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Research Article

Acceptability of MungRinga (Vigna Radiata and Moringa Oleifera Powder) Pandesal

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About Article

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ABSTRACT

As interest in functional foods grows in response to nutritional deficiencies and consumer demand for healthier alternatives, this study explores the sensory acceptability of *MungRinga Pandesal*—a fortified bread enriched with mung bean flour and moringa powder—as a functional substitute for traditional pandesal. The research aimed to assess consumer preferences across four treatments: one commercial variant (Treatment 0) and three experimental formulations (Treatments 1, 2, and 3). A descriptive research design was employed, using a standardized sensory evaluation tool to measure appearance, taste/flavor, smell/odor, texture, and overall acceptability. Data were analyzed through weighted means. Results showed that Treatment 0 (commercial moringa pandesal) received the highest scores for "liking extremely" its appearance, with the majority of respondents expressing the same sentiment for its taste. Treatment 3 emerged as the most promising experimental variant, with the majority of respondents indicating a high likelihood of frequent consumption, despite moderate reactions to flavor and odor. Treatment 1 was rated positively for appearance but showed mixed feedback on taste and smell, while Treatment 2 had generally balanced but less enthusiastic responses. Overall, all treatments demonstrated potential for consumer acceptance, particularly in terms of visual appeal and texture. However, improvements in flavor and aroma are essential for optimizing the experimental variants. The study highlights the viability of integrating locally sourced, nutrient-rich ingredients into baked goods. It contributes to ongoing efforts in food innovation, dietary diversification, and the development of functional products in the bakery industry.

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1. INTRODUCTION

Recent trends in the food industry reflect growing consumer demand for nutritious, functional, and sustainable products. Consumers are increasingly concerned about their ecological footprint, driving demand for environmentally friendly and socially responsible food options (Franc & Kujevac, 2021). This has led to an increase in organic foods, clean labels, and locally sourced ingredients (Aguilar *et al.*, 2019). The industry is also witnessing a surge in fortified and functional foods, personalized nutrition, and innovative production methods, such as cultured meat and precision fermentation (Hassoun *et al.*, 2022). These trends are closely linked to advancements in Industry 4.0 technologies, which are revolutionizing food production, transportation, and consumption. Additionally, the sports nutrition sector influences broader food trends as consumers seek products that support their health and wellness goals (Arenas-Jal *et al.*, 2020). To remain competitive, food companies must innovate and diversify their offerings to meet evolving consumer expectations and contribute to sustainable development.

Traditional foods play a crucial role in addressing nutritional deficiencies and health issues in various Asian countries. In Bangladesh, traditional foods like rice, tubers, small indigenous fish, and homestead herbs are essential for nutrition and health (Alam & Naser, 2020). Similarly, fortifying traditional foods with spinach in India can combat folic acid deficiency and related disorders (Divya, 2022). Rediscovering traditional foods offers an opportunity for healthier eating and improved quality of life. A study across Indonesia, Thailand, Malaysia, and Nepal highlighted the potential of traditional foods in preventing and managing lifestyle-related diseases and nutritional deficiencies (Harmayani *et al.*, 2019). Enhancing the nutritional profile of traditional foods through fortification and scientific research can help achieve nutritional security and address common health issues (Alam & Naser, 2020; Divya, 2022). This approach aligns with the Sustainable Development Goals and supports local market economies (Harmayani *et al.*, 2019).

Pandesal is a popular Filipino bread with significant cultural relevance in the Philippines. It serves as a staple food and continues to evolve through various product innovations (Oric *et al.*, 2023; Visco & Ebron, 2024). Traditional pandesal ingredients include wheat flour, but recent studies have explored alternative ingredients to enhance its nutritional value and support local agriculture. These include incorporating dried saluyot leaves (Oric *et al.*, 2023), arrowroot flour (Visco & Ebron, 2024), and even using nipa fruit as a filling. These studies demonstrate the ongoing efforts to innovate and improve this beloved Filipino bread while addressing health concerns. Improving the nutritional value of staple foods, such as pandesal, is crucial for supporting public health initiatives. Food reformulation, particularly of commonly consumed processed foods, is necessary to combat obesity and reduce the risk of chronic diseases (Estruch *et al.*, 2020). Bread, a traditional staple food, contributes significantly to the energy, carbohydrate, protein, fiber, and micronutrient intakes of many diets (Lockyer & Spiro, 2020). Enriching bread with alternative ingredients can enhance its nutritional profile while maintaining consumer acceptability (Bawa *et al.*, 2020). Large-scale staple food fortification is recognized as a cost-effective solution to address micronutrient deficiencies, particularly in countries like India, where current strategies, such as dietary diversity and supplementation, have shown limited success (Duggal *et al.*, 2022). Implementing such fortification programs can help reach vulnerable populations and reduce dietary nutrient gaps, particularly in food and nutrition insecurity exacerbated by the COVID-19 pandemic.

