PANTAO
International Journal of the Humanities and Social Sciences
ISSN 3028-0877
Volume 4, Issue 2 (2025)

Development and evaluation of tapuy-flavored ice cream

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Abstract: This study aimed to produce an ice cream recipe flavored with Benguet fermented rice wine, which is locally called tapuy. The study is quantitative research, specifically a factorial experimental research design. The sixty consumer type panelists were selected students and faculty of BSU Bokod Campus who evaluated the tapuy-flavored ice cream products. Three treatments of tapuy-flavored ice creams were produced, plus the control. The formulations were ¼ cup, ½ cup, and 1 cup of tapuy flavor using tapuy lees. Sensory method, particularly descriptive analysis, was conducted to determine the quality attributes of the ice cream, such as color, flavor, body (texture and mouthfeel), and aroma. As to the degree of sensorial acceptability of the tapuy-flavored ice cream, affective sensory evaluation was done. The result of the study revealed that the treatment with ½ cup of tapuy flavor is the most liked and accepted formulation, considering the quality attributes of the tapuy-flavored ice cream. Nutrition analysis was conducted to determine its ash, crude fat, crude protein, moisture, sodium, and total carbohydrate content. There is a significant difference in the level of acceptability of the tapuy-flavored ice cream formulations as perceived by the group of consumer-type panel. Moreover, the perceived quality characteristics of tapuy-flavored ice cream that include color, flavor, body, aroma, and overall acceptability vary depending on the amount of tapuy flavor added. Further study on the physicochemical analysis and shelf life was recommended to improve the ice cream's quality. Another recommendation was a feasibility study for the commercialization of tapuy-flavored ice cream, reiterating its livelihood and health benefits to gauge consumer interest and market demand.

Keywords: Ice Cream, Tapuy, Frozen Dessert,

Date Submitted: May 13, 2025
Date Accepted: May 26, 2025
Date Published: June 2, 2025

INTRODUCTION

The study was inspired by the tapuy-flavored ice cream created and sold by Mrs. Jovielyn Salamat Sianen at Sinner or Saint Café in Km. 3, La Trinidad, Benguet (The Baguio Channel, 2024). Interestingly, the recipe had not yet been patented nor formally assessed for quality or marketability; it was simply being served to customers in the café. Ice cream, as defined by Britannica, is a frozen dairy product made from cream or butterfat, milk, sugar, and flavorings, consumed primarily for its pleasurable taste, indulgence, and emotional satisfaction. Different demographic groups have varying preferences: older generations like Generation X lean toward traditional dairy ice creams, while younger consumers such as millennials and Gen Z increasingly prefer non-dairy alternatives. According to Innova Market Trends (2024), the most influential factors in consumer ice cream choices today are natural ingredients and product safety claims, with chocolate, vanilla, and nut flavors leading the market due to ongoing innovation and premium offerings.

Globally, the ice cream market was valued at USD 113.40 billion in 2023 and is projected to grow at an annual rate of 3.9% through 2030, driven by rising demand for new flavors,

impulse treats like cones and sandwiches, and health-conscious premium products. Gelato is expanding rapidly, especially in Europe, while North America is seeing growth in lactose-free and vegan options. In the Asia Pacific, evolving consumption habits are creating demand for innovative and diverse flavors (Grand View Research, 2025). Within the Philippines, consumer interest is increasingly shifting toward indulgent, creative, and Instagram-worthy ice creams, fueled by a vibrant food culture and the influence of social media. Local favorites like ube, mango, and coconut dominate, and there has been a surge in artisanal and premium brands (Statistica, 2024).

Specifically, the Cordillera Administrative Region, with Benguet as a key player, has actively showcased locally inspired ice cream flavors, using regional products such as sayote, tamarillo, and passion fruit at cultural fairs and festivals. Among these local specialties is tapuy (also known as tapuey or tapey), a traditional rice wine produced in Benguet, Ifugao, and Mt. Province. Tapuy is crafted from pigmented rice through a fermentation process using bubod, a starter culture made from ground glutinous rice, wild grass roots, ginger, and old bubod (Sanchez, 1999). Historically, tapuy has been central to festive and ceremonial occasions (Bandonill et al., 2009), and its production methods vary across provinces, reflecting generations of trial-and-error refinement (Tanimura et al., 1977).

