Siber Journal of Advanced Multidisciplinary (SJAM)
E-ISSN: 2987-1069
P-ISSN: 2987-1018
+62 822 1012 3600 https://research.e-siber.org siberpublisher.info@gmail.com
DOI: https://doi.org/10.38035/sjam.v4i2

An Investigation of the Proportion of Banana Corm and Tapioca Flour on the Organoleptic Properties of Crackers and Their Business Feasibility

Justino Mendes Pereira[1*], Celestino Mendes Pereira[2], Armando Afonso
[1] Universitas Oriental Timor Lorosa'e, Avenida Liberdade da Impresa Becora Dili, Timor Leste, pereiramjustino@gmail.com.
[2] Universitas Oriental Timor Lorosa'e, Avenida Liberdade da Impresa Becora Dili, Timor Leste, celestinomendespereira7@gmail.com.
[3] Universitas Oriental Timor Lorosa'e, Avenida Liberdade da Impresa Becora Dili, Timor Leste, armandoafonso513@gmail.com.

[*]Corresponding Author: pereiramjustino@gmail.com[1]

Abstract: Banana corm is generally regarded as agricultural waste and remains underutilized despite its potential as a value-added food ingredient. This study evaluated the effect of different proportions of banana corm and tapioca flour on the organoleptic properties of crackers and assessed the business feasibility of the product. The experiment employed a single-factor Completely Randomized Design (CRD) with five treatments: A1 (300:700), A2 (400:600), A3 (500:500), A4 (600:400), and A5 (700:300) (banana corm:tapioca flour), each replicated three times. Crackers were prepared by mixing the ingredients with seasonings, followed by steaming, drying, and frying. Sensory quality was evaluated using the hedonic rating scale. Data were analyzed using analysis of variance (ANOVA), and significant differences among treatments were further examined using the Least Significant Difference (LSD) test at the 5% significance level. The best treatment was determined using the De Garmo weighting method. The results indicated that treatment A3 (500:500) achieved the highest overall sensory acceptance, with the best weighted score (1.00). The business feasibility analysis showed that banana corm cracker production is economically viable, with a break-even point (BEP) of 17,795.45 units (USD 2,189.19) and a revenue-cost ratio (R/C ratio) of 1.16.

Keywords: *Banana Corm, Tapioca Flour, Crackers, Organoleptic Evaluation, Business Feasibility.*

INTRODUCTION

Banana (*Musa spp.*) is one of the most widely cultivated crops in tropical countries, generating substantial quantities of agricultural residues during cultivation and harvesting. Among these residues, the banana corm has received relatively little attention despite its potential as a valuable food resource. Anatomically, the banana corm consists of spongy tissues, collenchyma, and lignified cells that provide structural support while serving as a

storage organ for water and nutrients required for the development of new shoots (Wahyuni & Astuti, 2020). Understanding the structural characteristics of banana corm not only contributes to sustainable crop management but also provides opportunities for developing value-added products from agricultural waste.

The increasing emphasis on sustainable food production and waste reduction has encouraged the utilization of agricultural by-products as alternative food ingredients. Banana corm, traditionally regarded as agricultural waste, can be processed into various value-added products, including animal feed, organic fertilizer, alternative flour, and processed food products. Its utilization as a food ingredient contributes to waste minimization while increasing the economic value of banana cultivation (Anggraeni & Haryanto, 2020). Moreover, banana corm contains dietary fiber, carbohydrates, moisture, and small amounts of protein and essential minerals, making it a promising raw material for the development of functional food products.

One potential application of banana corm is in cracker production. Crackers are popular snack foods widely consumed because of their crispy texture, pleasant taste, and relatively long shelf life. Banana corm crackers are produced by combining processed banana corm with starch-based ingredients, seasonings, and other food additives before steaming, drying, and frying. Compared with conventional starch-based crackers, banana corm crackers have the potential to provide higher dietary fiber while maintaining desirable sensory characteristics (Nurhidayat & Suryani, 2019). Previous studies have also reported that appropriate processing techniques, including drying and fermentation, can improve the nutritional quality of banana corm and increase its economic value while supporting sustainable food production (Rahmawati & Susanto, 2022; E. Yuliana & Hartono, 2021).

