

Product Development and Sensory Acceptability of Malunggay (*Moringa oleifera*) and Kalabasa (*Cucurbita maxima*) Ice Cream

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Abstract

This study aimed to develop and evaluate malunggay (*Moringa oleifera*) and kalabasa (*Cucurbita maxima*) ice cream as a nutritious traditional dessert. Specifically, it determined the acceptability of malunggay and kalabasa ice cream in terms of taste, texture, color, appearance, general acceptability, economic analysis and market turnover. An experimental research design was employed of four different treatments using varied proportion of ingredients. Sensory evaluation was conducted using the 9-point hedonic scale with 100 respondents. The data gathered were analyzed using descriptive statistics, particularly frequency, percentage, and mean to determine the level of general acceptability of the malunggay and kalabasa ice cream. Results revealed that Treatment 3 is the most acceptable treatment in terms of taste, texture, color, and appearance. The findings suggest that malunggay and kalabasa using treatment 3 can serve as a feasible and nutritious dessert option while maintaining consumer acceptability. It is also a viable food product that can be developed for health-conscious individuals, particularly children and consumers seeking alternative healthy dessert options. Economic analysis of the most acceptable treatment is Treatment 3 revealed a total production cost of ₱348.00 and a net income of ₱102.00 per batch. The computed Return on Investment (ROI) was 29.31%, indicating that the product is economically viable and profitable. Furthermore, Treatment 3 generated a market turnover of ₱450.00 per production batch from the sale of 15 packs at ₱30.00 per pack, demonstrating its potential marketability and revenue-generating capability. These findings suggest that the developed Malunggay and Kalabasa Ice Cream is not only highly acceptable to consumers but also feasible for commercialization.

Keywords: Malunggay, Kalabasa, Vegetable Ice Cream, Sensory Evaluation, Product Development

1. Introduction

Ice cream is one of the most popular frozen desserts consumed all over the world because of its taste, creamy, and refreshing qualities. The food industry focuses on developing innovative products that not only satisfy consumer preferences but also provide nutrition benefits for the product developed. One of these innovations is the incorporation of vegetables particularly malunggay and kalabasa into ice cream formulations to enhance their nutritional value while maintaining desirable sensory characteristics. Researchers have reported that vegetable ice cream can serve as a functional food product by providing essential vitamins, minerals, dietary fiber, and antioxidants while remaining acceptable to consumers (El-Kholy and Abbas, 2015; Kulkarni et al., 2017). One strategy is the development of malunggay (*Moringa oleifera*) and kalabasa (*Cucurbita maxima*). Since ice cream is widely accepted by people of different ages, incorporating vegetables into this product may help increase vegetable intake while providing a nutritious frozen dessert. Previous studies have shown that the addition of vegetable ingredients such as pumpkin improved the nutritional profile of ice cream without reducing its sensory quality (El-Koly and Abbas, 2015). Likewise, Kulkarni et al. (2017) found that pumpkin-enriched ice cream obtained favorable ratings of flavor, texture, color, and overall acceptability.

Sensory acceptability is a critical factor in determining the success of developed products. Consumers evaluate products based on sensory attributes such as taste, texture, aroma, appearance, and overall acceptability. Sensory evaluation is important in determining whether malunggay and kalabasa ice cream can be accepted by potential consumers. Squash is best when steamed or baked; some people even use it in soup. The Hubbard squash, due to its hard shell, is usually baked in the shell. Squash may be used to add variety to the menu. Summer squash is boiled or steamed and served as a vegetable with drawn butter or cream sauce, or it may be served mashed. The delicate flavor of summer squash is lost by boiling it in large quantities of water and, of course, nutrients are lost when the cooking water is thrown away. (Health-Care-Clinic.Org) Fresh malunggay (*Moringa oleifera*) leaves are rich in vitamins A, B, C, calcium, potassium, protein and iron. Studies showed (Hernandez and Guarin, 2008) that malunggay gives a feeling of wellness and at the same time balances sugar and cholesterol content in the body. Leaves can be prescribed to treat anemia. Dubbed as miracle vegetable or the power gulay, malunggay is now being processed into a food fortificant, food supplement, and even potent medicine.

