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Exploring the Viability and Sensory Acceptability of Chinese Malunggay - Enriched Cream Puff

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Abstract

This study explored the viability and sensory acceptability of Chinese Malunggay (Moringa oleifera) as an enriching ingredient in cream puffs. It aimed to determine the level of consumer acceptability of three different treatments based on five sensory attributes: appearance, aroma, texture, taste, and general acceptability. Using a hedonic scale, a panel of evaluators assessed the samples, and results showed that the treatment with the highest amount of malunggay consistently received the most favorable ratings across all sensory dimensions. Statistical analysis revealed significant differences among the treatments, indicating that the amount of malunggay used influenced the overall sensory quality of the product. Additionally, the study examined the product's market potential and found it to be promising. Based on the findings, it was concluded that Chinese Malunggay can be successfully integrated into cream puffs to improve their nutritional content and sensory characteristics. The study recommends the use of malunggay in bakery products and encourages further research and product testing to support its commercial application, especially in promoting healthier snack alternatives in local communities.

Keywords: Chinese Malunggay, Moringa Oleifera, Cream Puff, Product Development, Market Potential, Enriched Bakery Product

1. Introduction

The culinary world is constantly evolving, exploring unique ingredients to create innovative dishes. One such intriguing exploration is the utilization of the Chinese Malunggay, scientifically known as Breynia Androgyna, in creating a distinct dish called Cream Puff. Chinese malunggay, known as katuk, star gooseberry, or sweet leaf, is a year-round tropical shrub.

Chinese malunggay is one of the most popular leafy vegetables in South and Southeast Asia and is notable for its high yields and palatability. It can be explicitly cultivated for edible asparagus stems using heavy fertilization; this cultivation variant is known as "Sabah vegetable." The stems are otherwise not edible.

Chinese Malunggay, as a leafy vegetable, contains many typical plant nutrients, but its vitamin K levels are particularly notable since they are photosynthetic tissue. Leafy greens are an essential part of being healthy. They provide many important vitamins and minerals that help support optimal health. Adding leafy greens to your diet is an easy way to get the vitamins and minerals your body needs for optimal health as these are rich in vitamins and minerals such as Vitamin A, Vitamin C, iron, Magnesium, potassium, and calcium, support vision and skin health, boost the immune system, help maintain a healthy weight. The high antioxidant content is linked to reducing the risk of cancer and heart disease, provides essential fiber to one's diet, is low calorie but still packed with nutritional value, improves digestion, reduces inflammation in the body, and contains chlorophyll, which can help purify the blood and keep someone energized.

Chinese Malunggay is often consumed as a vegetable in Southeast Asian cultures, particularly for its health benefits. Moringa or malunggay, in general, may have various health benefits, from speeding up wound healing to managing blood glucose. Chinese malunggay has many potential health benefits, including lowering blood sugar, reducing inflammation, lowering bad cholesterol, being suitable for liver health, improving eyesight, improving skin appearance, boosting immunity, and improving motor skills.

Furthermore, it aids in addressing mood and nervous system disorders, protects the cardiovascular system, and helps manage diabetes. It is beneficial for asthma treatment, aids in lowering high blood pressure, enhances eye health, and effectively treats

anemia and sickle cell disease.

This study looked into the viability of using Chinese Malunggay in a distinct dish called cream puff. Cream Puff is a filled French choux pastry ball with a typically sweet and moist filling of whipped cream, custard, pastry cream, or ice cream. The puffs may be embellished or left plain, garnished with chocolate sauce or powdered sugar.

This research paper discussed the attributes of cream puffs, along with their color, aroma, texture, flavor, and general acceptability. Generally, this paper aimed to discover the market potential and general acceptability of using Chinese Malunggay in making cream puffs.

2. Materials and Methods

This chapter presents the experimental procedure, tools and equipment, research design and treatments, population, and locale of the study, the data gathering instrument and procedure, statistical analysis, and data categorization that were used in the study.