Tapioca flour is an important ingredient in cracker manufacturing because it contributes to texture formation, expansion during frying, and overall product acceptability. Produced from cassava starch, tapioca flour possesses desirable physicochemical characteristics that are largely determined by the structure of its starch granules and the proportions of amylose and amylopectin. These properties influence water absorption, gel formation, crispness, and the sensory quality of the final product (Santoso & Wulandari, 2023). Consequently, the proportion of banana corm and tapioca flour is expected to play a crucial role in determining the quality of banana corm crackers.

Consumer acceptance of newly developed food products is commonly evaluated through organoleptic assessment. Sensory evaluation measures product attributes such as color, aroma, taste, texture, and overall acceptability using human sensory perception. Because these attributes cannot be fully quantified through instrumental analysis, organoleptic testing remains an essential method for product development, formulation optimization, and quality control in the food industry (Winarno, 2004). Recent developments have further emphasized the integration of statistical analysis with sensory evaluation to improve the reliability and objectivity of consumer preference studies (Yuliana & Handayani, 2019).

In addition to product quality, the commercial feasibility of food innovation should also be evaluated. A business feasibility analysis examines whether a product can be produced and marketed profitably by considering technical, financial, market, managerial, and operational aspects (Hanafiah, 2018). Recent approaches also incorporate sustainability, technological innovation, and risk assessment to ensure that new food products remain economically viable and environmentally sustainable (Suryana & Priyanto, 2020). Such evaluation is particularly important for home-scale food industries seeking to commercialize value-added agricultural products.

Although several studies have explored the nutritional potential of banana corm, limited information is available regarding the optimal proportion of banana corm and tapioca flour for producing crackers with desirable sensory characteristics while maintaining economic feasibility. Therefore, this study aimed to evaluate the effect of different proportions of banana

corm and tapioca flour on the organoleptic quality of banana corm crackers and to assess the business feasibility of producing these crackers at the household scale. It was hypothesized that varying the proportion of banana corm and tapioca flour would significantly influence the sensory quality of the crackers and that the selected formulation would be economically feasible for small-scale production.

METHODS

Study Site

The study was conducted at the Laboratory of the Faculty of Agriculture, Oriental University Timor Lorosa'e, Timor-Leste, from October to November 2024.

Materials

Fresh banana corms were used as the primary raw material, while tapioca flour served as the binding agent. Other ingredients included coriander, garlic, candlenut, salt, water, and cooking oil. The equipment used comprised a digital balance, meat grinder, milling machine, mixing bowls, knives, measuring jug, pressing cloth, steamer, frying pan, spatula, and plastic containers.

Experimental Design

This study employed a single-factor Completely Randomized Design (CRD) to investigate the effect of different proportions of banana corm and tapioca flour on the quality of banana corm crackers. Five treatment formulations were evaluated:
A1: 300 g banana corm + 700 g tapioca flour
A2: 400 g banana corm + 600 g tapioca flour
A3: 500 g banana corm + 500 g tapioca flour
A4: 600 g banana corm + 400 g tapioca flour
A5: 700 g banana corm + 300 g tapioca flour
Each treatment was replicated three times.

Preparation of Banana Corm Crackers

Fresh banana corms were washed thoroughly, peeled, cut into small pieces, and ground into a fine paste. The banana corm paste was then mixed with tapioca flour according to each treatment formulation. Coriander, garlic, candlenut, salt, and water were added and thoroughly mixed until a homogeneous dough was obtained. The dough was steamed until fully cooked, cooled to room temperature, sliced into thin pieces, dried, and deep-fried in hot cooking oil until crispy. The resulting crackers were cooled before sensory evaluation.

Organoleptic Evaluation

The sensory properties of the crackers were evaluated using a hedonic test involving 20 untrained panelists. The panelists assessed color, aroma, taste, texture, and overall acceptability using a five-point hedonic scale, where 1 = dislike very much and 5 = like very much.