Sison (2016) developed a ready-to-drink beverage from malunggay (*Moringa oleifera*) and found that malunggay can be successfully utilized in food product development while maintaining consumer acceptability. The study highlighted the nutritional value of malunggay and its potential as a functional ingredient in developing nutritious food products. This finding supports the use of malunggay as an ingredient in the development of value-added products such as ice cream. Likewise, Olano (2016) developed vegetable jellies using malunggay and other leafy vegetables. The study revealed that malunggay jelly had the highest acceptability among the products evaluated and was rich in protein, fat, carbohydrates, and energy content. The findings demonstrated the potential of malunggay as a nutritious ingredient for food product development and commercialization.

Similarly, Enero et al. (2016) developed a squash seed spread as an alternative to peanut butter and highlighted that kabocha squash contains substantial amounts of carotene, which is beneficial for health. The study emphasized the nutritional value of squash and its potential for product innovation and food processing applications. Aller et al. (2015) developed pastry fillings from malunggay and sweet potato and found that the product was highly acceptable in terms of color, flavor, texture, and overall acceptability. The study emphasized that malunggay can be successfully incorporated into food products while enhancing their nutritional value and consumer appeal. This finding supports the use of malunggay as an ingredient in value-added food products. Ablaza (2015) investigated different drying techniques for malunggay flowers intended for tea production. The study demonstrated the potential of malunggay as a functional food ingredient and highlighted its utilization in developing nutritious food products. The findings further support the versatility and nutritional importance of malunggay in food processing. Similarly, Moreno (2015) evaluated the sensory acceptability of squash (*Cucurbita maxima*) in ice cream production. The study found that squash can be successfully incorporated into ice cream formulations while maintaining acceptable appearance, aroma, texture, taste, and overall acceptability. The findings demonstrate the potential of kalabasa as a nutritious ingredient in innovative food products. The declining vegetable consumption among Filipinos and the growing demand for healthier food alternatives, the development of malunggay and kalabasa ice cream presents an opportunity to promote vegetable intake through a product that is both nutritious and appealing. Hence, this study aims to determine the sensory acceptability of malunggay and kalabasa ice cream in terms of taste, texture, color, appearance, general acceptability of the different treatment. Moreover, it also aims to determine the economic analysis and market turnover of the highest acceptable treatment.

2. Material and methods

2.1 Research Design

The study employed an experimental design to determine the sensory acceptability of malunggay and kalabasa ice cream. Experimental research is appropriate because it allows the researcher to develop and evaluate a product by manipulating the formulation and observing its effect on specific sensory attributes. Various treatments were prepared by the different proportions of the malunggay and kalabasa ice cream. Each treatment was produced under controlled conditions to ensure consistency from preparation, processing, and storage.

The developed malunggay and kalabasa ice cream was subjected to sensory evaluation by selected respondents. The product was evaluated based on five sensory attributes: taste, texture, color, appearance, and overall acceptability. A structured questionnaire using a 9-point Hedonic Scale was employed to gather the respondent's assessment of the product.

The data obtained from the sensory evaluation were analyzed using appropriate statistical tools. The frequency, percentage and weighted mean were used to determine the level of acceptability of each treatment in terms of the sensory attributes. The results served as the basis for identifying the most acceptable formulations of malunggay and kalabasa ice cream.

2.2 Locale of the Study

The study employed an experimental design to determine the sensory acceptability of malunggay and kalabasa ice cream. Experimental research is appropriate because it allows the researcher to develop and evaluate a product by manipulating the formulation and observing its effect on specific sensory attributes. Various treatments were prepared by the different proportions of the malunggay and kalabasa ice cream. Each treatment was produced under controlled conditions to ensure consistency from preparation, processing, and storage. The developed malunggay and kalabasa ice cream was subjected to sensory evaluation by selected respondents. The product was evaluated based on five sensory attributes: taste, texture, color, appearance, and overall acceptability. A structured questionnaire using a 9-point Hedonic Scale was employed to gather the respondent's assessment of the product. The data obtained from the sensory evaluation were analyzed using appropriate statistical tools. The frequency, percentage and weighted mean were used to determine the level of acceptability of each treatment in terms of the sensory attributes. The results served as the basis for identifying the most acceptable formulations of malunggay and kalabasa ice cream.

2.3 Respondents of the Study

The respondents of the study were selected individuals from Apayao State College who participated in the sensory evaluation of the malunggay and kalabasa ice cream. They were composed of students, teaching and non-teaching who are willing to evaluate the product and provide their assessments based on the established sensory attributes.

2.4 Sample and Sampling Procedure

A total of 100 respondents were selected using purposive sampling. The respondents were chosen based on their availability, willingness to participate, and ability to evaluate food products. Individuals with known allergies to any of the ingredients used in the malunggay and kalabasa ice cream were excluded from the study to ensure their safety and well-being.