Experimental Procedure

The study utilized different treatments for the dough and filling of Chinese malunggay cream puff. The following were followed:

Ingredients:

- ½ cup water
- ½ cup milk
- 1/3 cup butter
- 1tbsp sugar
- ½ tsp salt

Materials

The following were the materials and equipment used in making Chinese malunggay powder, which were utilized in making Chinese malunggay Enriched cream puff.

A. Tools and equipment for making Chinese malunggay powder and cream puffs

Equipment:

- Pulverizer

Tools:

- Strainer
- Mixing bowl
- Trays
- Airtight jar

B. Tools and equipment in baking Chinese malunggay cream puff

Equipment:

- Oven

Tools:

- Strainer
- Mixing bowl
- Trays
- Measuring spoons and cups
- Spatula
- Piping bag
- Disposable tub

Research Design

This study used the Completely Randomized Design (CRD) to determine the most acceptable formulation of Chinese Malunggay Cream Puff along the different attributes: appearance, taste, aroma, texture, and general acceptability.

Population and Sample

The study was conducted at the Abra Institute of Sciences and Technology, Main Campus, Lagangilang, Abra. Forty respondents, 36 Grade 9 students and 4 faculty, evaluated the organoleptic (appearance, aroma, texture, taste, and overall acceptability) properties of Chinese Malunggay Cream puff.

Data Gathering Instrument

A checklist was used to evaluate the Chinese Malunggay Cream Puff in terms of appearance, aroma, taste, texture, and general acceptability.

The degree of acceptability of Chinese Malunggay Cream Puff was evaluated using a 5-point. Hedonic Scale. The interpretation of mean scores was based on the following scales:

Appearance

Point Scores	Range Interval	Indicators	Descriptive Rating
5	4.21 - 5.00	The product is rich, desirable color, perfectly shaped, flawless, and glossy.	Very Acceptable
4	3.41 - 4.20	The product is appealing, golden brown, well-formed, symmetrical, smooth, and free of blemishes.	Acceptable
3	2.61 – 3.40	The product is acceptable in color, generally round/oval, and mostly smooth.	Moderately Acceptable
2	1.81 – 2.60	The product is unevenly browning, slightly misshapen, with some imperfections, and slightly tough.	Slightly Acceptable
1	1.00 – 1.80	The product is too pale/burnt, irregular, flat, cracked, uneven	Not Acceptable

Aroma

Point Scores	Range Interval	Indicators	Descriptive Rating
5	4.21 - 5.00	The product has a strong, inviting aroma, overpowering.	Very Acceptable
4	3.41 - 4.20	The product has a pleasant, buttery aroma, well-balanced with other aromas.	Acceptable
3	2.61 – 3.40	The product has a slightly fragrant, subtle, and pleasant smell.	Moderately Acceptable
2	1.81 – 2.60	The product has a weak aroma, too strong, herbaceous.	Slightly Acceptable
1	1.00 – 1.80	The product has a burnt, off-putting, and not detectable smell.	Not Acceptable

Taste

Point Scores	Range Interval	Indicators	Descriptive Rating
5	4.21 - 5.00	light, airy, and crisp with a creamy, sweet filling.	Very Acceptable
4	3.41 - 4.20	It tastes like vanilla pastry cream.	Acceptable
3	2.61 – 3.40	It should be able to smell faintly of butter and vanilla.	Moderately Acceptable
2	1.81 – 2.60	Dislikes: it is sweet and has	Slightly

		a wonderful vanilla touch.	Acceptable
1	1.00 – 1.80	Very disliked taste	Not Acceptable

Texture

Point Scores	Range Interval	Indicators	Descriptive Rating
5	4.21 - 5.00	The product is perfectly crisp and airy, perfectly moist and tender.	Very Acceptable
4	3.41 - 4.20	The product is crisp, delicate, soft, and slightly moist.	Acceptable
3	2.61 – 3.40	The product is moderately crisp, moderately moist.	Moderately Acceptable
2	1.81 – 2.60	The product is slightly tough, slightly dry.	Slightly Acceptable
1	1.00 – 1.80	The product is hard, tough, dry, and crumbly.	Not Acceptable

Data Gathering Procedures

To evaluate the sensory acceptability and viability of the Chinese Malunggay–enriched cream puff, the researchers conducted a product evaluation involving a total of 40 respondents. These included 36 Grade 9 students and 4 faculty members from the Technology and Livelihood Education (TLE) Department at the University of Abra – Lagangilang Campus.