Statistical Analysis

The sensory evaluation data were analyzed using one-way analysis of variance (ANOVA) to determine the effect of treatment on the organoleptic characteristics of the crackers. When significant differences ($p < 0.05$) were detected, treatment means were compared using the Least Significant Difference (LSD) test at the 5% significance level. The most preferred formulation was determined using the De Garmo Effectiveness Index (De Garmo et al., 1984; Susruni, 2003). All statistical analyses were performed using GenStat Release 17.1 (VSN International Ltd., Hemel Hempstead, UK), which provides advanced statistical procedures for experimental design and analysis (Jones & Williams, 2022).

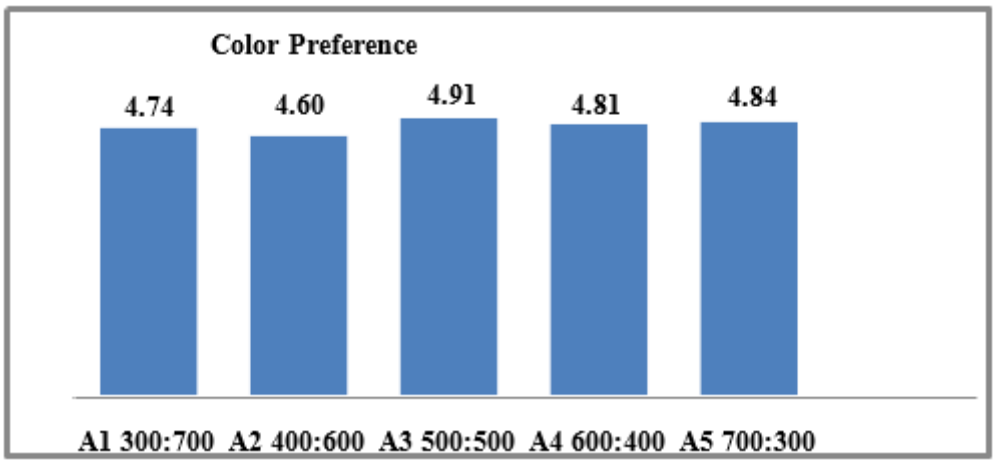
Business Feasibility Analysis

The formulation identified as the best treatment based on sensory evaluation was further subjected to a business feasibility analysis. Economic feasibility was assessed using the Break-Even Point (BEP) and Revenue-Cost Ratio (R/C Ratio) to determine the profitability and economic viability of banana corm cracker production at the household scale.

RESULTS AND DISCUSSION

Color Preference

Color is one of the most important sensory attributes influencing consumers' first impression of food products. The hedonic scores for color preference of banana corm crackers ranged from 4.60 to 4.91, indicating that all formulations were generally acceptable to the panelists. The highest preference score was obtained by treatment A3 (500 g banana corm:500 g tapioca flour), while the lowest score was observed in treatment A2.



Source: Research Data (2024)

Figure 1. Effect of different proportions of banana corm and tapioca flour on the color preference of banana corm crackers.

To determine whether the differences among treatments were statistically significant, the sensory data were analyzed using one-way analysis of variance (ANOVA). The results are presented in Table 1.

Table 1. Analysis of variance for color preference of banana corm crackers.

Source of variation	df	SS	MS	F-value	p-value
Treatment	4	1.0962	0.2741	0.33	0.856
Residual	90	74.4874	0.8276		
Total	94	75.5836			

Source: Research Data (2024)

The ANOVA results showed that the proportion of banana corm and tapioca flour had no significant effect on the color preference of banana corm crackers ($p = 0.856$). Although statistical differences were not detected, variations in the mean hedonic scores indicate that consumers tended to prefer certain formulations, particularly the balanced proportion of banana corm and tapioca flour.