Vigna radiata (mung bean) and Moringa oleifera are nutritionally rich ingredients with potential health benefits. Mung beans are an excellent source of protein, dietary fiber, minerals, vitamins, and bioactive compounds such as polyphenols, polysaccharides, and peptides (Hou *et al.*, 2019). They have been shown to possess antidiabetic, anticancer, anti-inflammatory, and immunomodulatory properties (Acharjee *et al.*, 2024). Vitexin and isovitexin are significant polyphenols in mung beans (Hou *et al.*, 2019). When combined with Moringa oleifera leaves, mung beans can significantly improve the nutritional density of food recipes, particularly in terms of energy and vitamin A content (Bankole *et al.*, 2023). Mung beans may also help prevent hypercholesterolemia and coronary heart disease, as well as reduce the absorption of toxic substances (Kalim *et al.*, 2021). However, further research is needed to fully understand the mechanisms of these health benefits and address existing knowledge gaps (Acharjee *et al.*, 2024).

Integrating Vigna radiata (mung bean) and Moringa oleifera into food products, including bakery items like pandesal, offers significant nutritional and public health benefits. These plants are rich in essential nutrients, with Moringa oleifera containing high levels of proteins, amino acids, vitamins, minerals, and bioactive compounds (Milla *et al.*, 2021; Trigo *et al.*, 2022). The incorporation of these ingredients can enhance the nutritional profile of foods, increasing their energy content, crude fat, fiber, and micronutrients (Hussin *et al.*, 2020). Studies have shown that recipes containing these plants can significantly contribute to meeting daily nutritional requirements, especially for vitamin A (Bankole *et al.*, 2023). Moreover, Moringa oleifera exhibits various health-promoting properties, including anti-diabetic, anti-inflammatory, and antioxidant effects (Milla *et al.*, 2021). However, carefully considering incorporation levels is necessary, as high concentrations may affect organoleptic properties and consumer acceptance (Trigo *et al.*, 2022; Hussin *et al.*, 2020). Thus, this study explores the acceptability of MUNGRINGA, a novel bread variant that combines Vigna radiata (mung bean) and Moringa oleifera (moringa) powder with the classic pandesal recipe. The study is significant for several reasons, particularly in product development, nutrition, and sustainability. Moringa and mung beans are recognized for their rich nutritional content, offering essential vitamins, minerals, antioxidants, protein, and fiber. Incorporating these superfoods into pandesal, a popular Filipino bread, enhances its nutritional profile and provides a potential solution to address malnutrition and protein deficiencies, thereby contributing to the achievement of SDGs 2 and 3. Investigating the sensory acceptability of this fortified bread is crucial in understanding consumer preferences and whether the market can embrace such an innovation. As consumer demand for functional foods increases, this study could reveal how much people are willing to adopt health-oriented products, even if they initially seem unfamiliar (SDG 12). Moreover, both moringa and mung beans are climate-resilient and sustainable crops that require minimal water and can thrive in various climates, making their inclusion in this product environmentally friendly. This aligns with promoting sustainable agriculture and supporting local farmers (SDG 13). Additionally, the successful commercialization of mungringa pandesal could stimulate local economies by creating new business opportunities for small-scale farmers and local bakeries (SDG 8). Ultimately, the study provides valuable insights for future product development, research, and policy-making, particularly in the areas of nutrition, sustainable agriculture, and functional foods.