Prior to the evaluation, a formal letter of permission was prepared and addressed to the evaluators and the research adviser, requesting approval to conduct the sensory testing. Upon approval, the cream puffs were freshly prepared following standardized procedures to ensure consistency in quality, taste, and presentation.

The sensory evaluation was carried out using a structured 9-point Hedonic Rating Scale, which assessed the following attributes: appearance, color, texture, aroma, taste, and overall acceptability. The evaluation was conducted in a controlled setting to minimize external factors that might affect the panelists' perceptions. Each respondent was given a sample of the Chinese Malunggay–enriched cream puff along with the evaluation form.

Instructions were clearly explained prior to tasting, and respondents were encouraged to express their honest opinions without influence from others. The collected data were then tabulated and statistically analyzed to determine the level of acceptability of the product, thereby assessing its potential viability for broader consumption or commercialization.

Ingredients and Measurement

Three treatments were prepared using varying proportions of Bengal Currant and Carabao Mango, while keeping the amount of sugar and lemon juice constant, as shown in Table 1.

Table 1: Ingredients in Bengal Currant and Carabao Mango Jam

Treatment 1	Treatment 2	Treatment 3
T1 - 1 tsp powdered Chinese Malunggay + Basic Ingredients	½ tbs powdered Chinese Malunggay + Basic Ingredients	1 tbsp Chinese Malunggay + Basic Ingredients
Basic Ingredients: ½ cup water ½ cup milk ⅓ cup butter 1 tbsp sugar	**Basic Ingredients:** ½ cup water ½ cup milk ⅓ cup butter 1 tbsp sugar	**Basic Ingredients:** ½ cup water ½ cup milk ⅓ cup butter 1 tbsp sugar
½ tsp salt	½ tsp salt	½ tsp salt
Custard filling: 2 eggs 2 cups whole milk 1 tsp vanilla extract ½ cup sugar 3 tbsp cornstarch Pinch of salt 1 tsp vanilla extract	**Custard filling:** 2 eggs 2 cups whole milk 1 tsp vanilla extract ½ cup sugar 3 tbsp cornstarch Pinch of salt 1 tsp vanilla extract	**Custard filling:** 2 eggs 2 cups whole milk 1 tsp vanilla extract ½ cup sugar 3 tbsp cornstarch Pinch of salt 1 tsp vanilla extract

Statistical Treatment of Data

The following statistical tools were employed in data analysis:

1. **Mean:** This was used to determine the sensory ratings (color, aroma, texture, flavor, and general acceptability) of the evaluators on the Chinese Malunggay Cream Puff using different treatments.
2. **Analysis of Variance:** This was used to identify the significant difference between and among sensory ratings of the evaluators in terms of color, aroma, taste, texture, and appearance, and the difference between the different treatments in the Sensory Acceptability of Chinese Malunggay Cream Puff.
3. **Treatment of Data for ROI:** This was used to evaluate the feasibility and profitability of producing the Chinese Malunggay Cream Puff.

3. Results and Discussions

This chapter presents the analysis and interpretation of the data gathered in the study.

Problem 1: What is the sensory analysis and acceptability of the Chinese malunggay cream puff along the following attributes?