Table 2. Mean color preference scores of banana corm crackers

Treatment	Mean score
A1	4.737

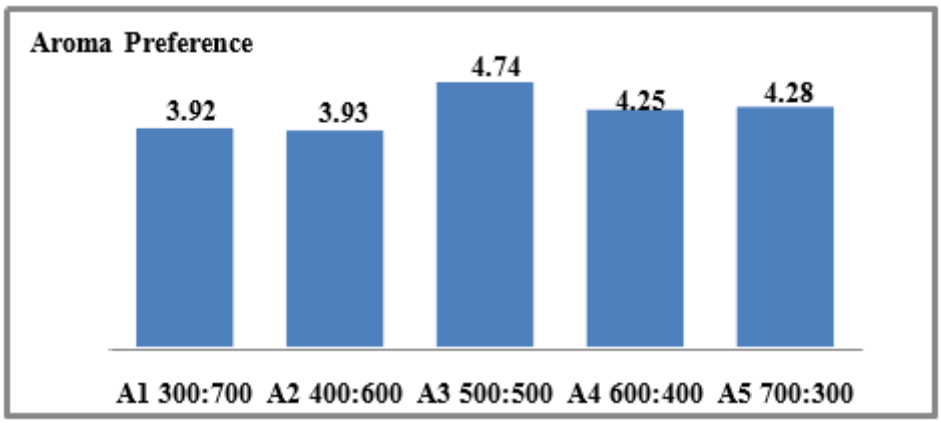
A2	4.595
A3	4.911
A4	4.805
A5	4.842

Source: Research Data (2024)
Note: Grand mean = 4.778; SED = 0.2952; LSD (5%) = 0.5864; CV = 19.0%.

Treatment A3 exhibited the highest mean color preference score, suggesting that an equal proportion of banana corm and tapioca flour produced the most attractive appearance after frying. The balanced starch composition likely promoted a desirable golden-brown color without excessive darkening. In contrast, increasing the proportion of banana corm tended to produce darker crackers due to intensified browning reactions during frying. Winarno (2004) reported that color is the first quality attribute evaluated by consumers and plays a decisive role in determining the acceptability of food products. Therefore, although the statistical analysis indicated no significant differences, the balanced formulation showed greater practical acceptance among panelists.

Aroma Preference

Aroma is another important sensory attribute that contributes to consumer acceptance because it directly influences the perception of food quality before tasting. The aroma preference scores ranged from 3.88 to 4.74, demonstrating that all formulations produced acceptable aroma characteristics. The highest aroma preference was obtained from treatment A3, whereas treatment A2 received the lowest score.



Source: Research Data (2024)
Figure 2. Effect of different proportions of banana corm and tapioca flour on the aroma preference of banana corm crackers.

The significance of treatment effects on aroma preference was evaluated using one-way ANOVA, and the results are summarized in Table 3.

Table 3. Analysis of variance for aroma preference

Source of variation	df	SS	MS	F-value	p-value
Treatment	4	9.178	2.294	2.11	0.086
Residual	90	97.988	1.089		
Total	94	107.166			

Source: Research Data (2024)

The ANOVA results indicated that differences among treatments were not statistically significant at the 5% significance level (p = 0.086). Nevertheless, differences in the average

hedonic scores suggested that panelists preferred formulations containing a balanced proportion of banana corm and tapioca flour.

Table 4. Mean aroma preference scores of banana corm crackers

Treatment	Mean score
A1	3.92
A2	3.88
A3	4.74
A4	4.25
A5	4.30

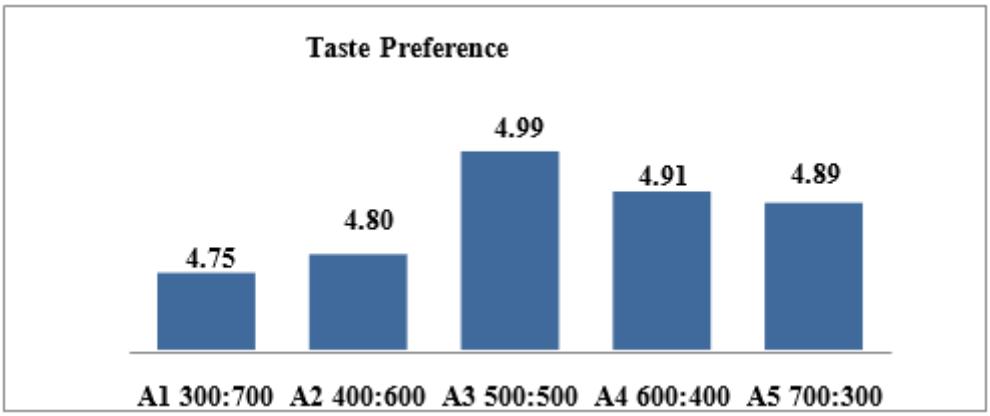
Source: Research Data (2024)

Note: Grand mean = 4.22; SED = 0.339; LSD (5%) = 0.673; CV = 24.8%.