1.1. Framework of the Study

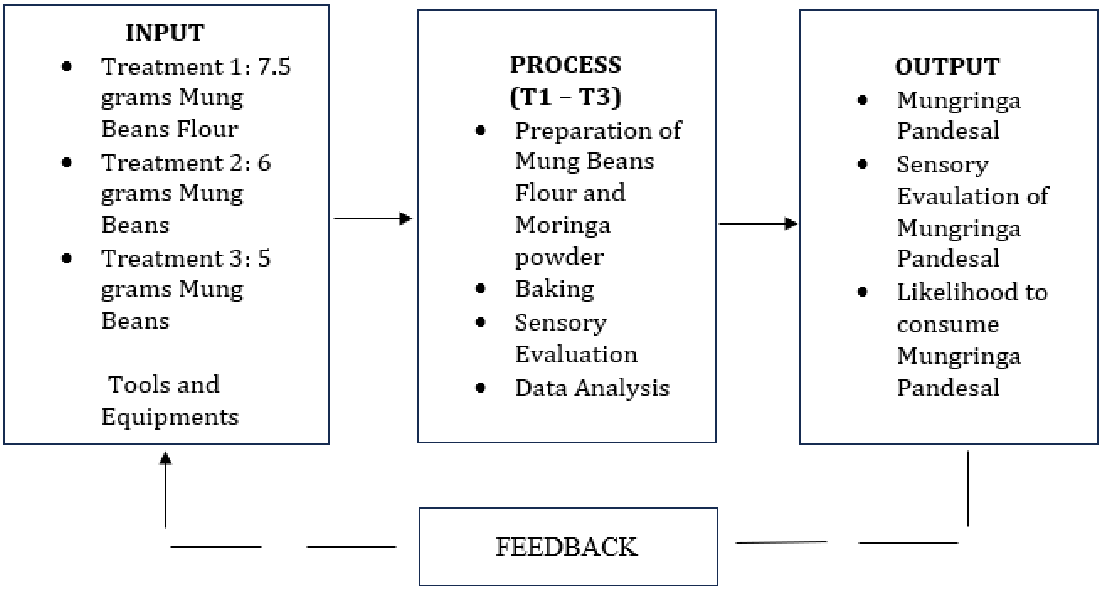

Figure 1. Research Paradigm

The conceptual framework presented in Figure 1 illustrates the Input-Process-Output (IPO) model used in a study evaluating the sensory attributes and consumer acceptability of "Mungringa Pandesal"—a bread product incorporating mung bean flour and moringa powder. In the input stage, three different treatments are outlined based on varying quantities of mung bean flour: 7.5 grams (Treatment 1), 6 grams (Treatment 2), and 5 grams (Treatment 3). These inputs also include the necessary tools and equipment required for the preparation and baking process. The process stage encompasses several key activities: the preparation of mung bean flour and moringa powder, the actual baking of the pandesal, sensory evaluation involving panelists or consumers, and data analysis to interpret the results. Finally, the study aims to produce the final product—Mungringa Pandesal—and evaluate it based on sensory attributes, including taste, texture, aroma, and appearance. It also includes measuring the participants' likelihood or willingness to consume the product. The feedback component at the bottom of the framework indicates a cyclical relationship, where outcomes from the sensory evaluation and acceptability analysis can inform improvements or adjustments to the formulation and process in future iterations, promoting a continuous quality enhancement approach.

1.1. Objectives of the study

This study aims to assess the acceptability of Mung bean flour and Moringa powder in Baking Pandesal. Specifically, this study aims to determine:

1. The level of acceptability of Moringa Pandesal (Treatment 0) in terms of:
   i. Taste;
   ii. Aroma;
   iii. Texture;
   iv. Appearance; and
   v. Overall Acceptability.
2. The level of acceptability of Moringa Pandesal (Treatment 1) in terms of:
   i. Taste;
   ii. Aroma;
   iii. Texture;
   iv. Appearance; and
   v. Overall Acceptability.
3. The level of acceptability of Moringa Pandesal (Treatment 2) in terms of:
   i. Taste;
   ii. Aroma;
   iii. Texture;
   iv. Appearance; and
   v. Overall Acceptability.
4. The level of acceptability of Moringa Pandesal (Treatment 3) in terms of:
   i. Taste;
   ii. Aroma;
   iii. Texture;
   iv. Appearance; and
   v. Overall Acceptability.

