are used in the preparation of this dessert. Sensory Evaluation refers to assessing the overall sensory characteristics of the dessert, including its taste, texture, aroma, and appearance of both the traditional and egg-free leche flan, with this evaluation aiming to gauge how well the egg-free version compares to traditional leche flan in terms of flavor, consistency, and overall enjoyment. Traditional Leche Flan refers to a creamy and indulgent dessert made from eggs, condensed milk, and caramelized sugar, with its name "leche," meaning milk in Spanish, reflecting its primary ingredients; this term refers to the conventional recipe of leche flan which

includes eggs as a primary ingredient and is prepared following standard methods and proportions. Stabilizer refers to substances that increase stability and thickness, ensuring that the leche flan sets properly and maintains its smooth and creamy texture without relying on eggs for stability. Substitute refers to using something else instead of the original item, such as the use of banana as an alternative to egg as one of the primary ingredients in making leche flan, and banana as a stabilizer. Taste refers to the overall flavor profile experienced when consuming the dessert, specifically the egg-free leche flan, with participants providing feedback on the flavor, sweetness, and overall taste experience. Texture refers to the creaminess, firmness, yet softness with a silky consistency that melts in the mouth. Resistant Starch refers to a type of indigestible carbohydrate that escapes digestion and functions like fiber in the body.

RESULTS AND DISCUSSION

This chapter presents the analysis and interpretation of data gathered from 103 respondents who participated in the sensory evaluation and consumer acceptability study of banana-stabilized leche flan across three formulations, designated as F1 (Pilko banana), F2 (Latundan banana), and F3 (Lakatan banana). The study employed a mixed-method research design, utilizing a modified 5-point hedonic scale questionnaire grounded in the hedonic parameters of Vagias (2006) as the primary data collection instrument. Quantitative data were analyzed using descriptive statistics, specifically weighted means, as well as inferential statistical tests including the Friedman test and the Durbin-Conover post-hoc test, while Cronbach's alpha was employed to assess the reliability and internal consistency of the sensory evaluation scores. Qualitative data derived from open-ended responses were subjected to thematic analysis following the framework of Braun and Clarke (2006). The results presented and discussed in this chapter are interpreted in direct relation to the objectives of the study, which centered on determining the production cost, sensory acceptability, microbiological safety, nutritional value, shelf life, packaging preference, marketability, and consumer perception of banana-stabilized leche flan across the three formulations. All findings are grounded in the data gathered and are discussed in conjunction with relevant scholarly literature to support and contextualize the interpretations.

Ingredients, cost, and production analysis

A comparative cost and pricing analysis of the three banana-based formulations reveals a clear variation in total production cost and final selling price driven primarily by differences in raw material cost, while other ingredient proportions remained constant across all formulations. The common ingredients shared by all three formulations include evaporated milk at a unit cost of 31.85 per 360g with an edible portion of 80g contributing a cost of 7.08, condensed milk at 43.00 per 374g with an edible portion of 100g contributing 11.50, vanilla extract at 19.50 per 120ml with an edible portion of 2.3ml contributing 0.33, and salt included in a pinch at no assigned cost. The banana varieties differed across formulations: F1 used Pilko banana at 20.00 per 1000g with an edible portion of 150g contributing 2.70 to ingredient cost; F2 used Latundan banana at 50.00 per 1000g with an edible portion of 135g contributing 6.00; and F3 used Lakatan banana at 75.00 per 1000g with an edible portion of 165g contributing 11.25.

Among the three formulations, F1 recorded the lowest total cost of ingredients at 21.61, resulting in a labor cost of 7.56 (35%), an operating cost of 4.32 (20%), a markup of 3.24

(15%), and a total production cost of 36.73, yielding a selling price of 18.37 per piece from a yield of 2 pieces. F2 had a total ingredient cost of 24.91, a labor cost of 8.72, an operating cost of 4.98, a markup of 3.74, and a total production cost of 42.35, with a selling price of 21.18 per piece. F3 recorded the highest total ingredient cost of 30.16, a labor cost of 10.56, an operating cost of 6.03, a markup of 4.52, and a total production cost of 51.27, with the highest selling price at 25.64 per piece, all from a yield of 2 pieces per formulation. These results indicate that Pilko banana contributes to the most cost-efficient formulation due to its lowest unit price, while Lakatan banana significantly increased overall production costs due to its higher market price. F2 provides a middle-ground option that balances cost and pricing. The choice of banana variety therefore plays a strategic role in targeting varying market segments through product affordability and positioning. This finding is consistent with Istiyanti et al. (2024), who noted that different input costs can lead to variations in value-added, which directly impacts pricing.