The superior aroma acceptance observed in treatment A3 indicates that a balanced combination of banana corm and tapioca flour generated a more pleasant aroma than the other formulations. Excessive amounts of banana corm may produce a characteristic earthy odor that reduces consumer preference, whereas excessive tapioca flour may weaken the distinctive aroma of the product. Winarno (2008) stated that aroma is a major determinant of food acceptability because volatile compounds released during processing strongly influence consumer perception. The balanced formulation therefore provided a more harmonious aroma profile, resulting in greater panelist acceptance.

Taste Preference

Taste is one of the most influential sensory attributes determining consumer acceptance of food products. The taste preference scores of banana corm crackers ranged from 4.75 to 4.99, indicating that all formulations were highly acceptable to the panelists. Among the treatments, A3 (500 g banana corm:500 g tapioca flour) achieved the highest mean taste preference score (4.99), while A1 recorded the lowest score (4.75). These findings suggest that a balanced proportion of banana corm and tapioca flour produced the most desirable flavor profile.



Source: Research Data (2024)

Figure 3. Effect of different proportions of banana corm and tapioca flour on the taste preference of banana corm crackers.

The effect of treatment on taste preference was evaluated using one-way analysis of variance (ANOVA), and the results are presented in Table 5.

Table 5. Analysis of variance for taste preference of banana corm crackers.

Source of variation	df	SS	MS	F-value	p-value
Treatment	4	0.6933	0.1733	0.28	0.889
Residual	90	55.1789	0.6131		
Total	94	55.8722			

Source: Research Data (2024)

The ANOVA results indicated that the different proportions of banana corm and tapioca flour did not significantly influence taste preference ($p > 0.05$). Although the treatments produced similar levels of consumer acceptance, differences in the mean scores suggested that the balanced formulation was generally preferred. The mean taste preference scores are summarized in Table 6.

Table 6. Mean taste preference scores of banana corm crackers

Treatment	Mean score
A1	4.753
A2	4.789
A3	4.989
A4	4.911
A5	4.889

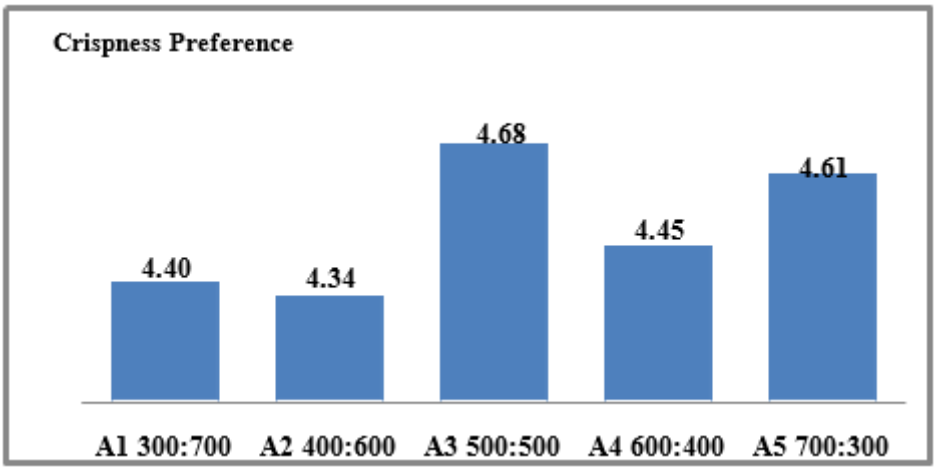
Source: Research Data (2024)

Note: Grand mean = 4.866; SED = 0.2540; LSD (5%) = 0.5047; CV = 16.1%.

Treatment A3 exhibited the highest taste preference score, indicating that equal proportions of banana corm and tapioca flour produced the most acceptable flavor. This formulation likely achieved a better balance between the characteristic flavor of banana corm and the neutral taste of tapioca flour, allowing the seasonings to be perceived more harmoniously. In contrast, increasing the proportion of banana corm may intensify its characteristic flavor, whereas excessive tapioca flour may dilute the overall taste of the product. Winarno (2008) stated that taste is the primary determinant of food acceptability because it directly influences consumer satisfaction and repeat purchase decisions. Therefore, maintaining an appropriate balance among the raw materials is essential for developing crackers with desirable sensory quality.