Modern innovations have explored tapuy beyond its traditional uses. For example, PhilRice has developed tapuy-based cocktails by optimizing fermentation parameters, improving quality and shelf life, and removing sulfites to reduce hangover and allergy risks (Ominga, 2013). Moreover, by-products like tapuy lees (residue from rice wine production) have been studied as potential food ingredients, showing promise as high-protein, high-fiber flour (Manaois et al., 2018). Despite the richness of local resources and the diverse range of commercial flavorings available, little published research exists on using Filipino rice wine as a food or dessert ingredient. Therefore, this study aims to address that gap by formulating a novel frozen dessert recipe featuring tapuy as a distinctive and culturally meaningful flavoring agent.

Problem Statement

The study generally aimed to produce an ice cream recipe that is flavored with Benguet fermented rice wine, which is locally called tapuy. Specifically, it aims to:

1. Determine the quality attributes of the tapuy-flavored ice cream formulations as to color, flavour, body, and aroma.
2. Determine the panelist's degree of acceptability of the tapuy-flavored ice cream in terms of color, flavour, body, aroma, and overall acceptability
3. Determine if there is a significant difference on the degree of acceptability of the tapuy-flavored ice cream in terms of color, flavor, body, aroma and overall acceptability when consumer panelists are grouped according to their profile: (a) role in school and (b) sex.
4. Determine the basic nutrient values of the most accepted tapuy-flavored ice cream, using proximate analysis, formulation as to ash, crude fat, crude protein, moisture, sodium, and total carbohydrates.

METHODOLOGY

Research design

The study is quantitative research with a quasi-factorial experimental research design. Quasi-factorial experimental research is a systematic and scientific approach in which the researcher

manipulates one independent variable and observes the effect on a dependent variable while controlling the extraneous variables. This method allows for the establishment of cause-and-effect relationships between variables. It involves manipulating one independent variable simultaneously to observe its interaction effects on the dependent variable. All possible combinations of the independent variables are tested (Saha, 2024). The effect of the said treatments on the tapuy-flavored ice cream was measured and analyzed. The qualitative part is the survey on the acceptability of the color, flavor, body, aroma, and overall acceptability.

Materials and ingredients

This section presents the ingredients of the vanilla ice cream and the proportion of tapuy lees as flavoring for each treatment. It also shows the tools and equipment needed to prepare the product, the scorecard used to evaluate the quality attributes, and the nutritional analyses of the most accepted tapuy-flavored ice cream formulation.

The ingredients in the ice cream recipe used in the study were the same as the recipe of Sinner or Saint Café, but the amount of each ingredient was modified. The ingredients include whipped cream, all-purpose cream, white sugar, evaporated milk, cornstarch, egg yolks, salt, and vanilla extract for the control. Modifications were done on the proportions for ingredients such as the four cups of heavy cream and two cups white sugar proportion for Sinner or Saint Cafe were reduced to one cup whipped cream and one cup all-purpose cream with one cup white sugar. The modification on the proportion of ingredients was done to determine the quality attributes of the ice cream, particularly on the color, flavor, body, and aroma,

Formulation

The recipe of tapuy-flavored ice cream follows the following procedures: 1) In a medium saucepan, combine evaporated milk, ½ cup white sugar, cornstarch, vanilla extract, egg yolks, and salt over medium heat; 2) Mix thoroughly until the mixture thickens, then remove from heat; 3) In another bowl, mix the all-purpose cream until it doubles in size. Do the same with the whipping cream and combine them; 4) Let the milk-sugar mixture cool down before folding it into the cream mixture; 5) Fold the tapuy lees into the final mixture and freeze it for two hours; 6) Bring out the mixture from the freezer and manually mix it with wire whisk then transfer it to the 30 ml individual container with lid. Make sure that each container has 20ml of the ice cream mixture; 7) Put the ice cream back in the freezer and allow to freeze for 24 hours. Note that for best results, freeze it for 36 to 48 hours for the fruity flavor to develop.