Materials, tools, equipment, and production procedures

The preparation of banana-stabilized leche flan required a range of materials, tools, and equipment that are commonly available and affordable in local markets. Among the materials used were 10 pieces of special food-grade resistant paper for wrapping and presentation, 1 roll of kitchen napkin for cleaning spills and wiping surfaces, 1 roll of food-grade aluminum foil for covering the llanera and heat protection during cooking, 10 pieces of paper-based kraft or biodegradable food-safe containers for eco-friendly food packaging, 10 pieces of food-grade polypropylene or polyethylene plastic-based packaging for sealed storage or takeaway, and 3 pieces of fine or medium mesh food-grade cloth for straining and filtering liquids. The tools employed included 3 durable non-reactive stainless steel bowls for holding measured ingredients, a 2-liter food-grade stainless steel mixing bowl for blending ingredients to ensure consistency in texture, 1 set of plastic measuring cups in standard sizes of 1/4, 1/3, 1/2, and 1 cup for measuring water, banana, and other liquid or dry ingredients, 1 set of plastic measuring spoons in standard sizes of 1 tablespoon (15 ml), 1 teaspoon (5 ml), 1/2 teaspoon (2.5 ml), and 1/4 teaspoon (1.25 ml) for measuring small quantities of ingredients, 1 flat stainless steel utility tray for organizing and transporting ingredients, 1 heat-resistant aluminum food tong for handling hot llanera during caramel preparation, 9 aluminum oval llanera molds of medium size with an approximate capacity of 500 to 600 ml used as molding containers for steamed products, 1 fine mesh stainless steel strainer for filtering solids from liquids, 1 stainless steel utility knife with an ergonomic handle for peeling and slicing bananas, 1 food-grade polyethylene chopping board as a cutting surface, and 1 two-layer aluminum double boiler for gently heating the leche flan mixture. Equipment included 1 unit of an electric blender with 2 to 5 speed settings and a stainless-steel blade for blending and pureeing ingredients, as well as 1 unit of a standard LPG-powered gas range with 2 to 4 burners and adjustable flame control for cooking, boiling, and heating.

The use of appropriate tools and equipment is essential for achieving consistent and high-quality food products. As affirmed by the National Institute of Standards and Technology (2023), accurate measurement and proper use of equipment enable precise ingredient proportioning, proper mixing, and correct cooking procedures. This principle is further supported by foundational concepts in food science and home economics, which emphasize measurement accuracy, procedural correctness, and efficiency in food preparation as critical determinants of product quality.

The preparation of banana-stabilized leche flan followed a standardized procedure applicable to all three formulations, with the only variation being the type of banana variety used. The procedure began with the preparation of all ingredients, tools, and equipment, followed by thoroughly washing the banana under clean running water. The caramel was

prepared by placing sugar in a molder and heating it over medium flame until it melted and turned golden brown, after which the mold was tilted to coat the bottom evenly and left to cool. For the flan base, ripe banana, evaporated milk, condensed milk, and vanilla extract were placed in a blender and processed until the mixture was completely smooth. The smooth banana mixture was then poured into the caramel-coated mold, covered, and cooked using a double boiler over medium heat for 45 minutes. After cooking, a knife was run around the edges of the mold before carefully inverting it onto a plate or container, and the flan was left to cool and refrigerated for at least 6 to 8 hours or overnight before serving.

This preparation method differs meaningfully from the traditional egg-based leche flan in that the binding and stabilizing function typically provided by eggs is replaced by the natural starch content of ripe bananas. The use of indirect heat through double boiling is essential for preventing curdling and ensuring uniform gelation of the custard. Temperature monitoring, accurate ingredient ratios, and correct preparation technique are therefore critical elements in producing a smooth, cream-like, egg-free custard. This modification retains the expected sensory qualities of traditional leche flan while offering an accessible alternative for individuals with dietary restrictions or those who prefer egg-free products.

Shelf life of the three formulations

The shelf-life evaluation of the three banana-stabilized leche flan formulations under refrigerated storage revealed consistent patterns of sensory degradation across all treatments over a 7-day period. On Day 1, all three formulations, Pilko, Tundan, and Lakatan, exhibited smooth and creamy texture, sweet and mild to rich banana aroma, a glossy and uniform appearance, and a sweet banana-prominent flavor, indicating optimal sensory quality at the point of preparation. By Day 3, all formulations showed slight firmness in texture, mild aroma, slight surface moisture, and a mellowed flavor, reflecting early onset of starch retrogradation and minor moisture migration. On Day 5, all formulations developed creamy texture with minor graininess, a fading or weakening aroma, slight color darkening, and a less pronounced but still acceptable taste. By Day 7, all three formulations exhibited grainy and watery texture, a pale or weak aroma, noticeable surface darkening with minor liquid separation indicative of syneresis, and a diminished or mildly off banana flavor.

