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Banana Heart *(Musa Acuminate Colla)* bud crackers

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Abstract

This study developed Banana Heart Bud Crackers as a value-added, plant-based snack product utilizing banana heart bud as an underutilized local food resource. Specifically, the study aimed to determine the process involved in developing banana heart bud crackers, identify the required ingredients, tools, and equipment, assess the sensory acceptability of the processed product in terms of appearance, aroma, texture, and taste, and create Information, Education, and Communication (IEC) materials for knowledge dissemination. A research-and-development approach was employed to formulate and produce banana heart bud crackers through standardized preparation procedures, including raw material selection, cleaning and pre-treatment, mixing, shaping, cooking, and packaging. Documentation of the development process included step-by-step workflow descriptions and process notes to support product replication. The study also compiled a detailed inventory of ingredients and the necessary tools and equipment used during production to guide small-scale and community-based implementation. Sensory evaluation was conducted using a structured evaluation tool to gather acceptability ratings from selected evaluators, focusing on the product's appearance, taste, texture, and aroma. Findings indicated that banana heart bud crackers are feasible to produce and can achieve favorable sensory acceptability, with crisp texture and balanced flavor noted as key attributes when proper preparation and moisture control are applied. To support dissemination and adoption, IEC materials were developed highlighting the product concept, ingredient list, equipment needs, step-by-step processing guide, and basic quality and safety reminders. The study demonstrates the potential of banana heart bud crackers as an innovative snack alternative and a practical option for livelihood and microenterprise initiatives, while contributing to food resource utilization through product innovation.

Keywords: banana heart bud, cracker development, product innovation, sensory evaluation

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1. Introduction

Chips are widely consumed snack products commonly produced from thinly prepared plant materials that are fried or baked to achieve a crisp texture and low moisture content, which supports convenience and shelf stability for consumers (Starch in Food, 2024). Because chips readily accept added seasonings and flavor profiles and can be produced in small batches, they provide a practical platform for transforming locally available agricultural materials into value-added snack innovations. This flexibility is especially relevant in communities where plant resources are abundant but not consistently utilized for processed food products. One promising but often underutilized ingredient is the banana heart bud also referred to as banana blossom or banana inflorescence the edible flower structure of banana plants (*Musa* spp.). Recent literature describes banana inflorescence as an agricultural by-product with "untapped potential" for food and health applications and notes that it contains bioactive constituents such as phenolics and flavonoids that may support functional food development when appropriately processed (Senevirathna & Karim, 2024). Related reviews further emphasize that banana blossoms contain phytochemical constituents associated with antioxidant-related properties, strengthening the rationale for exploring banana heart bud beyond traditional culinary use and into value-added product development (Suffi et al., 2021).

In addition to compositional value, banana flower has been investigated for potential relevance to metabolic health. Experimental evidence reported beneficial effects of banana flower and pseudostem supplementation on hyperglycemia-related outcomes and on advanced glycation end-products (AGEs) in a diabetic animal model, indicating a scientific basis for continuing exploration of banana blossom as a functional food ingredient (Bhaskar et al., 2011). While health-oriented claims for new snack products must be carefully supported and appropriately scoped, these findings suggest that banana heart bud has properties worthy of further investigation as an ingredient in plant-based snack formulations. At the same time, for any novel snack innovation to be viable, consumer acceptance remains crucial; sensory analysis is therefore fundamental in product development because it captures how consumers perceive key quality attributes such as appearance, aroma, taste, and texture attributes that strongly influence liking and product choice (Ruiz-Capillas et al., 2021).

Developing banana heart bud chips also aligns with broader sustainability priorities by promoting more resource-efficient use of agricultural materials and supporting waste reduction, consistent with the intent of SDG 12 (Responsible Consumption and Production) (United Nations, n.d.-a). At the community level, value-adding local crops and by-products can contribute to livelihood opportunities consistent with SDG 8 (Decent Work and Economic Growth) while supporting food options that contribute to well-being consistent with SDG 3 (Good Health and Well-Being) (United Nations, n.d.-b, n.d.-c). To strengthen adoption beyond the research setting, translating standardized procedures and findings into Information, Education, and Communication (IEC) materials can support practical knowledge transfer and correct practice among intended users, including community producers, schools, and small enterprises (Food and Agriculture Organization of the United Nations [FAO], n.d.). In this context, transforming banana heart bud into a shelf-stable chips product offers a realistic pathway to improve local food utilization, reduce avoidable waste, and promote a locally sourced snack alternative compatible with community-based food innovation and sustainable food systems.

This study aimed to develop Banana Heart Bud (Musa acuminat Colla) Crackers and evaluate their acceptability as an innovative and value-added snack product. Specifically, it sought to determine the standardized process involved in the development of the crackers, identify the ingredients, tools, and equipment used in their preparation, and assess the sensory acceptability of the developed product in terms of appearance, aroma, texture, and taste. Additionally, the study aimed to create Information, Education, and Communication (IEC) materials to support knowledge dissemination and promote the product for potential community utilization and small-scale

enterprise development.