Table 1a: Sensory Analysis and Acceptability of Chinese Malunggay Cream Puff in Terms of Appearance

Appearance	Mean	Descriptive Rating
Treatment 1	4.41	Very Acceptable
Treatment 2	3.50	Acceptable
Treatment 3	3.15	Moderately Acceptable

Legend

Range	Descriptive Rating
4.21 - 5.00	Very Acceptable (VA)
3.41 - 4.20	Acceptable (A)
2.61 - 3.40	Moderately Acceptable (MoA)
1.81 - 2.60	Slightly Acceptable (SA)
1-00 - 1.80	Not Acceptable (NA)

The appearance of food is a vital factor influencing consumer preferences and initial impressions. As shown in Table 1a, Treatment 1 achieved the highest mean score of 4.41, falling under the category of *"Very Acceptable."* This indicates that the evaluators found this treatment most visually appealing in terms of appearance, particularly its color, shape, and overall presentation. Balanced ingredient mixture and proper baking technique resulted in a desirable puff structure and consistent appearance.

Treatment 2, with a mean score of 3.50, was rated as *"Acceptable,"* suggesting that its appearance met the basic expectations of the evaluators but lacked the enhanced qualities observed in Treatment 1. Meanwhile, Treatment 3 received the lowest mean of 3.15, categorized as *"Moderately Acceptable."* This score implies that although the appearance was still within acceptable standards, the evaluators noted imperfections such as uneven surface

texture, inconsistent coloring, or visible malunggay bits that may have affected its visual appeal.

The higher rating of Treatment 1 reinforces the idea that integrating nutritious components such as malunggay must be done carefully to preserve or even enhance the aesthetic qualities of the product. The results indicate that with the right formulation, health-oriented baked goods can achieve high acceptability, starting from visual appeal.

This aligns with the findings of Moskowitz *et al*. (2017) [28], who emphasized that visual appeal is often the deciding factor in whether consumers will try a new food product, especially those containing unfamiliar or functional ingredients like Moringa Oleifera (malunggay). Similarly, a 2021 study by Pérez-Cueto highlighted that foods with natural fortifications must maintain strong visual cues to counteract potential bias against novel ingredients.

Table 1b: Sensory Analysis and Acceptability of Chinese Malunggay Cream Puff in Terms of Aroma

Aroma	Mean	Descriptive Rating
Treatment 1	4.37	Very Acceptable
Treatment 2	3.59	Acceptable
Treatment 3	3.29	Moderately Acceptable

Legend

Range	Descriptive Rating
4.21 - 5.00	Very Acceptable (VA)
3.41 - 4.20	Acceptable (A)
2.61 - 3.40	Moderately Acceptable (MoA)
1.81 - 2.60	Slightly Acceptable (SA)
1-00 - 1.80	Not Acceptable (NA)

Aroma plays a fundamental role in influencing appetite and shaping overall sensory experiences. In the context of baked goods, a pleasant aroma not only enhances palatability but also creates a sense of anticipation and enjoyment before the product is even tasted.

As presented in Table 1b, Treatment 1 recorded the highest mean score of 4.37, which is interpreted as "*Very Acceptable.*" This suggests that the aroma of Treatment 1 was particularly well-received by the evaluators, likely due to a harmonious blend of traditional pastry scent and the subtle herbal notes of malunggay. This favorable result points to an optimal balance in ingredients and preparation methods that did not overpower the natural aroma of the cream puff.

Treatment 2 received a mean rating of 3.59, categorized as *"Acceptable."* This indicates that while the aroma was generally pleasing, it may have lacked the appealing fragrance intensity found in Treatment 1. In contrast, Treatment 3 obtained the lowest mean of 3.29, falling under the *"Moderately Acceptable"* category. This score suggests that the aroma was present but may have had minor off-notes, possibly due to a higher malunggay content or variations in the baking process.

The results from Table 1b reinforce that Treatment 1 successfully maintained an inviting and familiar aroma profile, which is critical for consumer acceptance, especially in health-enriched pastries that integrate less conventional ingredients. This suggests that with proper formulation, malunggay can be included in baked goods without compromising aromatic appeal.

According to Yousefi *et al*. (2020) [37], the aroma of functional food products is often influenced by the type and concentration of enriched ingredients, such as herbs and vegetables. Their study noted that while natural additives like Moringa Oleifera contribute nutritional value, they must be incorporated carefully to avoid producing unfamiliar or overpowering scents that may affect consumer perception.