These observations are consistent with the findings of Arlai (2022), who noted that during refrigerated storage, native starches undergo retrogradation, which leads to increased firmness and eventual graininess. The transition from smooth to grainy texture observed particularly between Day 3 and Day 7 reflects this starch-related textural breakdown. Despite the absence of eggs, the product remains highly perishable under refrigerated conditions, and the data indicate that banana-stabilized leche flan is best consumed within the first 3 to 5 days of refrigeration to ensure optimal sensory quality. These findings have direct implications for product shelf life labeling and food safety guidance for both commercial and household production.

Microbiological safety

The microbiological analysis of all three banana-stabilized leche flan formulations, namely Pilko, Tundan, and Lakatan, yielded negative results for Escherichia coli detection using the Pour Plate IMViC test method based on BAM Chapter 4. The absence of E. coli contamination across all formulations indicates that the preparation and handling procedures were conducted under proper sanitary conditions, thereby confirming the microbiological

safety and suitability of the product for consumption. According to the World Health Organization, E. coli contamination is typically transferred through cross-contamination, and in the case of banana-stabilized leche flan, the additional handling steps associated with incorporating fresh banana increase the inherent risk of microbial contamination if food safety practices are not strictly observed. The negative test results therefore underscore the effectiveness of proper hygiene, correct use of tools, and adequate cooking procedures in preventing contamination. This finding reinforces the importance of strict adherence to food safety protocols, as insufficiently cooked or improperly stored products may allow bacterial multiplication and pose health risks to consumers.

Proximate and nutritional value

The proximate and nutritional analysis of the three banana-stabilized leche flan formulations showed relatively similar compositions with slight variations across specific nutrients. In terms of moisture content, Pilko recorded 51.1g, Tundan 49.5g, and Lakatan 49.0g, all of which indicate high water content across the formulations, although no specific recommended daily intake (RDI) has been established for moisture. Ash content was 0.912g for Pilko, 0.804g for Tundan, and 0.866g for Lakatan, also without an established RDI. Total fat was 2.12g for Pilko, 2.01g for Tundan, and 2.68g for Lakatan, compared to the recommended daily intake of 44 to 77g per day, indicating that all formulations can be considered low-fat desserts. This finding aligns with Khasi (2024), who noted that the use of starch and plant-based ingredients in custard formulations can effectively reduce fat content while maintaining acceptable texture and stability. Crude protein was 0.988g for Pilko, 1.11g for Tundan, and 1.10g for Lakatan, well below the RDI of 50g per day. Carbohydrate content was 44.9g for Pilko, 46.6g for Tundan, and 46.4g for Lakatan, against a daily reference range of 225 to 325g per day. Caloric values ranged from 203 kcal for Pilko, 209 kcal for Tundan, to 214 kcal for Lakatan, relative to the daily energy requirement of 2,000 to 2,500 kcal per day, suggesting that the product makes a moderate caloric contribution and can serve as an energy-dense snack or dessert. Potassium content was 236mg for Pilko, 200mg for Tundan, and 310mg for Lakatan, against a recommended daily intake of 2,600 to 3,400mg per day, with Lakatan recording the highest value attributable to its naturally higher mineral content. While this represents only a small contribution to the daily potassium requirement, it adds nutritional value consistent with bananas being a recognized dietary source of potassium. Overall, the nutritional profile indicates that banana-stabilized leche flan is primarily a carbohydrate-based product with low fat and protein content and moderate energy contribution, making it more appropriately categorized as a supplementary food rather than a primary daily nutritional source.

Packaging preference

The respondents' evaluation of two types of packaging using a 5-point Likert scale showed a clear preference for Container A, the paper-based option, over Container B, the plastic-based option. For Container A, the criterion on overall attractiveness of appearance received a weighted mean (WM) of 4.63 described as "Very Much Preferred," the criterion on making the product look delicious and fresh received a WM of 4.54 described as "Very Much Preferred," and the criterion on ease and convenience of opening received a WM of 4.60 described as "Very Much Preferred," yielding a grand mean of WM = 4.59 described as "Very Much Preferred." For Container B, the criterion on overall attractiveness received a WM of 4.13 described as "Very Preferred," the criterion on making the product look delicious and fresh received a WM of 4.24 described as "Very Much Preferred," and the criterion on ease and

convenience of opening received a WM of 4.32 described as "Very Much Preferred," yielding a grand mean of WM = 4.23 described as "Very Much Preferred."

Although both packaging types were rated as "Very Much Preferred" at the grand mean level, Container A consistently obtained higher ratings across all three criteria, indicating a strong consumer preference for the paper-based option. This preference may be attributed to consumer perceptions of paper-based packaging as more natural, eco-friendly, and visually appealing, qualities that enhance the perceived freshness and quality of the product. In contrast, plastic packaging, while practical and durable, is often associated with mass-produced goods, which may slightly diminish its perceived attractiveness. This finding is consistent with the position of the Food and Agriculture Organization, which reports that consumers increasingly prefer eco-friendly packaging. The preference for Container A therefore suggests that sustainable and visually appealing packaging significantly shapes consumer acceptance and the perceived value of banana-stabilized leche flan.