2.5 Research Instrument

The research instrument used in this study was a sensory evaluation questionnaire designed to assess the sensory acceptability of the malunggay and kalabasa ice cream. The questionnaire consisted of two parts. The first part gathered the basic profile of the respondents, while the second part contained the sensory evaluation form used to rate the ice cream product.

A 9-point Hedonic Scale was employed to measure the respondents' level of acceptability of the malunggay and kalabasa ice cream in terms of taste, texture, color, appearance, and general acceptability. The respondents were asked to indicate their degree of liking for each attribute by selecting the appropriate rating on the scale.

The instrument served as the primary means of collecting data regarding the respondent's perceptions and level of acceptability of the developed malunggay and kalabasa ice cream. The responses obtained from the questionnaire were tabulated and analyzed using appropriate statistical tools to determine the most acceptable treatment.

2.6 Data Gathering Procedure

The researcher first prepared the four treatment formulations of the malunggay and kalabasa ice cream following the established production procedure. After the product was prepared and stored properly, the researcher secured permission to conduct the sensory evaluation and identified the respondents through purposive sampling. The purpose of the study and the evaluation procedures were explained to the respondents, and informed consent was obtained prior to their participation. Each respondent was provided with coded ice cream samples and an evaluation questionnaire using 9-point hedonic scale to assess the product in terms of taste, texture, color, appearance, and general acceptability. Upon completion of the evaluation, the questionnaires were collected, checked for completeness, and the responses were tabulated and analyzed using appropriate statistical tools. The most acceptable treatment was then subjected to economic analysis and market turnover assessment to determine its commercial viability.

2.7 Data Analysis Techniques

The data gathered from the sensory evaluation were tabulated, summarized, and analyzed using descriptive statistical tools. Frequency and percentage distribution were used to describe the profile of the respondents, while the weighted mean was employed to determine the level of acceptability of each treatment in terms of taste, texture, color, appearance, and general acceptability. The treatment with the highest mean score was identified as the most acceptable formulation and was further evaluated through economic analysis, including the computation of return on investment (ROI) and market turnover, to determine its commercial viability.

2.8 Ethical Considerations

The study was conducted in accordance with ethical research standards. Participation in the sensory evaluation was voluntary, and informed consent was obtained from all respondents. The confidentiality and anonymity of the participants were maintained, and the information gathered was used solely for academic and research purposes. Proper food safety and sanitation practices were also observed in the preparation of the malunggay and kalabasa ice cream.

3. Results and Discussion

3.1 Frequency and percentage distribution of the respondents according to age

The result shows that majority of the respondents are in the age bracket of 19-21 with 45%, followed by age 22 and above with 23%, ages 16-18 with 15%, ages 10-12 with 10%, and ages 13-15 with 7%. It implies that the bulk of the respondents are ages 19-21. This means that during taste test majority of the respondents were at the middle-aged and mature customers.

3.2 Frequency and percentage distribution of the respondents according to sex

The result shows that majority of the respondents are female with 54% and male with 46%. It implies that number of respondents for male and female are almost equal.

3.3 The level of acceptability of each treatment in terms of taste

The result shows the taste level of acceptability of malunggay and kalabasa ice cream. Treatment 3 has the highest mean with 4.81 followed by Treatment 2 with a mean of 4.46, Treatment 1 with a mean of 4.28 and Treatment 4 with a mean of 4.24 all the different Treatments were “very much accepted” respectively. It implies that any treatments in terms taste were very much accepted by the respondents but still Treatment 3 dominant in terms of taste. The very much acceptability rating in terms of taste indicates that the incorporation of malunggay and kalabasa did not adversely affect the sensory quality of the ice cream.

This result is supported by the study of Kwak et al. (2016), who conducted consumer acceptance tests on commercial vanilla ice creams. Their study found that taste-related attributes such as sweetness and flavor significantly influenced consumer acceptance, with products exhibiting desirable taste characteristics receiving the highest overall quality ratings. The researchers concluded that taste is one of the primary drivers of consumer preference and acceptability in ice cream products.

Furthermore, Kumari and Dubey (2016) reported that nutritious ice cream developed from alternative ingredients were found acceptable by consumers. Their study emphasized that the successful incorporation of nutrient-rich ingredients can enhance the nutritional value of ice cream without compromising its taste acceptability.