Crispness Preference

Crispness is one of the defining quality attributes of crackers because it determines the textural characteristics perceived during consumption. The crispness preference scores ranged from 4.34 to 4.68, indicating that all cracker formulations were generally considered crispy by the panelists. Treatment A3 (500 g banana corm:500 g tapioca flour) received the highest preference score (4.68), whereas treatment A2 produced the lowest score (4.34).



Source: Research Data (2024)

Figure 4. Effect of different proportions of banana corm and tapioca flour on the crispness preference of banana corm crackers.

The influence of treatment on crispness preference was analyzed using one-way ANOVA, and the results are shown in Table 7.

Table 7. Analysis of variance for crispness preference of banana corm crackers.

Source of variation	df	SS	MS	F-value	p-value
Treatment	4	1.677	0.419	0.38	0.825
Residual	90	100.324	1.115		
Total	94	102.001			

Source: Research Data (2024)

The ANOVA results demonstrated that the different proportions of banana corm and tapioca flour did not significantly affect the crispness preference of the crackers ($p > 0.05$). Nevertheless, variations in the mean scores indicated that the balanced formulation tended to produce a more desirable texture than the other treatments. The mean crispness preference scores are presented in Table 8.

Table 8. Mean crispness preference scores of banana corm crackers.

Treatment	Mean score
A1	4.37
A2	4.34
A3	4.68
A4	4.45
A5	4.61

Source: Research Data (2024)

Note: Grand mean = 4.49; SED = 0.343; LSD (5%) = 0.681; CV = 23.5%.

Treatment A3 produced the highest crispness preference score, demonstrating that the equal proportion of banana corm and tapioca flour generated the most desirable textural characteristics. Crispness is strongly influenced by starch composition, moisture content, and the formation of porous structures during frying. Tapioca starch contributes to expansion and the development of a light, crispy structure, whereas excessive banana corm may increase fiber content and reduce expansion during frying, resulting in a denser texture. These findings are consistent with Nugroho (2020), who reported that crispness is one of the most important quality attributes of crackers because it directly affects consumer satisfaction. The interaction

between starch gelatinization during steaming and moisture evaporation during frying plays a crucial role in producing the characteristic crispy texture of fried snack products.

Selection of the Best Treatment

The determination of the best treatment was performed using the De Garmo Effectiveness Index, which integrates multiple sensory parameters into a single preference value. This method enables the selection of the most appropriate formulation by assigning weights to each sensory attribute and calculating the overall effectiveness score for every treatment. In this study, color, aroma, taste, and crispness were considered the primary indicators of consumer acceptance. The effectiveness index values for each treatment are presented in Table 9.

Table 9. Effectiveness index values for selecting the best treatment of banana corm crackers.

Sensory Parameter	Weight	A1 (NH)	A2 (NH)	A3 (NH)	A4 (NH)	A5 (NH)
Color	1	0.1076	0.0000	0.1000	0.0677	0.0774
Aroma	2	0.0000	0.0024	0.2000	0.0804	0.0878
Taste	3	0.0000	0.0624	0.3000	0.1998	0.1749
Crispness	4	0.0704	0.0000	0.4000	0.1292	0.3176
Total NH	10	0.1780	0.0648	1.0000	0.4771	0.6580

Source: Research Data (2024)

Based on the De Garmo et al. (1984) Effectiveness Index, treatment A3 (500 g banana corm:500 g tapioca flour) obtained the highest effectiveness value (NH = 1.00), indicating that it was the most preferred formulation among all treatments. This formulation consistently produced the highest or near-highest scores for all sensory attributes evaluated, including color, aroma, taste, and crispness.

The superior performance of treatment A3 demonstrates that a balanced proportion of banana corm and tapioca flour provides an optimum combination of appearance, flavor, aroma, and texture. Increasing the proportion of banana corm beyond 500 g tended to reduce sensory acceptance because of darker color, stronger characteristic aroma, and reduced expansion during frying. Conversely, excessive tapioca flour diminished the distinctive characteristics contributed by banana corm. Therefore, an equal proportion of banana corm and tapioca flour represents the most suitable formulation for producing banana corm crackers with high consumer acceptability.