Marketability of the banana-stabilized leche flan

The marketability assessment was conducted over 10 days across three selling locations, namely the school canteen, sidewalk, and wet market, with 10 pieces displayed daily for each formulation. Across all locations and formulations, the number of units sold varied daily, with the sidewalk and wet market demonstrating more consistent sales performance than the school canteen, averaging approximately six to eight units sold per day compared to five to seven at the school canteen. At the school canteen, F1 sales ranged from 5 to 7 units per day, F2 ranged from 3 to 6 units per day, and F3 ranged from 4 to 7 units per day. At the sidewalk, F1 sales ranged from 6 to 8 units per day, F2 ranged from 3 to 6 units per day, and F3 ranged from 5 to 7 units per day. At the wet market, F1 sales ranged from 5 to 8 units per day, F2 ranged from 4 to 6 units per day, and F3 ranged from 6 to 8 units per day. Across all three venues, F1 consistently recorded the highest sales volumes, while F2 recorded the lowest, indicating that differences in consumer preference were influenced by both location and the specific banana variety used in the formulation.

These findings are consistent with Barnet et al. (2025), who demonstrated that food selection is influenced by factors including availability, access, and individual preferences. Ungureanu et al. (2025) further highlighted that peer-to-peer interactions, product taste, and the time and ease of product acquisition are major factors in driving actual purchase decisions. The observed variation in sales performance across locations and formulations suggests that consumer purchasing behavior is context-dependent and that product characteristics, including sensory appeal associated with the banana variety, play a meaningful role in determining marketability.

Sensory acceptability of the banana-stabilized leche flan

The sensory evaluation of the three formulations was conducted among 103 respondents using a 5-point hedonic scale, with results assessed across four sensory attributes, namely appearance, aroma, taste, and texture, as well as a general acceptability rating. In terms of appearance, Formulation 2 obtained the highest weighted mean of 4.43 described as "Very Much Acceptable" and ranked first, followed by Formulation 3 with a weighted mean of 4.40 also described as "Very Much Acceptable" and ranked first, while Formulation 1 received a weighted mean of 4.34 described as "Very Much Acceptable" and ranked third. For aroma, Formulation 1 ranked highest with a weighted mean of 4.38 described as "Very Much

Acceptable" and ranked first, while both Formulation 2 and Formulation 3 each received a weighted mean of 4.28 described as "Very Much Acceptable" and ranked second. Regarding taste, Formulation 1 again received the highest weighted mean of 4.36 described as "Very Much Acceptable" and ranked second, followed by Formulation 3 with a weighted mean of 4.24 described as "Very Much Acceptable" and ranked third, and Formulation 2 with a weighted mean of 4.21 described as "Very Much Acceptable" and ranked third. For texture, Formulation 2 received a weighted mean of 4.21 described as "Very Much Acceptable" and ranked third, Formulation 3 received a weighted mean of 4.20 described as "Acceptable" and ranked fourth, while Formulation 1 received a weighted mean of 4.15 described as "Acceptable" and ranked fourth. In terms of general acceptability, Formulation 1 recorded the highest mean of 4.31 described as "Highly Acceptable" and ranked first, while both Formulation 2 and Formulation 3 each recorded a mean of 4.28 described as "Highly Acceptable" and ranked second.

The results demonstrate that all three formulations were generally well accepted by the respondents, with most ratings falling within the "Very Much Acceptable" range, indicating a strong positive perception of the products. The slight advantage of Formulation 2 in appearance and texture suggests that its composition likely resulted in a more uniform structure and visually appealing finish, possibly attributable to a better moisture balance or more effective ingredient blending during processing. This is consistent with findings from the Food Safety Institute (2025), which affirmed that appearance is the first attribute evaluated by consumers and strongly influences their initial acceptance of food products. The higher ratings of Formulation 1 in aroma and taste suggest that its ingredient composition may have enhanced the release of flavor compounds during preparation. Aroma plays a critical role in food perception because it is linked to volatile compounds that directly affect liking and acceptability, as noted by the Agriculture Institute (2025). Although Formulation 3 did not consistently rank highest in any single sensory category, its uniformly high and consistent scores across all attributes indicate a well-balanced sensory profile. As observed by Mendez et al. (2020), small changes in formulation variables may result in differing scores for individual sensory attributes; however, when no major sensory deficiencies are present, overall consumer acceptance scores typically remain high across all products. The relatively similar grand means across formulations, with general acceptability scores of 4.31 for Formulation 1 and 4.28 for both Formulations 2 and 3, reflect strong and consistent consumer response, supporting the finding that all three banana-stabilized leche flan formulations were acceptable to respondents. This level of acceptance aligns with the position of Wu (2026), who established that the sensory attributes of foods are widely considered important determinants of acceptability and the physiological state of the individual.

