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Development of Malunggay (*Moringa Oleifera*) Enriched Chewy Candy

Japhet Reubin D. Abaoag, Julia Angelyn C. Altezo, Samantha Lizeth S. Cancino, Krysel Jane Dela Cruz, Kathrina R. Lucero, Mathew Jake D. Soriano, Rosalinda G. Cochico, Amelita M. De Vera, Rexian Noah V, Zareno, Lai N. Uson, Maria Virginia A. Fontanos, Arlene A. De Guzman, Mary Ann C. Soriano, Beverly R. Domingo, Vanessa T. Salazar
Pangasinan State University, Lingayen Campus, Lingayen, Pangasinan, Philippines

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Abstract - *The economic viability and sensory acceptability of chewy Malunggay (Moringa Oleifera) candies were examined in this study. Four main topics were addressed in the study: the best Malunggay ratio for desired sensory qualities; customer perceptions of the sensory attributes (taste, texture, color, scent, and appearance); the outcomes of microbiological analysis; and the return on investment (ROE). Using a nine-point Hedonic scale, thirty students from Pangasinan State University-two majoring in home economics for their Bachelor of Technology and Livelihood Education and food service management for their Bachelor of TechVoc Teacher Education-participated in a sensory evaluation. Respondents were used as random factors and Malunggay powder doses as fixed factors in a randomized full block design. SPSS and GLM-ANOVA were used for data analysis. The results showed that sensory qualities were typically improved by raising Malunggay levels, with Treatment 3 (the highest concentration of Malunggay) continuously receiving the highest overall acceptance scores. There were notable variations in appearance, texture, color, scent, and taste between treatments. A high aerobic plate count requires additional research into production hygiene and possible contamination sources, even though the confectionery passed the mold/yeast and coliform tests. Strong profitability potential was suggested by the financial analysis's significant ROE of 47.19%. According to the study's findings, chewy candy can successfully contain malunggay, and Treatment 3 provides the best balance between profitability and sensory appeal. It is advised to carry out shelf-life studies, address the high aerobic plate count by better sanitation procedures and process optimization, and ascertain the exact Malunggay ratio. The commercialization of this nutrient-dense and perhaps lucrative food has a solid basis thanks to this research. To determine consumer demand and improve the product for broader appeal, more market research and a test launch are advised.*

Keywords – *Malunggay Chewy Candy, Sensory Evaluation, Microbial Test, Return of Expenditure*

INTRODUCTION

The formulation and sensory evaluation of “Moringa” chewy candy is essential research within the field of food science and herbal product development. Moringa oleifera, sometimes referred to as the "tree of life" or "miracle tree," is a significant herbal plant because of its many therapeutic and non-therapeutic uses. Wounds, pain, ulcers, liver illness, heart disease, cancer, and inflammation are all traditionally treated with this herb (Pareek et al., 2023). Chewy candy with various sweeteners, either nutritive or calorie-reduction types can be possible to create appropriate sugar-free, reduced-sugar, and reduced-calorie products by combining those ingredients. According to Favaro-Trindade, Rocha-Selmi, and dos Santos (2015), stevia and xylitol are two sweeteners that are intriguing due to their low-calorie content, thermostability, and adequate sweetening power. According to Radi et al. (2018), candy is a confection made with sugar, honey, natural and artificial sweeteners, and can

be combined with cereals or fruits and flavored. The physical, textural, and sensory aspects of certain elements might give customers varying impressions. Almost every part of the moringa plant is used for food and traditional medicine in the Philippines, making it one of the most beneficial trees in the world. Currently, a few studies and projects are concentrated on food fortification to take use of moringa's nutritional value and therapeutic potential. The Philippines' moringa business has expanded dramatically over the last ten years because of increased research and development projects. The main raw resources for cosmetics, herbal medicine, and the food and nutrition sector are moringa leaves and seed oil. The leaf powder is mostly used for food fortification in the form of bread, noodles, juices, milk, and tea, whereas the leaf powder capsule is primarily utilized as a dietary supplement and herbal medication. Moringa oil is mostly utilized in cosmetics and personal health care items, including shampoo, soap, fragrances, and skin care. (Palada, M. C. (2017). The formulation and sensory evaluation of Moringa oleifera-enriched chewy candy provides an attractive opportunity to investigate the integration of traditional practices and modern eating habits. By incorporating Moringa oleifera powder into chewy candy, a popular confectionery, the researchers hope to analyze the acceptance and preferences for Moringa-enriched chewy candy, considering the appearance, aroma, color, taste, and texture and overall liking. This study aims to provide significant insights into the creation of functional herbal confectionery items to meet the market's growing demand for natural, health-conscious and sweet treats.