Business Feasibility Analysis

In addition to sensory quality, the commercial potential of the selected product was evaluated through a business feasibility analysis. The economic assessment was conducted using the Break-Even Point (BEP) and Revenue-Cost Ratio (R/C Ratio), which are commonly employed to determine the profitability of small-scale food processing enterprises. The break-even point was calculated using the following equation:

$$\text{BEP (units)} = \frac{\text{Fixed Cost}}{\text{Selling Price per Unit} - \text{Variable Cost per Unit}} \quad (1)$$

The economic efficiency of the production process was further evaluated using the Revenue-Cost Ratio:

$$\text{R/C Ratio} = \frac{\text{Total Revenue}}{\text{Total Production Cost}} \quad (2)$$

The economic analysis was performed using the formulation identified as the best treatment (A3). The production process utilized 15 kg of raw materials per day, producing approximately 14.5 kg of crackers, equivalent to 145 packages of 100 g each. The total annual production cost was USD 13,320.00, while the estimated annual revenue reached USD 43,500.00. The annual depreciation cost was calculated at USD 167.75, resulting in a production cost of USD 0.31 per package. With a profit margin of 15%, the selling price was established at USD 0.36 per package, generating a net daily profit of approximately USD 7.25. The results of the feasibility analysis are summarized in Table 10.

Table 10. Economic feasibility analysis of banana corm cracker production.

Parameter	Value
Production capacity	15 kg day^{-1}
Finished product	14.5 kg day^{-1}
Product packages (100 g)	145 packages day^{-1}
Annual production cost	USD 13,320.00
Annual revenue	USD 43,500.00
Annual depreciation	USD 167.75
Production cost per package	USD 0.31
Selling price per package	USD 0.36
Net profit per day	USD 7.25
Break-Even Point (BEP)	17,795.45 packages
BEP (sales value)	USD 2,189.19
Revenue-Cost Ratio (R/C)	1.16

Source: Research Data (2024)

The calculated R/C ratio of 1.16 indicates that banana corm cracker production is economically feasible because the revenue generated exceeds the total production cost. Furthermore, the BEP analysis shows that the enterprise reaches the break-even point after producing 17,795.45 packages, corresponding to a sales value of USD 2,189.19. Since the R/C ratio is greater than one, the production of banana corm crackers can be considered financially viable for household-scale enterprises. The utilization of banana corm as a value-added food ingredient also contributes to agricultural waste reduction while creating additional income opportunities for local communities. These findings support previous studies emphasizing that the conversion of agricultural by-products into marketable food products can enhance both economic returns and environmental sustainability.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

This study evaluated the effect of different proportions of banana corm and tapioca flour on the organoleptic characteristics of banana corm crackers and assessed the economic feasibility of their production. Among the five formulations tested, treatment A3, consisting of 500 g banana corm and 500 g tapioca flour, was identified as the best formulation based on the De Garmo Effectiveness Index. This formulation achieved the highest overall sensory acceptance, particularly in terms of color, aroma, taste, and crispness. Although the statistical analysis indicated no significant differences among treatments for the evaluated sensory attributes, the balanced proportion of banana corm and tapioca flour consistently produced the most favorable organoleptic performance. Furthermore, the business feasibility analysis demonstrated that banana corm cracker production is economically viable, with a Break-Even Point (BEP) of 17,795.45 units (USD 2,189.19) and a Revenue-Cost (R/C) ratio of 1.16, indicating that the enterprise is profitable for household-scale production. These findings demonstrate that banana corm, commonly regarded as agricultural waste, can be transformed

into a value-added food product, thereby contributing to sustainable agricultural waste utilization and the development of small-scale food industries.

Limitations

This study has several limitations. First, the experiment was conducted under laboratory conditions using banana corm obtained from a single source, which may limit the generalizability of the findings to other production environments or banana varieties. Second, the evaluation focused primarily on organoleptic characteristics and business feasibility, while important quality parameters such as nutritional composition, physicochemical properties, shelf life, and microbiological quality were not investigated. Third, consumer acceptance was assessed using only 20 panelists, which may not fully represent broader consumer preferences. Therefore, the findings should be interpreted within the scope and conditions of this study.

