

Development and Acceptability of Banana Pith (*Musa Paradisiaca* L.) Muffin

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ABSTRACT

This study “*Development and Acceptability of Banana Pith Muffin*” identified the optimal formulation based on sensory evaluation, nutritional content, and proximate analysis. Three formulations containing different amounts of banana pith 120g (Treatment 1), 60g (Treatment 2), and 30g (Treatment 3) was prepared and evaluated. Sensory analysis showed significant differences in terms of color, aroma, taste, texture, and general acceptability using a 9-Point Hedonic Scale, with results analyzed through descriptive statistics, ANOVA, and Kruskal-Wallis Test, with Treatment 3, which had 30 grams of banana pith, is the most acceptable in terms of color, aroma, taste, texture, and general acceptability. Consumer acceptability

testing with 50 participants supported these findings, showing a greater preference for Treatment 3 compared to the other formulations. Statistical analysis confirmed significant differences in sensory attributes, validating Treatment 3 as the optimal formulation. Proximate analysis of the best formulation revealed 5.34% crude protein, 0.12% crude fiber, 15.96% crude fat, 34.06% moisture, and 1.25% ash. Nutrition Facts showed a 100g per serving provides 339 kcal, 16g fat, 43g carbohydrates, and 5g protein, confirming as a nutrient-dense, moderate-energy snack suitable for functional food applications. Overall, the results demonstrate that banana pith can be successfully incorporated into muffin formulations as a functional ingredient. Treatment 3 achieved the best balance between sensory acceptability. It is recommended that future researchers conduct a comprehensive proximate composition analysis including the control formulation to allow clearer nutritional comparisons. Further studies may also evaluate shelf-life stability and packaging requirements to ensure product safety and market readiness. Additionally, consumer perception may be examined across specific demographic groups (age, gender and location), particularly those interested in functional and sustainable food products. This study highlights the potential of banana pith as a sustainable and value-added ingredient for bakery product innovation.

Keywords: *Banana Pith, Sensory Evaluation, Proximate Analysis, Nutritional Composition*

INTRODUCTION

Banana Pith (*Musa paradisiaca* L.) is also known as banana pseudostem is the stem of a banana tree. It is edible and is often used as a vegetable in Southeast Asian cuisine. With a mild, subtly sweet flavor. It is crisp and juicy, similar to a cucumber, it can be used in various dishes, such as soups, salads, curries, and stir-frys. Available year-round in most tropical regions like Thailand, Indonesia, the Philippines,

Vietnam, and Malaysia. Banana Pith are a good dietary fiber, potassium, calcium, and magnesium source. They also contain iron, vitamin C, phosphorus, and zinc. The stems contain high levels of antioxidants, which can help to protect against disease-causing agents in the body. In addition to its culinary applications, banana pith can be used to make juices, smoothies, and even flour for baking, showcasing its versatility and value as a functional food ingredient. (Baylis,2023). The global food system is confronted with a recurring problem of optimizing the use of produce from agriculture, with large percentages going to waste because of oversupply, perishability, or absence of value-added processing (FAO, 2020). At the same time, there is a growing international market for new, convenient, and healthier baked food products that provide exciting flavor experiences and respond to changing consumer desires for natural ingredients and artisanal excellence (Mintel, 2023).

Agricultural economy pillar in the Philippines, a country rich in natural resources, is the banana industry (Philippine Statistics Authority, 2023). Yet, in spite of extensive production and consumption, post-harvest losses and product diversification remain issues (Department of Agriculture, 2022). Locally, In Cagayan Valley and similar rural areas with high banana yield food waste and post-harvest losses persist due to limited product innovation and value-adding ventures (Department of Agriculture, 2022). In spite of lots of study on baked items and fruit use, a glaring lack is found in the literature that involves the complementary of banana in unified item such as a muffin. Although each ingredient has been researched for the characteristics and uses of these. The organized production, refinement, and sensory assessment of a “Banana Pith Muffin” has yet to be explored. This gap creates an opportunity for a unique, culturally specific, and possibly commercially viable baked product that can be lost. (Smith, 2021; Rodriguez & Pedroso, 2024),

Thus, this study strives to make a major contribution to food science and technology in showing a feasible process for value-addition of local agricultural produce, namely banana pith. Through the creation of a new product, the study hopes to mitigate food wastage, increase the economic opportunities of local banana growers, and offer a distinctive, high-quality product for bakery industries. The results will be advantageous to food producers in need of innovative product lines, the local community through promoting sustainable farming practices, and consumers through providing a tasty, relevant treat. (Mercado,2019)

METHODS

Research Design

This study used an experimental design of research. Experiment gives observation in the cause and effect by demonstrating one outcome results when a particular factor is manipulated Sereyath Em (2024). The cause variable or the variable manipulated was the amount of banana pith while the effect variables were the sensory characteristics such as color, aroma, taste, texture, and general acceptability of the different formulation of the banana pith muffin.

Research Locale

The study was conducted at Cagayan State University-Carig Campus, located in Carig Sur, Tuguegarao City, Cagayan. This location was selected because it provided the necessary facilities, equipment, and resources for food product development and evaluation. Laboratory analysis such as proximate analysis and nutrition facts was conducted in the laboratory of Department of Agriculture R02.