Significant difference in sensory attributes

The analysis of significant differences in sensory acceptability among the three formulations was conducted using the Friedman test at the 0.05 level of significance. Regarding appearance, the Friedman test yielded a test statistic of 10.4 with a p-value of 0.006, leading to the rejection of the null hypothesis and establishing that a significant difference exists in the appearance ratings among the three formulations. Subsequent pairwise comparisons using the Durbin-Conover post-hoc method revealed that the comparison between Formulation 1 and Formulation 2 produced a test statistic of 3.044 with a p-value of 0.003, resulting in the rejection of the null hypothesis and indicating a significant difference. The comparison between Formulation 1 and Formulation 3 produced a test statistic of 2.604 with a p-value of 0.010, also resulting in the rejection of the null hypothesis and confirming a significant difference. However, the comparison between Formulation 2 and Formulation 3 produced a test statistic

of 0.441 with a p-value of 0.660, leading to a decision to not reject the null hypothesis and indicating no significant difference between these two formulations. These results indicate that the observed differences in appearance are primarily driven by Formulation 1, whose distinct visual characteristics set it apart from Formulations 2 and 3, while the latter two share comparable visual properties likely attributable to similar ingredient composition or processing conditions. These findings are reinforced by Hu et al. (2022), who demonstrated that product appearance is among the most important factors in determining consumer choice and purchase decision, underscoring the importance of treating appearance as a primary indicator of product quality in formulation development.

For aroma, the Friedman test produced a test statistic of 1.35 with a p-value of 0.509. Since the p-value exceeds the 0.05 significance level, the null hypothesis is not rejected, indicating that there is no statistically significant difference in aroma among the three formulations. This finding suggests that the formulation variations did not produce meaningful changes in the volatile compounds responsible for aroma, thereby maintaining a consistent aromatic profile across all samples. As noted by Ni (2026), food quality and consumer preference are strongly influenced by aroma, and the consistency demonstrated here may be advantageous in product development by confirming that adjustments to other formulation variables do not adversely affect this critical sensory attribute.

For taste, the Friedman test yielded a test statistic of 2.27 with a p-value of 0.321. Since the p-value is greater than 0.05, the null hypothesis is not rejected, indicating that there is no significant difference in taste among the three formulations. This result implies that all three formulations are comparable in terms of taste and that variations in formulation did not significantly affect the perceived flavor profile of the product. As emphasized by Tumalip (2026), taste is one of the most important factors in determining product quality and consumer satisfaction, and the comparable flavor characteristics across the formulations suggest that all three have a strong foundation for broad consumer appeal.

For texture, the Friedman test produced a test statistic of 0.747 with a p-value of 0.688. Since the p-value exceeds the critical value of 0.05, the null hypothesis is not rejected, confirming that no significant difference exists in the texture ratings among the three formulations. This outcome indicates that formulation variation had no meaningful effect on the structural and mouthfeel characteristics of the products, likely owing to uniform processing conditions and the consistent use of banana as a natural stabilizer across all treatments. According to Burdon (2026), texture is a significant predictor of commercial acceptability because it directly influences consumer satisfaction and the likelihood of repeat purchase. The consistent texture observed across formulations therefore supports the structural integrity and market readiness of the product, ensuring that no formulation presents a textural disadvantage relative to the others.

Consumer perception

Qualitative data gathered through open-ended responses were analyzed thematically and organized into two overarching categories, namely consumers' perception and market potential, each of which encompassed distinct themes and codes that enriched the interpretation of the quantitative findings.

Under consumers' perception, four themes were identified: health benefits, dietary inclusivity, willingness to try, and willingness to purchase. With respect to health benefits, participants described the product using terms such as "nutritious," "easily digestible," and "promotes bodily functions," which aligns with the code of nutritional content and functional

versatility. Many respondents identified the product as a source of vitamins, minerals, and potassium, with some noting its potential benefits for bone and muscle development attributable to its potassium content. Participants also described the product as being easy on the stomach, reflecting its perceived digestive comfort. This perception is grounded in the characteristics of bananas as a mild and easily processed food. As affirmed by Ajomiwe et al. (2024), digestibility is a major factor in how efficiently nutrients are absorbed and utilized by the body, and foods that are more digestible are generally considered nutritionally accessible. Several participants also characterized the banana component as a flavor enhancer and natural sweetener, further reinforcing the connection between health perception and the positive quantitative evaluations recorded across all formulations.

Regarding dietary inclusivity, participants emphasized that the egg-free formulation makes the product suitable for individuals with egg allergies, dietary restrictions, or those following a plant-based diet. Key descriptors used by respondents included "picky in foods," "health conscious," "alternative accessible product," "accessibility to diverse consumers," and "suitability for vegan individuals." For allergy safety, participants used terms such as "non-allergenic product," "no allergy triggers," and "help reduce the amount of allergy," reflecting a strong awareness of the product's accessibility advantage. This is supported by Apostolidis and McLeay (2021), who demonstrated that plant-based and allergen-free food alternatives increase consumer acceptance by addressing dietary restrictions and promoting inclusivity.