5. Likelihood of eating Moringa and Mungringa Pandesal

2. LITERATURE REVIEW

Mung bean (Vigna radiata L.) is a nutritious legume with numerous health benefits. It is rich in protein, dietary fiber, minerals, vitamins, and bioactive compounds such as polyphenols, polysaccharides, and peptides (Hou *et al*., 2019). Germination enhances its nutritional profile, increasing protein content, total phenolics, and antioxidant capacity (Hung *et al*., 2020; Kapravelou *et al*., 2020). Mung bean exhibits antidiabetic, anticancer, anti-inflammatory, and immunomodulatory properties (Acharjee *et al*., 2024). Its major polyphenols, vitexin, and isovitexin, contribute to these health benefits (Hou *et al*., 2019). Germinated mung bean shows improved cytoprotective features against radical oxygen species in human cell lines and antiproliferative effects in colon cancer cells (Kapravelou *et al*., 2020).

Mung bean (Vigna radiata) is a valuable legume crop with diverse characteristics suitable for various applications. Studies have shown wide variability in agronomic traits among mung bean genotypes, including flowering time (30-50 days), pod maturity (50-88 days), and 100-seed weight (2.43-7.96g) (Soehendi *et al*., 2021). Biochemical analysis of promising genotypes revealed variations in protein content, husk percentage, and processing losses (Singh *et al*., 2022). Characterization using Distinctness, Uniformity, and Stability (DUS) traits has demonstrated significant diversity among genotypes, which can be utilized in breeding programs (Gull *et al*., 2024). While traditional morphological characterization is time-consuming and influenced by environmental factors, molecular markers like Simple Sequence Repeats (SSRs) offer a rapid and accurate alternative for assessing genetic diversity (Kaur *et al*., 2017). This genetic diversity in mung beans provides valuable resources for developing improved varieties with enhanced nutritional qualities and agronomic performance.

On the other hand, Moringa oleifera leaves are nutrient-dense, containing high levels of protein (22.99-29.36%), vitamins, and minerals, particularly calcium, potassium, and iron (Sultana, 2020; González-Burgos *et al*., 2021; Peñalver *et al*., 2022). They exhibit significant antioxidant properties due to their rich phenolic content (González-Burgos *et al*., 2021; Peñalver *et al*., 2022). Functionally, Moringa leaves demonstrate water absorption capacity, foaming capacity, and foam stability (Sultana, 2020). Research indicates potential neuroprotective effects against oxidative stress-induced damage in human neuroblastoma cells (González-Burgos *et al*., 2021). The leaves nutritional profile and functional properties make them suitable for incorporation into various food products as functional ingredients or fortifiers (Peñalver *et al*., 2022). Additionally, Moringa oleifera possesses therapeutic properties, including anticancer, antiulcer, and antimicrobial activities (Sahay *et al*., 2017). These characteristics position Moringa oleifera as a promising functional food ingredient with potential health benefits beyond traditional nutrients.

3. METHODOLOGY

3.1. Ingredients

Treatment 1: 7.5 grams Mung Beans Flour, 1 gram moringa powder, 1 cup APF, 1/2 cup milk, 2.5 grams yeast, one (1) egg, one (1) pinch of salt, 1/8 cup breadcrumbs, 1/4 sugar, one (1) spoon margarine.

Treatment 2: 6 grams Mung Beans Flour,1 gram moringa powder, 1 cup APF, 1/2 cup milk, 2.5 grams yeast, one (1) egg, one (1) pinch of salt, 1/8 cup breadcrumbs, 1/4 sugar, one (1) spoon margarine.

Treatment 3: 5 grams Mung Beans Flour,1 gram moringa powder, 1 cup APF, 1/2 cup milk, 2.5 grams yeast, one (1) egg, one (1) pinch of salt, 1/8 cup breadcrumbs, 1/4 sugar, one (1) spoon margarine.

3.2. Equipments

i. Oven
ii. Mixing Bowls
iii. Measuring Cups and Spoons
iv. Wooden Spoon
v. Clean Kitchen Towel.
vi. Large Bowl
vii. Knife
viii. Baking Tray or Sheet Pan
ix. Parchment Paper
x. Pastry Brush

3.3. Preparation of mung beans flour and moringa powder

i. Dry the Mung beans and Moringa leaves.
ii. Clean the dried beans and Moringa leaves by getting rid of dirt.
iii. Grind the dried mung beans and Moringa leaves, and separate the two.
iv. Filter out the impurities and lumps, using a strainer.
v. Powderize the filtered mung beans and moringa leaves.
vi. Use the Fine powder to bake Pandesal.
vii. Package the Mung bean pandesal. Ready for testing.