Recommendations

Future studies should investigate the nutritional composition, physicochemical characteristics, storage stability, and microbiological safety of banana corm crackers to provide a more comprehensive evaluation of product quality. Consumer preference studies involving larger and more diverse panelists are also recommended to improve the reliability of sensory evaluation. Furthermore, future research should explore different processing techniques, additional functional ingredients, and various packaging methods to enhance product quality and shelf life. From an economic perspective, large-scale production and market analyses are recommended to evaluate the commercial potential of banana corm crackers and support their development as sustainable value-added food products.

Author Contributions

All authors made substantial contributions to this study. Justino Mendes Pereira conceptualized the research, designed the experiment, collected and analyzed the data, interpreted the findings, and prepared the original manuscript. Celestino Mendes Pereira contributed to the research methodology, data validation, manuscript review, and critical revision. Armando Afonso participated in data interpretation, business feasibility analysis, manuscript editing, and final review. All authors read and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

Acknowledgment

The authors sincerely express their gratitude to the Faculty of Agriculture, Oriental University Timor Lorosa'e, for providing laboratory facilities and technical support during this research. The authors also appreciate the valuable assistance of all panelists who participated in the organoleptic evaluation and everyone who contributed to the successful completion of this study.

REFERENCES

Anggraeni, L. A., & Haryanto, A. (2020). Potensi Pemanfaatan Bonggol Pisang sebagai Bahan Pangan Alternatif. *Jurnal Teknologi Pangan*, *14*(1), 45–52.

De Garmo, E. D., Sullivan, W. G., & Canada, J. R. (1984). *Engineering Economy*. Macmillan Publishing Company.

Hanafiah, M. A. (2018). *Analisis Kelayakan Usaha*. PT Raja Grafindo Persada.

Jones, M., & Williams, P. (2022). Enhancements in GenStat Version 17 for Advanced Statistical Analysis. *Journal of Computational Statistics*, *18*(3), 120–135.

Nugroho, A. (2020). *Kerupuk: Sejarah dan Ragamnya di Indonesia*. Pustaka Rasa.

Nurhidayat, D., & Suryani, L. (2019). Inovasi Produk Pangan Lokal: Pemanfaatan Limbah Bonggol Pisang dalam Produk Kerupuk. *Jurnal Pengembangan UMKM*, *3*(3), 29–35.

Rahmawati, D., & Susanto, A. (2022). Inovasi Pengolahan Bonggol Pisang Menjadi Produk Makanan Bernilai Gizi Tinggi. *Jurnal Teknologi Pangan*, *9*(2), 78–86.

Santoso, B., & Wulandari, D. (2023). Analisis Morfologi dan Karakteristik Tepung Tapioka. *Jurnal Teknologi Pangan*, *18*(2), 75–82.

Suryana, D., & Priyanto, A. (2020). Konsep dan Evaluasi Kelayakan Usaha Berbasis Keberlanjutan. *Jurnal Manajemen Dan Kewirausahaan*, *8*(3), 150–158.

Susruni. (2003). *Index Efektifitas: Suatu Pemikiran tentang Alternatif untuk Memilih Perlakuan Terbaik pada Penelitian Pangan* (2nd ed.).

Wahyuni, S., & Astuti, D. (2020). Morfologi dan Struktur Anatomi Bonggol Pisang sebagai Dasar Pengembangan Budidaya. *Jurnal Biologi Tropis*, *10*(2), 89–97.

Winarno, F. G. (2004). *Kimia Pangan dan Gizi*. Gramedia.

Winarno, F. G. (2008). *Kimia Pangan dan Gizi*. Gramedia Pustaka Utama.

Yuliana, E., & Hartono, S. (2021). Pemanfaatan Bonggol Pisang sebagai Bahan Makanan Sehat. *Jurnal Pangan Dan Gizi*, *17*(3), 145–154.

Yuliana, R., & Handayani, S. (2019). Inovasi dalam Uji Organoleptik Berbasis Teknologi Sensor. *Jurnal Teknologi Pangan*, *12*(2), 85–92.