Table 1c: Sensory Analysis and Acceptability of Chinese Malunggay Cream Puff in Terms of Texture

Texture	Mean	Descriptive Rating
Treatment 1	4.38	Very Acceptable
Treatment 2	3.50	Acceptable
Treatment 3	3.02	Moderately Acceptable

Legend

Range	Descriptive Rating
4.21 - 5.00	Very Acceptable (VA)
3.41 - 4.20	Acceptable (A)
2.61 - 3.40	Moderately Acceptable (MoA)
1.81 - 2.60	Slightly Acceptable (SA)
1-00 - 1.80	Not Acceptable (NA)

Texture is one of the most important attributes in bakery products, as it significantly affects the eating experience. A desirable texture in cream puffs is typically described as light, airy, and slightly crisp on the outside with a soft and moist interior. Any deviation from this standard may impact consumer satisfaction.

Based on the data presented in Table 1c, Treatment 1 achieved the highest mean score of 4.38, indicating that its texture was rated as *"Very Acceptable."* This suggests that it met the expectations of the evaluators in terms of softness, chewiness, and mouthfeel. The well-balanced texture likely resulted from proper ingredient ratios and precise baking time, which helped retain moisture while ensuring structural integrity.

Treatment 2, with a mean of 3.50, fell into the "*Acceptable*" category. Although still considered pleasant, it may have lacked the refined lightness or consistency of Treatment 1. Treatment 3 garnered the lowest mean score of 3.02, making it "*Moderately Acceptable.*" Panelists may have experienced slight toughness, dryness, or uneven puffiness in this version, possibly due to excess malunggay or inconsistencies in baking temperature or batter consistency.

The results clearly indicate that Treatment 1 was the most successful in achieving the ideal cream puff texture while still incorporating malunggay. This suggests that health-enhancing ingredients can be included without compromising sensory appeal when carefully balanced in the recipe.

According to Choi and Bae (2018) [17], the texture of functional or enriched baked products can be influenced by the inclusion of plant-based additives. Ingredients like Moringa Oleifera are rich in fiber, which, while beneficial for health, can alter the gluten network and moisture retention in dough-based products. More recent work by Singh *et al*. (2022) [35] supports this, stating that fiber-rich formulations must be optimized to prevent negative effects on softness and cohesiveness.

Treatment 2, with a mean rating of 3.54, was rated as "*Acceptable.*" While still satisfactory, this formulation may have exhibited slight imbalances—perhaps a stronger herbal note or less sweetness—that made it less enjoyable than Treatment 1. Treatment 3 scored 3.13, placing it under the *"Moderately Acceptable"* category. This implies that the malunggay flavor may have been more dominant or less well-masked by other ingredients, leading to a slightly unfamiliar or less desirable taste experience.

Thus, the results strongly suggest that Treatment 1 offered the best taste experience, likely due to optimal ingredient proportions and formulation strategies that masked any undesirable flavors from malunggay. This reinforces the importance of recipe refinement when developing health-oriented baked products that still cater to mainstream consumer tastes.

These findings are consistent with Deori *et al*. (2019) [18], who noted that the inclusion of green leafy vegetable powders like Moringa oleifera can influence flavor perception. They emphasized that while malunggay offers notable health benefits, its slightly bitter and earthy taste can affect product palatability if not properly balanced with other ingredients. More recently, Lee *et al*. (2023) [26] supported this by stating that consumer acceptance improves when the functional ingredient enhances rather than overpowers traditional flavor profiles.