Treatment of Data

The responses from the 60 consumer type panelists were analyzed using the necessary statistical tools. The quality attributes of the tapuy-flavored ice cream and the level of acceptability of the qualities of the ice cream, as well as its overall acceptability, were analyzed using descriptive statistics, specifically using the mean with descriptive interpretation (Table 3).

On the other hand, the 9-point hedonic scale (Table 4) was used to determine the panelists perception along the identified qualities of the tapuy-flavored ice cream. The same scale was used in identifying the most accepted tapuy-flavored ice cream product.

Inferential statistics, particularly the t-test, were used to test the differences in the perception of the evaluators, specifically on the degree of acceptability of the product when consumer panelists are grouped by role and sex. It was used to reject or accept the hypotheses based on the distribution of data. This test was particularly used in determining whether the two data sets on

their significantly different from one another between the male and the female evaluators, and the students and teachers. In this case, the t-test was used to compare the means and standard deviations of two groups.

FINDINGS AND DISCUSSION

Quality attributes and acceptability

The study explored the sensory evaluation of tapuy-flavored ice cream formulations compared to a control, focusing on key quality attributes: color, flavor, texture (body and mouthfeel), and aroma.

In terms of color, the ice cream variant with ½ cup of tapuy lees received the highest acceptability, with panelists describing it as "thistle" in shade and extremely liked. Consumers showed a preference for moderately colored products—not too dark or pale—highlighting that visual appeal plays a critical role in food acceptability, consistent with findings by Hong et al. (2020) and Patel et al. (2010). This reflects a broader consumer tendency to associate delicate, balanced colors with higher quality and better taste experiences.

For flavor, the ½ cup tapuy lees formulation again emerged as the most favored, receiving the highest acceptability among the flavored samples. While the one-cup tapuy lees variant had a stronger flavor, it was only "very much liked," suggesting that moderate flavor intensity was preferable. This pattern aligns with Mbaey et al. (2012), who observed enhanced flavor acceptability in yogurt when only small amounts of beetroot juice were used. Furthermore, the findings resonate with current market trends emphasizing natural flavors over artificial ones, as consumers increasingly seek "clean label" products perceived as healthier and more authentic (Siddiqui et al., 2022).

Regarding texture and mouthfeel, the ½ cup tapuy lees variant was rated extremely liked, praised for its "boozy and chunky" character, contrasting with the smoother control. These results align with Pintor-Jardines et al. (2024), who emphasized that texture greatly influences consumer satisfaction in frozen dairy products. Additional research, such as Daungan et al. (2024) and Pon et al. (2019), highlights how ingredient choices like stevia or novel plant infusions can significantly affect ice cream's hardness, chewiness, and overall sensory appeal. This study reinforces that achieving a balanced, pleasing mouthfeel is as critical as flavor in ice cream development.

For aroma, the ice cream with ½ cup tapuy lees again led in consumer preference, described as having a moderate fruity fragrance and being extremely liked. This confirms patterns seen in studies by Hong et al. (2020) and Tahir et al. (2023), which noted that moderate, well-blended aromas enhance sensory appeal and consumer acceptance. Importantly, aroma plays a multi-step role in shaping the tasting experience, from initial package opening to in-mouth aroma release, ultimately shaping perceptions and enjoyment (Feyzi et al., 2020).

Overall degree of acceptability

The vanilla ice cream with ½ cup tapuy lees got the highest mean rating of 8.52, signifying that it is extremely liked by the consumer panelists. The result then implies that the vanilla ice cream with ½ cup tapuy lees is the most acceptable among the three formulations as perceived by the consumer type panel. This sensory evaluation is a vital aspect of tapuy-flavored ice cream

quality assessment. It involves trained consumer panelists conducting taste tests to assess flavor, aroma, sweetness, and overall sensory experience. By conducting sensory testing, ice cream producers can gather valuable feedback and make necessary adjustments to enhance the flavor and overall appeal of their product (Safemilklabs, 2022)

Significant differences in the acceptability of the ice cream products

The study compared the mean acceptability ratings of tapuy-flavored ice cream formulations between students and teachers, revealing that both groups favored the vanilla ice cream with ½ cup of tapuy lees, with students giving it the highest mean rating (8.62) and teachers similarly rating it extremely liked (mean = 8.26). However, students rated the one-cup tapuy lees formulation lowest, while teachers showed the least preference for the ¼ cup variant. Statistical analysis confirmed significant differences between students' and teachers' acceptability ratings across all formulations ($p < .05$), suggesting that age and differing exposure to wine flavors might influence these preferences.