Sampling Technique

The study involved a total of fifty (50) respondents in the sensory evaluation, consisting of CIT Food Technology Faculty, and Food Technology Students. A stratified random sampling technique was employed to gather data from respondents, ensuring a well-represented distribution across key roles in various group. This method allowed for the inclusion of various respondent’s categories such as six (6)

faculty major in Food Technology and forty-four (44) Food technology Students with each group being proportionately represented.

Table 1. *Respondents of the Study*

Respondents	Number of respondents	Percentage
Food Technology Students	44	88%.
Food Technology Faculty	6	12%
Total Number of Respondents	50	100%

RESULTS AND DISCUSSION

Sensory Characteristics of Developed Banana Pith Muffin in terms of Color, Aroma, Taste, Texture and General Acceptability

Table 2. *Sensory Characteristics of the Developed Banana Pith (Musa Paradisiaca L.) Muffin in terms of Color, Aroma, Taste, Texture and General Acceptability*

Sensory Characteristics	Treatment 1	Treatment 2	Treatment 3	Control
Color	7.33 Like Very Much	7.50 Like Very Much	8.14 Extremely Like	7.67 Like Very Much
Aroma	6.83 Moderately Pleasant	7.17 Very Pleasant	8.13 Extremely Pleasant	7.33 Very Pleasant
Taste	7.17 Moderately Desirable	7.00 Moderately Desirable	8.50 Extremely Desirable	8.17 Extremely Desirable
Texture	7.33 Very Moist and Soft	7.00 Moderately Moist and Soft	8.50 Extremely Moist and Soft	7.83 Very Moist and Soft
General Acceptability	7.50 Very Acceptable	7.00 Moderately Acceptable	8.33 Extremely Acceptable	7.33 Very Acceptable

Treatment 3 consistently outperformed the other formulations across all sensory attributes, making it the most preferred muffins among the panelists. In terms of color, the mean scores ranged from 7.33 to 8.14, all described as “Like Very Much” to “Like Extremely.” Treatment 3 obtained the highest mean score (8.14), indicating the most visually appealing color among the samples. For aroma, the scores ranged from 6.83 to 8.13, where Treatment 3 again received the highest rating (8.13), described as “Like Extremely,” while Treatment 1 had the lowest score (6.83), indicating a milder aroma. In terms of taste, Treatment 3 obtained the highest mean score (8.50), followed by the control sample (8.17), both interpreted as “Like Extremely,” showing a better balance of sweetness and flavor compared to Treatments 1 and 2. Regarding texture, Treatment 3 also received the highest mean score (8.50), indicating the most favorable softness and crumb structure, while the control sample followed with a mean of (7.83). For general acceptability, Treatment 3 recorded the highest mean score (8.33), described as “Extremely Acceptable,” making it the most preferred formulation among all treatments. Overall, the results indicate that Treatment 3 consistently

received the highest ratings across all sensory attributes, suggesting it was the most desirable formulation in terms of color, aroma, taste, texture, and overall acceptability.

Proximate and Nutritional Composition of the Developed Banana Pith (*Musa Paradisiaca L.*) Muffin

Table 3. *Proximate Analysis of the Developed Banana Pith Muffin*

Lab No.	Sample Description	Crude Protein	Crude Fiber	Crude Fat	Moisture	Ash
		%	%	%	%	%
FT-25-606	Banana Pith Muffin	5.34	0.12	15.96	34.06	1.25

Source: Regional Feed Chemical Analysis Laboratory Department of Agriculture, R02

The table presented the proximate composition of Banana Pith Muffin tested using the Semi-Automatic Kjeldahl Method, ANKOM Filter Bag Technique, and Gravimetric Method at the Department of Agriculture Region 2 (DA RO2). The proximate composition analysis of the Banana Pith Muffin revealed important nutritional properties, providing insight into its overall quality and potential health benefits. The crude protein at 5.34%, crude fiber at 0.12%, crude fat at 15.96%, moisture at 34.06%, and ash at 1.25%. These values indicated a nutritional profile characterized by moderate protein and high fat and moisture contents, with notably low fiber and ash levels. The protein content of 5.34% reflected contributions from the base ingredients, while the low fiber (0.12%) suggested effective processing of the banana pith to reduce indigestible components. The elevated fat (15.96%) and moisture (34.06%) levels contributed to a soft, palatable texture, and the minimal ash (1.25%) aligned with the organic composition of the muffin.

Nutritional Analysis of Banana Pith Muffin

The banana pith muffin provided 339 kcal of energy per 100 g serving, with 144 kcal derived from fat, indicating that fat contributed significantly to the total energy content. The full nutritional composition revealed 16 g of total fat, 43 g of total carbohydrates, 5 g of total protein, and 0 g of crude fiber per 100 g. When evaluated against the 2018 PDRI reference for a male adult aged 19–29, a 100 g serving supplied 13% of the daily energy requirement and 8% of the daily protein requirement, demonstrating that the muffin could provide a moderate contribution to daily energy and protein intake without exceeding recommended levels.