3.4 The level of acceptability of each treatment in terms of texture

The result shows the texture level of acceptability of malunggay and kalabasa ice cream. It shows that Treatment 3 has the highest mean with 4.61, followed by Treatment 4 with a mean of 4.21, Treatment 1 with a mean of 4.35 or “very much accepted”, and Treatment 2 with a mean of 3.62 or “much accepted” respectively. It implies that Treatment 3, and Treatment 4 were all very much accepted, but Treatment 3 still has the highest mean and most acceptable treatment in terms of texture. The high level of acceptability indicates that the incorporation of malunggay and kalabasa produced a product with a desirable mouthfeel and consistency. Respondents perceived the malunggay and kalabasa ice cream as smooth and pleasant, suggesting that the added vegetable ingredients did not adversely affect its textural quality.

This result is supported by the study of Rolon et al. (2016) reported that texture plays a crucial role in consumer acceptance of ice cream. Their study on fat reduction in ice cream revealed that fat contributes to the characteristic smoothness and desirable texture of the product. The researchers emphasized that maintaining appropriate texture characteristics is essential for preserving consumer acceptability.

3.5 The level of acceptability of each treatment in terms of color

The result shows the color level of acceptability of malunggay and kalabasa ice cream. Treatment 3 has the highest mean with 4.89 or “very much accepted”, followed by Treatment 4 with a mean of 3.96, Treatment 1 with a mean of 3.89, and Treatment 2 with a mean of 3.70 were all “much accepted” respectively. It implies that Treatment 3 were very much accepted in terms of color. The very much acceptability rating in terms of color indicates that the incorporation of malunggay and kalabasa produced a visually appealing product. The natural yellow-orange pigment of kalabasa, combined with the green color of malunggay leaves may have enhanced the attractiveness of the ice cream, making it appealing.

This finding is supported by the study of Lima et al. (2016), who evaluated the sensory acceptability of vanilla ice cream incorporated with beta-carotene encapsulated in solid lipid microparticles. The researchers found that the addition of beta-carotene enhanced the visual appearance of the ice cream and did not negatively affect consumer acceptance. The study emphasized that color is an important sensory attribute that influences consumers’ first impressions and overall acceptability of ice cream products.

3.6 The level of acceptability of each treatment in terms of appearance

The result shows the appearance level of acceptability of malunggay and kalabasa ice cream. Treatment 3 has the highest with a mean of 4.81 followed by Treatment 1 with a mean of 4.33 or “very much accepted” respectively. Treatment 2 with a mean of 4.14, and Treatment 4 with a mean of 4.13 or “much accepted” respectively. It implies that Treatment 3 and Treatment 1 were very much accepted in terms of appearance but Treatment 3 still dominates in this category. This reveals that malunggay and kalabasa ice cream was highly acceptable in terms of appearance indicates that the product possessed visually desirable characteristics that appealed to the respondents. The natural color and uniformity of the product may have contributed to its favorable evaluation. Respondents often form initial judgments based on appearance before assessing other sensory attributes.

This finding is supported by the study of Kwak et al. (2016), who reported that visual characteristics significantly influence consumer preference and acceptance of ice cream products. Likewise, Lima et al. (2016) found that improved visual appeal enhanced the acceptability of ice cream among consumers.

3.7 The level of general acceptability in every treatment.

Table 7 presents the general acceptability of the different treatments based on the respondents' evaluation of taste, texture, color, and appearance. Among the treatments, Treatment 3 obtained the highest general mean of 4.78 or very much accepted, indicating that it was the most preferred formulation. This was followed by Treatment 1 with general mean of 4.21, interpreted as very much accepted. Meanwhile, Treatment 4 has the general mean of 4.14 and Treatment 2 has the general mean of 3.98 were rated as much accepted. The results suggest that all formulations were generally acceptable to the respondents, with Treatment 3 emerging as the most acceptable treatment overall due to its consistently high ratings across all sensory attributes.

This finding is consistent with the study of Kwak et al. (2016), who reported that overall consumer acceptance of ice cream is strongly influenced by multiple sensory attributes, including taste, texture, appearance, and color. Likewise, Lima et al. (2016) found that the incorporation of functional ingredients into ice cream did not reduce consumer acceptability when desirable sensory qualities were preserved.

3.8 Economic Analysis of Treatment 3 (Malunggay and Kalabasa Ice Cream)

This presents the economic analysis of Treatment 3 of the Malunggay and Kalabasa Ice Cream. The treatment generated a total sales revenue of ₱450.00 from the production of 15 packs (125 g each) sold at ₱30.00 per pack. The total production cost amounted to ₱348.00, which includes expenses for ingredients, packaging materials, labels, and fuel used in preparation.