This pattern aligns with the findings of Gisulga (2018), where adults favored a nutrient-rich but distinctively flavored malunggay ice cream formulation, while younger consumers leaned toward milder options. Similarly, Esteron (2023) showed differing evaluations across food experts, sellers, and consumers regarding ice cream flavors, though all groups agreed on the high acceptability of a balanced formulation. Interestingly, Piañar (2024) found no significant differences in acceptability ratings across teenagers, young adults, and adults for GUOKCA ice cream, suggesting that certain formulations can achieve broad cross-age appeal when well balanced.

Additionally, the study examined the acceptability ratings by gender, finding that both male and female evaluators favored the ½ cup tapuy lees formulation, with slightly higher preference from females. Statistical testing revealed no significant differences between male and female ratings for the control and ½ cup tapuy lees formulations ($p > .05$), indicating broad gender agreement on these products. However, significant differences emerged for the ¼ cup and one-cup formulations ($p < .05$), suggesting that male and female panels diverged in their acceptability judgments for these variants.

Nutrition facts of the most accepted tapuy-flavored ice cream formulation

The study's nutrient analysis of the most accepted tapuy-flavored ice cream formulation – the vanilla ice cream with ½ cup tapuy lees - revealed that it delivers approximately 52.92 kilocalories, 6.7 g of carbohydrates, 0.62 g of protein, and 2.58 g of fat per serving. Notably, carbohydrates contributed the highest percentage to nutrient adequacy at 9.44%, followed by fat at 6.29%, with energy and protein trailing at 2.09% and 1.18%, respectively. These results suggest that beyond being a flavorful frozen dessert, the tapuy-flavored ice cream can serve as a light energy-boosting snack during school recess or work breaks. As Bernhard (2025) explains, a kilocalorie refers to the energy required to raise the temperature of one kilogram of water by one degree Celsius, and it is the standard unit used for food energy on labels.

The moisture content of this ice cream formulation was measured at 62.59 g per 100 g, aligning closely with literature values for vanilla ice cream (61.70%) but exceeding the 43.75% reported by Gindi et al. (2022) for ice cream incorporated with Baccaurea angulata peel. This was determined using oven drying, a common proximate analysis method. For carbohydrates, the

product contained 20.166 g per 100 g, calculated by the difference method—subtracting measured protein, fat, water, alcohol, and ash from the total food weight, a widely accepted approach in food analysis.

Additionally, the ash content, representing the total mineral content, was found to be 14.1 g per 100 g, determined using ignition gravimetry, which involves incinerating the sample at high temperatures to leave behind inorganic matter. As Harris and Marshall (2017) note, ash analysis provides insight into the presence of essential minerals like calcium, magnesium, sodium, potassium, and trace elements such as manganese, iron, and zinc.

CONCLUSION

Based on the findings of the study, several important conclusions can be drawn. First, the quality attributes of tapuy-flavored ice cream, including color, flavor, body, and aroma, vary depending on the amount of tapuy flavor incorporated into the formulation, indicating that the balance of this unique local ingredient plays a crucial role in shaping the sensory characteristics of the product. Among the different formulations tested, the tapuy-flavored ice cream with ½ cup tapuy lees emerged as the most liked and most acceptable version, although other variations were found to be equally acceptable by the evaluators, reflecting the general appeal of the tapuy-infused product. Additionally, the study revealed that factors such as the respondent's role in school and sex influence their perception of the acceptability of the tapuy-flavored ice cream, suggesting that demographic variables may shape consumer preferences. Finally, the most accepted formulation, which contains ½ cup tapuy lees, was found to make a significant contribution to the daily basic nutrient requirements, highlighting its potential not only as an innovative dessert but also as a functional food product with nutritional value.

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