3.4. Baking process

i. Mix all the dry ingredients (APF, munggo flour, sugar, salt, moringa powder). Then, mix all the liquid ingredients. Dissolve the yeast in the milk, then add the egg to the solid mixture. Lastly, add the liquid margarine to finalize the mixture.
ii. Knead the mixture until it turns into a dough. Then, rest for 30 minutes, knead the dough until it becomes elastic, and let it rest for an additional hour.
iii. Portion the dough, then coat it with bread crumbs. Rest for 7 hours.
iv. Bake the portioned dough. Preheat the oven to 180 degrees Celsius for 10 minutes, then bake the bread for 20 minutes.
v. After 20 minutes, take out the baked pandesal from the oven.
vi.Package the finished product.

3.5. Research design

This study employed a developmental and experimental research design to develop and determine the best combination of Mung Beans and Moringa flour ratio. A descriptive research design was employed to evaluate the level of acceptability of MungRinga Pandesal, a bread enriched with mung bean flour and Moringa powder. Specifically, the research aimed to evaluate four treatments (Treatment 0 to Treatment 3), each formulated with varying proportions of mung bean flour and Moringa powder. The study focused on the sensory attributes of taste, aroma, texture, appearance, and overall acceptability for each treatment, as well as the likelihood of consumers eating the product.

3.6. Research respondents

A total of 30 trained food panelists were purposively selected for the sensory evaluation. These individuals were regular bread producers and consumers with no known food allergies and were familiar with sensory assessments. According to Mammasse and Schlich (2014), the panel size should be adjusted based on the product's complexity and the specific objectives of the sensory evaluation. For instance, a study analyzing seven different product types found that adequate panel sizes ranged from 20 to 150 participants, influenced by the sensory differences among the products.

3.7. Data gathering procedure / instrument

All Pandesal samples were prepared under standardized baking conditions to ensure uniformity in texture, color, and size across treatments. For data collection, a 9-point hedonic scale was utilized to evaluate each treatment's taste, aroma, texture, appearance, and overall acceptability. This scale, widely used in sensory research, enabled panelists to express their liking for each attribute. To assess the likelihood of eating MungRinga Pandesal, the Food Action Rating Scale was used to assess consumer preferences for food samples. The scale consists of several statements that describe varying levels of preference for a food item. Each tester's responses are recorded for each food sample, enabling an analysis of overall preferences and individual differences. The hedonic and Food action rating scale (likelihood rating) data were subjected to statistical analysis.

3.8. Data analysis

Descriptive statistics, including weighted means and percentages, were used to summarize sensory scores for each attribute.

4. RESULTS AND DISCUSSION

4.1. Level of acceptability of moringa pandesal (T0) and mungringa pandesal (T1-T3)

Table 1. Weighted mean on the level of acceptability of moringa pandesal (TO) and mungringa pandesal (T1-T3)

Indicators	TO	D.I	T1	D.I	T2	D.I	T3	D.I
Appearance	7.20	LM	7.13	LM	7.51	LVM	7.79	LVM
Taste/Flavor	6.90	LM	6.43	LS	6.14	LS	6.72	LM
Smell/Odor	7.20	LM	6.36	LS	6.29	LS	6.42	LS
Texture	6.70	LM	5.64	LS	6.07	LS	6.89	LM
Overall Acceptability	7.30	LM	6.50	LM	5.93	LS	6.79	LM

Descriptive Interpretation (D.I): 8.5-9.0 = Like extremely (LE), 7.5-8.4 = Like very much (LVM), 6.5-7.4 = Like moderately (LM), 5.5-6.4 = Like slightly (LS), 4.5-5.4 = Neither like nor dislike (NLD),3.5-4.4 = Dislike slightly (DS), 2.5-3.4 = Dislike moderately (DM), 1.5-2.4 = Dislike very much (DVM), 1.0-1.4 = Dislike extremely (DE).

Table 1 presents the comparative weighted mean scores and descriptive interpretations of four sensory indicators—appearance, taste/flavor, smell/odor, and texture—and overall acceptability for the control sample (T0: Moringa Pandesal) and three variations of MungRinga Pandesal (T1–T3), each formulated with different proportions of mung bean flour and constant moringa powder content.