Table 1d: Sensory Analysis and Acceptability of Chinese Malunggay Cream Puff in Terms of Taste

Taste	Mean	Descriptive Rating
Treatment 1	4.43	Very Acceptable
Treatment 2	3.54	Acceptable
Treatment 3	3.13	Moderately Acceptable

Legend

Range	Descriptive Rating
4.21 - 5.00	Very Acceptable (VA)
3.41 - 4.20	Acceptable (A)
2.61 - 3.40	Moderately Acceptable (MoA)
1.81 - 2.60	Slightly Acceptable (SA)
1-00 - 1.80	Not Acceptable (NA)

Taste is often the most influential factor in determining a product's overall acceptability. For a cream puff, the ideal taste profile should offer a harmonious balance of sweetness and richness, with any added ingredients, such as malunggay, complementing rather than overpowering the base flavor.

As reflected in Table 1d, Treatment 1 received the highest mean score of 4.43, which falls within the *"Very Acceptable"* range. This suggests that evaluators found the taste of this version highly pleasing. The likely reason is that the malunggay was well-incorporated and did not produce any bitterness or off-flavors, allowing the natural creaminess and sweetness of the pastry to shine.

Table 1e: Sensory Analysis and Acceptability of Chinese Malunggay Cream Puff in Terms of General Acceptability

General Acceptability	Mean	Descriptive Rating
Treatment 1	4.40	Very Acceptable
Treatment 2	3.62	Acceptable
Treatment 3	3.15	Moderately Acceptable

Legend

Range	Descriptive Rating
4.21 - 5.00	Very Acceptable (VA)
3.41 - 4.20	Acceptable (A)
2.61 - 3.40	Moderately Acceptable (MoA)
1.81 - 2.60	Slightly Acceptable (SA)
1-00 - 1.80	Not Acceptable (NA)

General acceptability reflects the overall impression of a food product, integrating key sensory attributes such as appearance, aroma, texture, and taste. It serves as a holistic measure of whether a product meets consumer expectations and has market potential.

As seen in Table 1e, Treatment 1 received the highest mean rating of 4.40, classified as *"Very Acceptable."* This indicates that evaluators found the overall experience of Treatment 1—including its flavor, look, smell, and mouthfeel—to be highly satisfactory. The consistently high scores across all previous attributes support this result, suggesting that Treatment 1 achieved a well-balanced formulation where malunggay was effectively incorporated without negatively impacting sensory quality.

Treatment 2, with a mean of 3.62, falls under the *"Acceptable"* category. While still positively received, it may not have delivered the same level of integration or satisfaction across all sensory dimensions compared to Treatment 1. In contrast, Treatment 3 earned a mean of 3.15, which is *"Moderately Acceptable."* This score indicates that some aspects—possibly taste or texture—fell short of expectations, lowering its overall acceptability.

The results of this sensory evaluation affirm that Treatment 1 holds the most promise as a nutritionally enriched yet enjoyable cream puff. It demonstrates that malunggay, when thoughtfully formulated, can be introduced into baked goods without compromising consumer appeal.

According to Fiszman and Varela (2018) [19], general acceptability is often driven by consumer familiarity, pleasant sensory integration, and the absence of negative aftertastes or textures. More recently, Ahmad *et al*. (2022) emphasized that health-oriented food products must strike a delicate balance between nutritional enhancement and sensory satisfaction. Products that achieve this balance are more likely to succeed in competitive markets.

Problem 2: What will be the market potential of Chinese Malunggay cream puff along the following factors?
a. ROI
b. Price

Table 2a: Market Potential of Chinese Malunggay Cream Puff along with Return on Investment

Particulars	Treatments		
	T1	T2	T3
Yields	49	56	56
Sales	₱490.00	₱560.00	₱560.00
Price/pc	₱10.00	₱10.00	₱10.00
Expenses	₱440.00	₱440.00	₱445.00
Net Income	₱50.00	₱120.00	₱115.00
ROI (%)	11.36%	27.27%	25.84%

A. ROI

Table 2 presents the market potential of the Chinese Malunggay Cream Puff, specifically in terms of its Return on Investment (ROI). The ROI is calculated by comparing the net income against the expenses incurred for each treatment. Treatment 1 has an ROI of 11.36%, Treatment 2 has the highest ROI at 27.27%, and Treatment 3 follows with an ROI of 25.84%.