OBJECTIVES OF THE STUDY

The study aims are to the develop Malunggay (Moringa Oleifera) enriched chewy candy. Specifically, it sought to answer the following questions:

1. What is the standard ratio of Malunggay (Moringa Oleifera) in incorporating into chewy candy to achieve the desired chewycandy, considering appearance, aroma, color, taste, and texture?

2. What are the sensory attributes of the Malunggay (Moringa Oleifera) enriched chewing gum as perceived by the respondents in terms of:
   a. Appearance;
   b. Aroma;
   c. Color;
   d. Taste;
   e. Texture
3. What is the result microbial analysis of the preferred Malunggay (Moringa Oleifera) Chewy candy?
4. What is the return of expenditure (ROE) of the Malunggay (Moringa Oleifera) chewy candy?

MATERIALS AND METHOD

This study utilized an experimental randomized complete block design to formulate and evaluate Malunggay (Moringa oleifera) Chewy Candy, adhering to the principles of true experimental research as defined by Salkind (2010), where at least one independent variable (ingredient ratios) was manipulated to assess its effect on sensory outcomes. The product was evaluated by 15 students from the Bachelor of Technology and Livelihood Education (BTLEd) majoring in Home Economics and 15 students from the Bachelor of Technical Vocational Teacher Education (BTVTEd) majoring in Food Service Management, all officially enrolled during the 2nd Semester of 2024–2025. For formulation, ingredients were precisely measured to ensure consistency: 1,400 grams of condensed milk provided a creamy, sweet base; 140 grams of glucose syrup enhanced chewiness and gloss; 140 grams of sugar balanced the earthy notes of malunggay; 34.12 grams of butter contributed richness and texture; and 26.46 grams of malunggay powder infused flavor and nutrients. Tools included calibrated measuring cups, spoons, a digital weighing scale, non-stick pans, mixing bowls, a rubber scraper,

and a candy thermometer to monitor cooking temperature. The procedure involved heating condensed milk, glucose syrup, sugar, and butter in a non-stick pan at 120°C, monitored by a thermometer. Once thickened, malunggay powder was incorporated, and the mixture was stirred continuously to prevent burning. The cooked candy was poured into molds, cooled, and subjected to sensory evaluation by the respondents to determine acceptability.

Table 19.

Analysis of Variance (ANOVA) Results for the Overall Acceptability Sensory Attribute of Malunggay (*Moringa Oleifera*) Chewy Candy

Characteristics		Sum of Squares	df	Mean Square	F	Sig.
Overall Acceptability	Between groups	2.061	3	.687	45.564	.000
	Within Groups	.241	16	.015		
	Total	2.302	19			

* The mean difference is significant at the 0.05 level.

Table 20.

Post Hoc Tukey HSD Test Results for the Overall Acceotability of Malunggay (*Moringa Oleifera*) Chewy Candy

Multiple Comparisons

	(I)Treatment	(O) Treatment	Mean Difference (I-J)	Std. Error	sig.
Tukey HSD	Treatment 0	Treatment 1	-.53800*	.07766	.000
		Treatment 2	-.47520*	.07766	.000
		Treatment 3	-.90240*	.07766	.000
	Treatment 1	Treatment 0	.53800.*	.07766	.000
		Treatment 2	.06280	.07766	.849
		Treatment 3	-.36440*	.07766	.001
	Treatment 2	Treatment 0	.47520*	.07766	.000
		Treatment 1	-.06280	.07766	.849
		Treatment 3	-.42720*	.07766	.000
	Treatment 3	Treatment 0	.90240*	.07766	.000
		Treatment 1	.36440*	.07766	.001
		Treatment 2	.42720*	.07766	.000

* The mean difference is significant at the 0.05 level.