Market potential

Under market potential, qualitative data revealed two central themes: consumer interest and purchase intention. Regarding consumer interest, participants highlighted sensory and visual appeal as primary triggers for trial behavior, with responses such as "I am interested in trying this product because it is not typically found" and "The color and the way it was presented made me want to try it." Other participants cited the natural and safe ingredient composition as a motivating factor, with one respondent stating "I feel it is safe and healthy because it is made from bananas and does not contain eggs," reflecting the influence of ingredient transparency on willingness to try. The preference for products made from natural rather than artificial ingredients emerged consistently across responses. These findings align with Alya et al. (2024), who found that sensory cues significantly influence food choice and initial decisions, and with Zaripova et al. (2023), who demonstrated that sensory cues influence perceived quality and willingness to pay, which in turn drives trial behavior. Aschemann-Witzel et al. (2022) further found that consumers are more likely to try innovative food products when they perceive them as both novel and beneficial to health, a pattern that is directly reflected in the qualitative responses gathered in this study.

Regarding purchase intention, participants identified factors including affordability, availability, nutritional content, and taste as motivators for purchase. Responses described the product as "friendly and affordable," with some participants expressing interest in packaging quality and production standards. In terms of purchase frequency, respondents generally viewed the product as suitable for occasional consumption rather than as a daily staple, with descriptions such as "occasionally, because it is sweet and it's not good to eat sweet food always," alongside responses indicating regular purchase intent such as "I will buy regularly since this is my favorite." This pattern suggests that the product functions more as a specialty dessert or treat rather than a routine dietary item. These qualitative perspectives are consistent with the quantitative sales data and support the finding that F1 demonstrated stronger purchase intent through its superior sales performance. This is aligned with Kemper et al. (2023), who showed that purchase intentions for alternative food products are strongly influenced by perceived health benefits, sensory expectations, and dietary considerations. Oliver et al. (2023)

further established that purchase intention is strongly influenced by product appeal, perceived quality, and packaging cues, which directly translate into actual buying behavior, a relationship observable in the contrasting sales performance between F1 and F2 across all three selling venues. The pattern of increasing market acceptance observed across the data collection period reflects what Bornstein (2022) described as the "mere exposure effect," wherein repeated exposure to a product increases familiarity and acceptance, suggesting that banana-stabilized leche flan has growing market potential and that prioritizing the commercialization of Formulation 1 is strategically advisable.

Proposed commercialization plan

The findings of the study provide a strong empirical basis for the proposed commercialization plan for banana-stabilized leche flan. The rationale for commercialization rests on the recognition that banana-stabilized leche flan offers an innovative variation of the popular Filipino custard dessert by replacing eggs with bananas as a stabilizing agent, thereby adding natural sweetness and flavor while expanding the product's accessibility to health-conscious consumers, individuals with egg allergies, and those seeking plant-based alternatives. Consumer acceptability data from the study confirm a willingness to purchase the product, making it a viable opportunity within the dessert category. The objectives of the commercialization plan are fourfold: to formulate a leche flan recipe incorporating bananas as a natural sweetener and stabilizer; to evaluate the taste, texture, appearance, and overall acceptability among consumers; to promote a healthier dessert option using natural ingredients instead of artificial additives; and to establish a small-scale production and marketing strategy for banana leche flan.

The implementation mechanisms include focusing on formulating the banana-stabilized leche flan by identifying the optimal ingredient ratio; conducting sensory evaluation and gathering consumer feedback to refine the product based on taste, aroma, texture, and appearance; procuring ingredients and equipment and developing standardized preparation procedures while ensuring food safety compliance; designing eco-friendly packaging that includes nutritional and shelf life information; launching sales through local and online channels with sampling promotions; and tracking sales and feedback on an ongoing basis to optimize pricing, production, and marketing while exploring opportunities for business growth.

The schedule of implementation is organized into six phases. The planning phase covers concept development and sourcing of materials during Week 1 and involves the researcher. The product development phase encompasses recipe trials and banana variation testing during Week 2 and involves a food technologist and the researcher. The testing and evaluation phase covers sensory testing, surveys, and revisions during Week 3 and involves the respondents, researcher, and data analyst. The production setup phase addresses the procurement of equipment and finalization of processes during Week 4 and involves the production team, researcher, and assistants. The marketing launch phase covers branding, packaging, and product selling over a period of 2 months and involves the marketing team, researcher, and sales personnel. The monitoring phase involves ongoing sales tracking and feedback gathering on a continuous basis and involves the researcher, data recorder, and consumers.