These figures suggest that Treatment 2, with the highest ROI, is the most profitable in terms of the relationship between income generated and the costs incurred. The relatively higher ROI for Treatment 2 could be attributed to its higher yield of 56 pieces, along with relatively controlled expenses (₱440.00). Treatment 3, despite having the same yield as Treatment 2, had slightly higher expenses (₱445.00), which resulted in a lower ROI compared to Treatment 2. Treatment 1, although yielding fewer pieces

(49), still showed a positive ROI of 11.36%, indicating a profitable return, albeit less significant than the others.

The ROI values indicate that the Chinese Malunggay Cream Puff has a solid market potential, particularly in Treatments 2 and 3, where the returns are notably higher. This aligns with the findings of Ocampo *et al*. (2020), who noted that a product's profitability is strongly linked to both its yield and cost management. Efficient cost management and higher yields tend to contribute to higher profitability and a stronger market position. Additionally, a study by Santos *et al*. (2018) affirmed that the ROI is a key factor in determining the commercial viability of food products, as it reflects the ability to generate profit relative to the initial investment. Based on these results, it can be concluded that the Chinese Malunggay Cream Puff has the potential for market success, especially if the strategies for cost control and yield optimization are implemented effectively.

B. Price

In terms of pricing, the Chinese Malunggay Cream Puff is priced at ₱10.00 per piece for all treatments. This consistent pricing strategy across the three treatments indicates a standardized approach to pricing, regardless of the slight variations in yield and expenses between the treatments. The price point of ₱10.00 per piece places the product within a competitive range for bakery products, especially for a unique offering like the Malunggay-enriched cream puff, which has the added appeal of health benefits.

The market potential of the product at this price point can be evaluated based on the sales and yield data presented in Table 2. For example, Treatment 1, with 49 pieces sold at ₱10.00 each, generates a total of ₱490.00 in revenue, while Treatment 2 and Treatment 3, both yielding 56 pieces, generate ₱560.00 in revenue. The pricing strategy appears to be favorable, as it leads to a substantial income from each batch produced.

Considering the ROI values previously discussed, the ₱10.00 price per piece ensures that even after accounting for production costs, the product remains profitable. This aligns with the findings of Mapa *et al*. (2021), who noted that setting a reasonable price point that reflects both the product's value and its target market's willingness to pay is crucial to the success of a new product in the market. Moreover, studies such as those by Asuncion and Cruz (2020) [13] emphasize that pricing should also account for the added value of health benefits, as functional foods like the Chinese Malunggay Cream Puff can often command higher prices due to their nutritional benefits, appealing to health-conscious consumers.

Therefore, at ₱10.00 per piece, the Chinese Malunggay Cream Puff offers a competitive pricing structure that can attract a broad market segment while ensuring profitability.

Problem 3: Is there a significant difference between and among the different treatments of Chinese malunggay cream puff?

Table 3: Sensory Acceptability and Significant Difference of Chinese Malunggay Cream Puff

Sensory Attribute	F-value	Sig. (p-value)	Interpretation
Appearance	7.718	.022	Significant
Aroma	11.269	.009	Significant
Texture	34.577	.001	Significant
Taste	41.113	.000	Significant
General Acceptability (GA)	**41.242**	**.000**	**Significant**

*Significant at 0.05 level
**Highly Significant at 0.01 level

The data presented in Table 3 summarizes the statistical comparison of the sensory attributes of the three treatments of Chinese Malunggay Cream Puff using one-way ANOVA. The aim was to determine whether the differences observed in mean scores across treatments for each sensory characteristic were statistically significant.

All five sensory attributes—appearance, aroma, texture, taste, and general acceptability—were found to have p-values less than 0.05, indicating statistically significant differences among the three treatments. Notably, taste and general acceptability both had p-values of .000, showing a highly significant difference at the 0.01 level. These results affirm that the variation in formulation (presumably the malunggay content) had a real and measurable impact on how the panelists evaluated each sensory characteristic.