After deducting the total production cost from the sales, a net income ₱102.00 was obtained. The computed return on investment (ROI) of 29.31% indicates that for every peso invested in the production process, approximately ₱0.29 was gained as profit. This shows that the product is still profitable despite the relatively moderate return.

Treatment 3 obtained the highest general acceptability rating among all treatments. This implies that consumers preferred this formulation in terms of sensory attributes such as taste, texture, color, and appearance. Therefore, even if its profitability is moderate, its strong consumer acceptance suggests higher market potential and greater likelihood of consumer purchase in actual commercialization.

3.9 Market Turnover of Treatment 3 (Malunggay and Kalabasa Ice Cream)

Table 9 presents the market turnover of Treatment 3 of Malunggay and Kalabasa Ice Cream. The product generated a total market turnover of ₱450.00 per production batch, derived from the sale of 15 packs priced at ₱30.00 each.

This indicates that the product can generate immediate revenue upon production, reflecting its potential demand in the market. The consistent turnover per batch suggests that the product has a stable marketability and acceptable price point for consumers. Considering that Treatment 3 also obtained the highest general acceptability, the result implies strong consumer interest, which may lead to repeated purchases and sustained market demand if commercialized.

4. Conclusion & Recommendations

The developed malunggay and kalabasa ice cream was well accepted by middle-aged and mature consumers, indicating its potential appeal to a broad range of customers. The nearly equal distribution of male and female respondents suggests that the product is acceptable regardless of sex. Treatment 3 exhibited the most desirable color among the formulations, making it the most visually appealing treatment to the respondents. All treatments were highly acceptable in terms of taste, demonstrating that the incorporation of malunggay and kalabasa did not negatively affect the flavor of the ice cream. However, Treatment 3 was the preferred formulation in terms of taste. The treatments generally possessed acceptable texture characteristics, with Treatment 3 obtaining one of the highest ratings, indicating a desirable mouthfeel and consistency. Treatment 3 exhibited a highly acceptable appearance, suggesting that its overall visual presentation contributed positively to consumer preference. Among all formulations tested, Treatment 3 emerged as the most acceptable treatment, obtaining the highest general acceptability rating. This indicates that the formulation achieved the best combination of taste, texture, color, and appearance. The economic analysis demonstrated that Treatment 3 is financially feasible, generating a positive net income and a Return on Investment (ROI) of 29.31%, which indicates profitability and efficient use of production resources. The market turnover of ₱450.00 per production batch indicates that Treatment 3 has revenue-generating potential and can serve as a viable product for commercialization. Treatment 3 is the most suitable formulation of malunggay and kalabasa ice cream in terms of sensory acceptability, profitability, and market potential, making it a promising product for commercialization and entrepreneurial ventures.

Based from the conclusion, Treatment 3 should be adopted as the preferred formulation of malunggay and kalabasa ice cream since it obtained the highest ratings in terms of color, taste, texture, appearance, and general acceptability. The product may be commercialized on a small-scale basis to determine its market performance and consumer demand in actual selling conditions. The researcher may consider producing the product as a nutritious and income-generating food product due to its favorable sensory acceptability and positive return on investment. Promotional activities and produce awareness campaigns should be conducted to encourage consumers to try vegetable-based ice cream and appreciate its nutritional benefits. Future studies should conduct nutritional analysis and shelf-life studies to determine the complete nutrient composition, storage stability, and safety of the product under different storage conditions. Future studies may include a larger number of respondents and different age groups obtaining more comprehensive data regarding the acceptability of the product.

Compliance with ethical standards

The author declares no conflict of interest. The study was conducted in accordance with accepted ethical standards for research involving human participants. Prior to the sensory evaluation, the purpose, procedures, benefits, and minimal risks of the study were clearly explained to all respondents, and informed consent was obtained from those who voluntarily agreed to participate. Respondents were informed of their right to decline or withdraw from the study at any time without penalty. The confidentiality and anonymity of all participants were strictly maintained, and the information collected was used solely for academic and research purposes. The Malunggay and Kalabasa Ice Cream Samples were prepared using quality ingredients while observing proper sanitation, hygiene, and food safety practices to ensure that the product was safe for consumption. Individuals with known allergies or sensitivities to any of the ingredients were advised not to participate in the sensory evaluation. Furthermore, the researcher ensured honesty, objectivity, and integrity in the collection, analysis, and reporting of data.

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