The evaluative measures for the commercialization plan are organized around five key criteria. Product quality is assessed through sensory evaluation surveys measuring taste, texture, aroma, and appearance. Customer acceptability is determined using feedback forms to track satisfaction and repeat purchases. Sales performance is monitored through sales records analyzing units sold and revenue growth. Production efficiency is evaluated through production

logs recording time per batch and cost control. Market demand is measured through customer inquiries and demand trends to gauge overall market acceptance.

The program matrix for the commercialization plan outlines specific objectives, corresponding activities, timelines, budgetary requirements, expected outputs, evaluative measures, and persons involved. The objective of developing banana-stabilized leche flan involves recipe formulation and testing during Weeks 1 and 2, with a budgetary requirement of 1,500 for ingredients, 500 for utilities, and 500 for testing materials, totaling 2,500, with a standardized product as the expected output and taste test results as the evaluative measure, involving the researcher, food developer, and assistants. The objective of assessing acceptability involves conducting surveys during Week 3, with a budgetary requirement of 300 for printing questionnaires, 1,000 for respondent tokens, and 500 for data processing, totaling 1,800, with consumer feedback data as the expected output and survey ratings as the evaluative measure, involving the respondents, researcher, and data analyst. The objective of establishing production involves procuring materials and producing during Week 4, with a budgetary requirement of 3,000 for bulk ingredients, 1,500 for packaging, and 2,000 for equipment, totaling 6,500, with a ready-to-sell product as the expected output and production efficiency as the evaluative measure, involving the production team, researcher, and assistants. The objective of marketing the product involves selling and promoting during Month 2, with a budgetary requirement of 1,000 for promotional materials, 1,500 for social media advertisements, and 1,000 for sampling costs, totaling 3,500, with increased sales as the expected output and revenue tracking as the evaluative measure, involving the marketing team, sales personnel, and researcher. The objective of ensuring sustainability involves monitoring and improving on an ongoing basis, with a budgetary requirement of 2,000 for a continuous supplies buffer and 1,000 for miscellaneous expenses, totaling 3,000, with stable business growth as the expected output and profit and feedback as the evaluative measures, involving the researcher, business manager, and stakeholders. The total budgetary requirement across all objectives amounts to 17,300.

Taken together, the findings of this study demonstrate that banana-stabilized leche flan is a feasible, safe, nutritionally relevant, and sensorially acceptable innovation that responds meaningfully to the growing demand for egg-free and plant-based food alternatives. The cost analysis confirms that the choice of banana variety, particularly Pilko in Formulation 1, significantly influences production costs and pricing strategies, with implications for market positioning. Microbiological testing validated the safety of all formulations under proper preparation conditions, while the proximate analysis confirmed the product's low-fat and moderate-energy nutritional profile, suitable for supplementary consumption. Shelf-life data indicate optimal quality within the first 3 to 5 days of refrigeration, a finding critical for production planning and consumer guidance. Sensory evaluation results showed that all three formulations were rated "Very Much Acceptable" across most attributes, with statistically significant differences identified only in appearance, specifically between Formulation 1 and Formulations 2 and 3, while aroma, taste, and texture showed no significant differences among formulations, thereby confirming a stable and broadly acceptable sensory profile. Consumer perception data reinforced the quantitative findings by revealing that health-conscious motivations, dietary inclusivity, sensory appeal, and natural ingredient composition are the primary drivers of product acceptance and purchase intention. The preference for paper-based, eco-friendly packaging further signals an opportunity to align product presentation with evolving consumer values. These findings collectively address the objectives of the study and contribute to the growing body of knowledge on egg-free custard alternatives and the functional use of bananas in food product development. The evidence presented in this chapter provides a strong empirical foundation for the proposed commercialization plan and positions the

subsequent chapter to present conclusions and recommendations grounded in the data and analysis discussed herein.

CONCLUSION

The study examined the sensory characteristics, acceptability, consumer perception, and market potential of banana stabilized egg free leche flan as an innovative alternative to traditional leche flan. The findings demonstrated that banana stabilization can successfully produce a dessert that retains the desirable sensory qualities associated with conventional leche flan while addressing the dietary needs of consumers who avoid eggs because of allergies, lifestyle preferences, or health concerns. The product profile analysis revealed important practical considerations regarding production, quality, safety, and market readiness. Among the banana varieties used, Lakatan incurred the highest production and selling costs due to its expensive raw materials, whereas Latundan represented a moderately priced option and Pilko emerged as the most economical variety. These findings indicate that the cost of production is largely influenced by the amount and price of raw material inputs, making Pilko a cost-effective alternative for commercial production. The study further established that the use of complete and appropriate materials, tools, and equipment contributed to accurate measurements, efficient preparation processes, and consistent product quality.