Table 21.

Test Result on the Microbial Analysis of the Malunggay (*Moringa Oleifera*) Enriched Chewy Candy

Parameter	Result	Allowable Limit	Interpretation
Aerobic Plate Count	120,000 CFU/g	100,000 CFU/g	Failed
Total Coliform Count	<3.0 MPN/g	10 MPN/mL	Passed
Mold and Yeast Count	<10 CFU/g	<10 CFU/g	Passed

Source: *FDA Circular No. 2022 012 Revised Guidelines for the Assessment of Microbiological Quality of Processed Foods

Table 22.

Return of Expenditure of Malunggay (*Moringa Oleifera*) Chewy Candy

Production Cost (Php)	Total Yield	Mark-Up (Php)	Price per piece (Php)	Gross Income (Php)	Net Income (Php)	ROE
Php 428.00	90 pcs @ 5 g	Php 4.24	Php 7.00	Php 630.00	Php 202.00	47.19%

RESULTS AND DISCUSSION

The study revealed Treatment 3 (highest malunggay concentration) as the most preferred formulation, excelling in sensory attributes. Consumers rated its appearance as clean and visually appealing, with ANOVA confirming significant differences in appearance across malunggay levels, though post-hoc tests indicated diminishing returns beyond Treatment 3. Aroma and color improved with higher malunggay, with Treatment 3's natural hue and balanced herbal-sweet taste scoring highest (post-hoc $p < 0.05$). Texture was optimal in Treatment 3, offering ideal chewiness and firmness. Microbial analysis showed the candy passed coliform and mold/yeast tests but exceeded aerobic plate counts, warranting further safety investigation. Financial analysis demonstrated profitability: producing 90 pieces at ₱4.76 each yielded a 47.19% return on equity (ROE) with ₱7.00 per unit sold. Overall, Treatment 3's superior sensory acceptance and economic viability highlight malunggay's potential in confectionery, though microbial refinement is needed for commercial viability.

CONCLUSION AND RECOMMENDATION

The study concluded that Treatment 3, with the highest malunggay concentration, delivered optimal sensory qualities in chewy candy, achieving the highest acceptance scores for its natural color, balanced herbal-sweet flavor, pleasant aroma, and ideal texture. Despite these successes, further refinement of the malunggay ratio is recommended to explore potential optimization while addressing microbial safety concerns, as the formulation passed coliform and

mold/yeast tests but exhibited a high aerobic plate count (APC). Though not inherently hazardous, this finding necessitates rigorous investigation into contamination sources (e.g., raw materials, equipment, or production hygiene) and implementation of enhanced sanitation protocols, such as routine sterilization of tools and evaluation of natural antimicrobial agents (e.g., citric acid), alongside regular APC monitoring to ensure compliance with safety standards. Economically, the product demonstrated strong viability with a 47.19% return on equity (ROE), underscoring its commercial potential. To capitalize on this, accelerated shelf-life studies under standard storage conditions are advised to establish an expiration date through periodic evaluation of microbial, chemical, and physical properties (e.g., texture, moisture). If shelf-life results fall short, adjustments to packaging (e.g., airtight materials) or preservatives should be explored. For commercialization, a detailed cost-benefit analysis covering labor, packaging, and distribution is critical, alongside positioning the candy as a nutrient-rich snack highlighting malunggay's health benefits. Pilot launches via local retailers or online platforms are recommended to gauge broader consumer demand, followed by iterative improvements (e.g., taste, pricing) based on market feedback. These steps—safety enhancements, shelf-life validation, and strategic marketing—will ensure the product's long-term viability while maintaining its sensory appeal and economic promise.

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