The control group (T0), which consists solely of moringa powder as the functional ingredient, consistently received ratings within the "Like Moderately" (LM) range across all sensory parameters. The highest score was observed in overall acceptability (7.30), followed by smell/odor and appearance (7.20 each), indicating a generally favorable consumer response to the traditional moringa-enriched pandesal. This suggests that the visual presentation, aroma, and general eating experience were well-accepted, although not exceptionally outstanding. Texture and taste/flavor, while still within the 'Like Moderately' range, registered slightly lower values at 6.70 and 6.90, respectively, suggesting that improvements in mouthfeel and flavor complexity could further enhance product appeal.

Treatment 1 (T1), formulated with 7.5 grams of mung bean flour and 1 gram of moringa powder, displayed moderate acceptability. Appearance maintained a score of 7.13 (LM), signifying favorable visual appeal despite a slight decrease from the control. However, taste (6.43), smell (6.36), and texture (5.64) were all rated within the "Like Slightly" (LS) range, indicating that the addition of mung bean flour at this level may have introduced off-notes or undesirable changes in mouthfeel that diminished consumer satisfaction. Notably, overall acceptability for T1 remained within LM (6.50), suggesting that while individual attributes required improvement, the product's integrated sensory profile remained palatable to most respondents. The results indicate that at this formulation level, mung bean flour begins to significantly influence the sensory properties, warranting reformulation or processing adjustments.

Treatment 2 (T2), with a reduced mung bean flour content (6 grams), demonstrated slightly lower overall acceptability (5.93), falling into the LS category—the lowest among all treatments. Despite a relatively strong performance in appearance (7.51, LVM), the drop in flavor (6.14, LS), smell (6.29, LS), and texture (6.07, LS) suggests that the altered ingredient ratio may not have effectively balanced the vegetal and beany flavor attributes of mung beans with the naturally herbaceous note of moringa. The findings suggest a potential mismatch in flavor combinations or insufficient masking of undesirable notes, resulting in decreased consumer acceptance. While visually attractive, the internal sensory dynamics—flavor, aroma, and texture—need further enhancement to improve marketability.

In contrast, Treatment 3 (T3), which may represent a more optimized formulation, outperformed all other variants in several sensory dimensions. It achieved "Like Very Much" (LVM) in appearance (7.79) and texture (6.89, LM). It attained higher ratings in taste (6.72) and smell (6.42), pushing it closer to the LM range and indicating improved sensory integration. Overall acceptability was rated at 6.79 (LM), the highest among the MungRinga samples, pointing to T3's potential as a commercially viable alternative to the control. This treatment appears to strike a better balance between nutrition enhancement and palatability, possibly due to improved formulation or ingredient interaction.

Generally, while the control product (T0) remains the most acceptable across all attributes, Treatment 3 shows considerable promise as a nutrient-enriched functional food with minimal compromise in sensory appeal. Treatments 1 and 2, although showing some strengths, particularly in appearance, fell short in flavor, texture, and smell, underscoring the importance of optimizing mung bean flour levels and improving sensory masking or enhancement techniques. Future product development efforts should focus on fine-tuning ingredient ratios, incorporating flavor-masking agents, or modifying processing techniques (e.g., fermentation or roasting of mung beans) to enhance the taste and texture without compromising nutritional benefits. The successful integration of these strategies can lead to a fortified pandesal product that meets both health and sensory expectations of consumers.

4.2. Likelihood of consumption

Table 2. Likelihood of eating commercial moringa and mungringa pandesal

Indicators	TO	T1	T2	T3
I would eat this every opportunity that I have.	28.57%	28.57%	-	57.14%
I would eat this occasionally.	42.86%	14.29%	14.29%	-
I like this and would eat it occasionally.	21.43%	7.14%	28.57%	21.43%
I would eat this if it were available, but I would not go out of my way.	-	14.29%	7.14%	-
I do not like this, but I would eat it on occasion.	-	7.14%	28.57%	21.43%
I would hardly eat this.	-	7.14%	7.14%	-
I would eat this only if forced to.	-	14.29%	-	-

The data presented in Table 2 shows the likelihood of eating commercial Moringa and MungRingo Pandesal (a variation of pandesal) for three different product treatments. The data captures how likely consumers are to eat the products under different conditions, providing insights into the overall consumer appeal for each treatment.

The commercial Moringa and MungRingon Pandesal received a notably positive reception, with 42.86% of respondents stating they would eat it very often. Furthermore, 28.57% of respondents indicated that they would eat it whenever they had the opportunity, suggesting a strong demand for this product. However, only 21.43% of participants indicated they would eat it occasionally, reflecting general satisfaction with the product. The commercial product is favored for frequent consumption, with limited resistance among respondents.