The preparation procedure successfully produced an egg free version of leche flan with a smooth and cohesive texture through the careful blending of ripe bananas, dairy products, and flavoring ingredients. This formulation maintained the sensory qualities expected of traditional leche flan while providing a suitable alternative for individuals with dietary restrictions. Shelf-life analysis revealed that refrigerated samples maintained acceptable quality for five to seven days, although gradual changes in texture, aroma, appearance, and taste occurred over time. In contrast, products stored at room temperature deteriorated more rapidly and became unacceptable within four to six days because of softening, watery texture, off flavors, and visible spoilage. These results highlight the importance of refrigeration in extending product quality and preserving consumer acceptability. Furthermore, microbiological analysis confirmed the absence of Escherichia coli in all samples, demonstrating that proper sanitation and handling procedures were followed and that the product met acceptable food safety standards.

The nutritional evaluation showed that banana stabilized leche flan is a low fat and carbohydrate rich dessert with moderate caloric content. While the product provided low levels of protein, fat, and potassium, it offered a healthier profile compared with traditional egg-based formulations. Packaging evaluation indicated a strong consumer preference for both packaging options, which were rated as very much preferred. However, the paper-based container consistently received higher ratings across appearance, freshness, and convenience criteria, suggesting greater consumer appeal and stronger potential for commercial presentation. In terms of marketability, the findings revealed that Formulation 1 generated the highest sales across various points of sale. Sales performance was more consistent in sidewalks and wet markets than in school canteens, indicating that both pricing strategy and product accessibility significantly influence consumer purchasing behavior.

The sensory evaluation demonstrated that all three formulations of banana stabilized leche flan achieved very high levels of acceptability among respondents. Consumers expressed positive evaluations across all sensory attributes, indicating strong overall acceptance of the product. Although Formulations 2 and 3 slightly outperformed Formulation 1 in appearance and texture, Formulation 1 received the highest ratings for aroma and taste. Statistical analysis

revealed that there were no significant differences among the formulations in terms of aroma, taste, and texture, suggesting that the sensory quality of the three formulations was generally comparable. However, a significant difference was observed in appearance, with Formulation 2 receiving the highest rating. This finding suggests that its balanced moisture content and uniform texture contributed positively to visual appeal. Despite minor variations in specific attributes, all formulations-maintained acceptability ratings within the acceptable to very acceptable range. Formulation 3, although not achieving the highest score in any individual category, consistently received high ratings across all sensory dimensions, indicating a balanced and stable sensory profile. Overall, the sensory differences among the formulations were minimal and did not substantially affect consumer acceptance.

The qualitative findings further strengthened the quantitative results by revealing highly favorable consumer perceptions of banana stabilized leche flan. Three major themes emerged from the analysis: nutritional benefits, dietary inclusiveness, and consumer interest. Participants perceived the product as nutritious, easy to digest, and beneficial because of the nutritional properties associated with bananas. Consumers also recognized the product as a suitable option for individuals with egg allergies, dietary restrictions, vegan preferences, and health-conscious lifestyles. The product was frequently described as a safe, inclusive, and innovative alternative that could broaden access to traditional desserts. Consumer willingness to try and purchase the product was strongly influenced by expectations regarding taste, appearance, and perceived health value. Overall, participants expressed positive attitudes toward both the sensory qualities and nutritional advantages of the product, indicating substantial acceptance and interest in its commercialization.

Taken together, the findings demonstrate that banana stabilized leche flan possesses strong potential as a commercially viable and consumer acceptable alternative to traditional egg based leche flan. The product achieved high levels of acceptability across sensory, nutritional, and market related dimensions. While appearance differed significantly among formulations, aroma, taste, and texture remained consistently favorable, confirming that banana stabilization can effectively replace egg stabilization without compromising overall product quality. The favorable consumer perceptions regarding health benefits, dietary inclusiveness, and product innovation further support the market potential of banana stabilized leche flan. Consumer willingness to purchase and repurchase the product, combined with positive evaluations across multiple points of sale, suggests promising opportunities for commercial introduction and expansion.

In light of these findings, future product development efforts should focus on improving and standardizing visual appearance, particularly for Formulation 1, to achieve greater consistency and consumer appeal. Additional formulation trials may further refine ingredient combinations and optimize sensory balance. Enhancing the nutritional profile through the incorporation of protein rich or fortified ingredients may improve the overall nutritional value of the product. Comparative studies between traditional leche flan and banana stabilized leche flan are also recommended to provide deeper insights into product performance and consumer preferences. Marketing efforts should prioritize high traffic selling locations such as sidewalks and wet markets while emphasizing affordability, taste, health benefits, and dietary inclusiveness. Further exploration of other banana varieties and natural stabilizers may contribute to continued product innovation and quality enhancement. Finally, future research should investigate consumer purchasing behavior and long-term acceptability to support sustained commercialization and market growth. Collectively, these recommendations can strengthen the product's competitiveness and further establish banana stabilized leche flan as a healthy, inclusive, and innovative dessert alternative.

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