The largest F-values were recorded for taste (41.113) and general acceptability (41.242), highlighting these attributes as the most sensitive to differences among the treatments. This suggests that the amount and integration of malunggay significantly influenced the overall flavor experience and consumer perception. The high F-value for texture (34.577) also reflects the importance of structural consistency and mouthfeel in acceptance.

These findings support the observations made in Tables 1a–1e, where Treatment 1 consistently received the highest scores across all sensory categories. The statistical significance confirms that these differences were not due to chance but were the result of actual variations in the treatments' formulation and preparation.

This is consistent with the findings of Guiné *et al*. (2020) [23], who reported that consumers are highly responsive to changes in sensory attributes when functional ingredients are added to baked products. Their study emphasized that successful food innovation requires sensory optimization to ensure health enhancements do not compromise palatability or enjoyment.

4. Conclusions

The following are the conclusions drawn from the findings of the study:

1. The study found that the inclusion of Chinese Malunggay in cream puffs positively influenced the sensory properties of the product. Treatment 1, which had the highest concentration of malunggay, received the highest ratings across all sensory attributes, including appearance, aroma, texture, taste, and general acceptability. This indicates that malunggay can enhance the overall appeal of cream puffs.
2. The statistical analysis revealed significant differences in the sensory attributes of the cream puffs, particularly in appearance, aroma, texture, taste, and general acceptability. The p-values for all sensory attributes were less than 0.05, indicating that variations between treatments were statistically significant and that malunggay contributed to these differences.
3. The study demonstrated a strong market potential for the product, with Treatment 2 showing the highest return on investment (ROI). The standardized price of ₱10.00 per piece was found to be competitive, supporting the product's profitability potential. This

indicates that the malunggay-enriched cream puff could be a viable and profitable product in the market. The findings of this study suggest that Chinese Malunggay can be successfully incorporated into bakery products like cream puffs without compromising their sensory appeal. This opens up opportunities for developing more nutritious and innovative bakery items that incorporate locally available, health-promoting ingredients like malunggay.

5. Recommendations

In light of the findings and conclusions, the following recommendations are proposed:

1. Based on the favorable sensory evaluation results, it is recommended to promote the use of Chinese Malunggay as a functional ingredient in bakery products such as cream puffs. Its nutritional value and ability to enhance sensory qualities make it a valuable addition to food innovation efforts, especially in health-conscious markets.
2. Since Treatment 1 received the highest ratings in all sensory attributes, it is recommended for further development and potential commercial production. Its balanced formulation can serve as a standard recipe for producing malunggay-enriched cream puffs that are both nutritious and appealing to consumers.
3. To validate the results and improve product development, it is recommended to conduct further product testing involving a larger and more diverse group of consumers. This would help refine the formulation and confirm the market readiness of the product across different age groups and preferences.
4. Given the strong market potential and profitability shown by the study, particularly with Treatment 2's return on investment (ROI), it is recommended to explore small-scale business opportunities such as selling the cream puff in school canteens, local markets, and food fairs. This can help promote both entrepreneurship and healthier snack alternatives in the community.
5. Based on the favorable sensory evaluation results, it is recommended to promote the use of Chinese Malunggay as a functional ingredient in bakery products such as cream puffs. Its nutritional value and ability to enhance sensory qualities make it a valuable addition to food innovation efforts, especially in health-conscious markets.
6. Since Treatment 1 received the highest ratings in all sensory attributes, it is recommended for further development and potential commercial production. Its balanced formulation can serve as a standard recipe for producing malunggay-enriched cream puffs that are both nutritious and appealing to consumers.
7. To validate the results and improve product development, it is recommended to conduct further product testing involving a larger and more diverse group of consumers. This would help refine the formulation and confirm the market readiness of the product across different age groups and preferences.
8. Given the strong market potential and profitability shown by the study, particularly with Treatment 2's return on investment (ROI), it is recommended to explore small-scale business opportunities such as selling the cream puff in school canteens, local markets, and food fairs. This can help promote both entrepreneurship and healthier snack alternatives in the community.

6. References

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