The likelihood of eating Treatment 1 was somewhat lower. While 28.57% of respondents indicated they would eat it at every opportunity, only 14.29% would eat it very often. Notably, 14.29% stated they would eat it if available but would not go out of their way, indicating a moderate level of interest. On the other hand, 7.14% of respondents said they would eat it now and then, while another 7.14% were more indifferent, saying they would hardly eat it. The data suggests that while Treatment 1 has some appeal, it lacks the more vigorous enthusiasm of the commercial product.

For Treatment 2, the likelihood of consumption showed more mixed results. 28.57% of respondents indicated that they would eat it now and then, while 14.29% would eat it more often. However, 28.57% also stated that they would eat it if available, but would not go out of their way, and 7.14% mentioned that they would hardly eat it. This suggests that while Treatment 2 is acceptable, it may not be the preferred option for regular or enthusiastic consumption compared to the commercial product.

Treatment 3 exhibited the highest level of enthusiasm, with 57.14% of respondents stating they would eat it at every opportunity. This was the highest percentage across all treatments, indicating strong interest in this formulation. However, Treatment 3 also displayed some variation, with 21.43% saying they would eat it occasionally and 21.43% indicating they would not go out of their way to eat it. This variation suggests that while Treatment 3 has the most favorable reception, there is room for improvement, as not all consumers are as eager to consume it regularly.

The commercial product is the most popular choice for frequent consumption, indicating its strong market appeal. Treatment 3, with the highest percentage of "I would eat this every opportunity I have" responses, shows potential for becoming a favored option. However, it could benefit from further optimization to ensure a broader appeal. Treatment 1 and Treatment 2 received mixed feedback, with some respondents indicating a preference for occasional consumption, suggesting that these formulations are less compelling than the commercial product and Treatment 3. The relatively higher percentages of individuals who would "eat it if available but not go out of their way" or "hardly eat it" for Treatment 1 and Treatment 2 highlight a need for product improvement, particularly in terms of flavor, texture, or other sensory attributes. In conclusion, while all treatments have potential, Treatment 3 holds the most promise; however, addressing consumer ambivalence in Treatments 1 and 2 could help increase their likelihood of consumption.

5. CONCLUSION

The study revealed a generally positive consumer response to the commercial Moringa Pandesal and its experimental variations (Treatments 1, 2, and 3), with varying levels of acceptability across sensory attributes. The commercial product received the highest ratings in appearance, taste, aroma, and texture, indicating strong market potential and a high likelihood of regular consumption. Treatment 1 was also well-received, primarily for its appearance, but received mixed reviews on taste, smell, and texture, suggesting a need for flavor balance and consistency refinement. Treatment 2 showed moderate acceptability; while appearance and aroma were rated reasonably well, taste and texture were cited as areas needing improvement. Treatment 3 showed strong potential in overall acceptability, particularly in terms of appearance and texture, but exhibited inconsistent ratings in flavor and aroma. Generally, the commercial Moringa Pandesal and Treatment 3 are the most viable for market release. Treatments 1 and 2, though promising, require further optimization to enhance their sensory appeal and consumer satisfaction.

Despite the general acceptance, some negative feedback was noted, indicating areas for improvement to enhance product quality and appeal. Pandesal is a nutritious breakfast option that combines the health benefits of moringa leaves and mung beans. However, the current version of the product still has room for improvement. Many respondents commented that the bread was "dry" and that the "texture was lacking" or "needed to be softer." Issues related to size and shape were also raised. These shortcomings were attributed to the researchers' limited experience in baking and the lack of proper baking equipment and utensils.

RECOMMENDATIONS

To further improve the product, adjustments in the measurement and ratio of ingredients can help refine its texture and make the shape more appealing. Access to proper baking tools and kitchen equipment is also essential. It is recommended that pilot tests be conducted with small groups before scaling up to larger groups to gather diverse feedback and fine-tune the formulation accordingly. Moreover, insights from the study "The Potential of Five Indigenous Plants of Ifugao as Functional Loaf Bread Ingredients" (Aliguyon, 2016) support the integration of lemongrass extract to extend shelf life. Lemongrass, known for its antifungal and antimicrobial properties, has been proven to extend the shelf life of loaf bread by five days. Thus, incorporating lemongrass into moringa pandesal may enhance its preservation and functional properties.

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