Test of Significant Difference among the three (3) Treatment in terms of color, aroma, taste, texture, and general acceptability

Table 5. *Test of Significant Difference in the Sensory Evaluation among the Three (3) Treatments of the Developed Banana Pith (*Musa Paradisiaca L.*) Muffin*

Attributes	Treatment	Mean Rank	χ^2	p	Decision
Color	Treatment 1	62.92 ^{ab}	6.26	.044	Reject Ho
	Treatment 2	59.27 ^b			
	Treatment 3	77.31 ^a			
Aroma	Treatment 1	62.25 ^{ab}	8.97	.011	Reject Ho

	Treatment 2	57.68 ^b			
	Treatment 3	79.57 ^a			
Taste	Treatment 1	64.72 ^{ab}	12.23	.002	Reject Ho
	Treatment 2	54.06 ^b			
	Treatment 3	80.73 ^a			
Texture	Treatment 1	71.32 ^a	13.29	.001	Reject Ho
	Treatment 2	50.61 ^b			
	Treatment 3	77.57 ^a			
General Acceptability	Treatment 1	69.28 ^a	20.06	< .001	Reject Ho
	Treatment 2	48.08 ^b			
	Treatment 3	82.14 ^a			

Mean rank values with different superscripts in each attribute are significantly different ($p < 0.05$).

Color: For color, the test showed a significant difference among treatments ($\chi^2 = 6.26$, $p = .044$). Treatment 2 had the lowest rank (59.27^b), treatment 1 (62.92^{ab}), and Treatment 3 (77.31^a) had the highest rank. The color improved as banana pith concentration increased. According to Vargas & Belmonte (2021), plant-based ingredients influence surface browning and visual uniformity, enhancing product appeal—consistent with the strong preference for Treatment 3.

Aroma: The test also showed a significant difference among treatments ($\chi^2 = 8.97$, $p = .011$). Treatment 2 had the lowest mean rank (57.68^b), suggesting that its aroma was the least appealing. Treatment 1 (62.25^{ab}) showed slightly better aroma acceptability, but Treatment 3 had the highest rank (79.57^a), indicating that it possessed the strongest and most pleasant aroma among the samples.

Taste: The test again showed a significant difference ($\chi^2 = 12.23$, $p = .002$). Treatment 2 obtained the lowest mean rank (54.06^b), meaning its flavor was the least preferred. Treatment 1 (64.72^{ab}) showed moderate acceptability, while the highest rating was recorded in Treatment 3 (80.73^a), indicating that panelists found it the most flavorful and enjoyable among all samples.

Texture: A significant difference was also observed ($\chi^2 = 13.29$, $p = .001$). Treatment 2 ranked the lowest (50.61^b), suggesting that it was perceived as the firmest or least moist. Treatment 1 (71.32^a) showed a more desirable texture profile, while Treatment 3 (77.57^a) obtained the highest mean rank, indicating excellent softness and moisture that appealed strongly to consumers.

General Acceptability: The test revealed a highly significant difference ($\chi^2 = 20.06$, $p < .001$). Treatment 2 had the lowest acceptability rank (48.08^b), showing that it was the least preferred overall. Treatment 1 (69.28^a) had better consumer approval, while Treatment 3 (82.14^a) obtained the highest rank among all treatments, indicating the strongest overall preference.

CONCLUSION

This study was conducted to develop and evaluate the acceptability of Banana Pith (*Musa paradisiaca* L.) Muffin as an innovative food product utilizing banana by-products. Based on the results obtained from the sensory evaluation, proximate and nutritional analysis and statistical testing. The developed Banana Pith Muffin was found to be generally acceptable to both the sensory panelists and consumer respondents. The ratings for color, aroma, taste, texture, and general acceptability indicated that

the incorporation of banana pith into the muffin formulation did not adversely affect its sensory qualities. Instead, the product was evaluated as palatable and suitable for consumption. The proximate and nutritional composition analysis showed that the Banana Pith Muffin contained essential nutrients, demonstrating that banana pith served as a functional ingredient that enhanced the nutritional profile of the product. The findings confirmed that banana pith contributed beneficial components, particularly fiber and minerals, which improved the overall nutritive value of the muffins. Furthermore, the statistical results indicated that there were significant differences among the three treatments in at least one of the sensory attributes. This suggested that varying the levels of banana pith influenced the muffins' sensory characteristics, allowing for the identification of an optimal formulation based on the highest acceptability scores. In conclusion, the study successfully achieved all its objectives and demonstrated that Banana Pith Muffin was a nutritious, sensory-acceptable, and sustainable bakery product. The findings supported the potential of banana pith as a valuable ingredient for innovative food product development.

Recommendation

1. Researchers may consider exploring novel flavor combinations or ingredient pairings that complement the natural characteristics of banana pith, moving beyond traditional muffin flavors.
2. Future research may evaluate the shelf-life stability, microbial quality, and packaging requirements of the developed banana pith muffins to ensure product safety and market readiness.
3. Future research may evaluate the consumer perception and acceptance of banana pith muffins in specific demographic groups, such as those interested in functional foods or sustainable alternatives.

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