2. Methods

Research Design - The study utilized an experimental research-and-development design to develop Banana Heart Bud *(Musa acuminate Colla)* Crackers. Three different formulations with varying ingredient proportions and processing methods were prepared as treatments to determine the most acceptable product. Sensory evaluations focusing on appearance, taste, texture, and aroma were conducted using a 9-point hedonic scale with thirty (30) respondents composed of students, faculty members, and community residents. The data gathered from the evaluations were analyzed to determine the formulation that produced the most acceptable and potential market-ready Banana Heart Bud crackers.

Participants of the Study - The participants of this study consisted of thirty (30) individuals, including students, faculty members, and community residents. The participants were selected purposively to obtain varied perspectives on product acceptability. The group included ten (10) students, ten (10) faculty members, and ten (10) community members, all of whom served as sensory evaluators of the Banana Heart Bud *(Musa acuminate Colla)* crackers. The researcher assessed the product's sensory attributes appearance, aroma, texture, and taste using the prescribed evaluation tool, and their responses provided the primary data for determining the overall acceptability of the developed product.

Data Gathering Instrument - The data gathering instrument used in this study was a sensory evaluation questionnaire patterned after the 9-point Hedonic Scale developed by Peryam and Pilgrim (1957). The scale ranges from 1 (Dislike Extremely) to 9 (Like Extremely), with the middle points indicating varying degrees of liking or disliking. This instrument is widely used in sensory evaluation to measure consumer acceptability of food products based on key attributes such as appearance, aroma, texture, and taste. The participants' ratings served as the primary basis for determining the overall sensory acceptability and preferred formulation of the Banana Heart Bud *(Musa acuminate Colla)* crackers.

Data Gathering Procedure - The data gathering procedure for this study involved several steps to ensure the systematic development and evaluation of the Banana Heart Bud *(Musa acuminate Colla)* crackers. Fresh banana heart buds were collected from Barangay Cagbunga, Gainza, Camarines Sur and prepared through standard pre-processing procedures such as washing, boiling, slicing, and soaking. Three product formulations were then prepared by varying the proportions of ingredients and processing methods while maintaining the general preparation procedure. The banana heart bud was mixed with rice flour, garlic powder, onion powder, salt, pepper, and water, then molded and steamed for about 15 minutes. After steaming, the product was cooled, sun-dried for two to three days until adequately dry, and then fried to achieve the desired crispness before packaging. Sensory evaluation was conducted with thirty (30) purposively selected participants composed of ten (10) faculty members, ten (10) students, and ten (10) community residents who evaluated the crackers' appearance, taste, texture, and aroma using a 9-point Hedonic Scale ranging from 1 (Dislike Extremely) to 9 (Like Extremely). After the evaluation, all accomplished forms were collected, the responses were tallied, and the data were organized for analysis to determine the most acceptable formulation of the developed product.

Ethical Considerations - The ethical considerations for this study ensured the protection of participants' rights and well-being throughout the sensory evaluation of the Banana Heart Bud *(Musa acuminate Colla)* crackers. Informed consent was obtained from all participants after explaining the purpose of the study, the procedures involved, and any minimal risks associated with tasting the samples. Participation was voluntary, and confidentiality was maintained by keeping all responses anonymous and using the collected data strictly for research purposes. Participants were also informed that they could withdraw from the study at any time without any consequence. The safety of the product samples was ensured through proper sanitation, safe food handling, and clean preparation and serving practices during the evaluation. Additionally, the study supported sustainability by utilizing locally available banana heart buds and promoting their value-added use, which contributes to reducing

food waste and supporting community-based food innovation.

Data Analysis **-** The data analysis for this study involved the evaluation of sensory data gathered from the respondents. The responses from the sensory evaluation forms were analyzed using the weighted mean to determine the overall acceptability of the Banana Heart Bud *(Musa acuminate Colla)* crackers. Each sensory attribute appearance, aroma, texture, and taste was rated using a 9-point Hedonic Scale, and the average ratings were computed for each treatment. The mean scores for each attribute were then calculated and compared to determine the most acceptable formulation. The treatment that obtained the highest overall mean score was considered the most preferred formulation of the developed Banana Heart Bud crackers.

3. Results and Discussion

Development of the Product - The development of Banana Heart Bud *(Musa acuminate Colla)* Crackers was guided by the goal of creating a nutritious, innovative, and value-added snack product using locally available banana heart buds through a simple and practical production process. A research-and-development (R&D) approach was applied, and the product was refined through several kitchen trials, testing, and modifications to improve the quality and acceptability of the crackers. The procedure began with the collection of fresh banana heart buds from Barangay Cagbunga, Gainza, Camarines Sur, followed by pre-processing such as washing, boiling, slicing, and soaking to remove impurities and reduce bitterness. The prepared banana heart bud was then combined with rice flour, garlic powder, onion powder, salt, pepper, and water to form a uniform mixture. The mixture was molded and steamed, cooled, sun-dried for two to three days to remove moisture, and finally fried to achieve the desired crisp texture.

In Trial 1, the initial formulation used higher proportions of rice flour and smaller amounts of seasoning. After the kitchen test, the crackers were found to have a bland taste and less desirable crispness. The texture was also observed to be slightly coarse, which was attributed to the proportion of flour and limited seasoning. As a result, adjustments were made in the succeeding trial by increasing the amount of seasonings and modifying the ingredient proportions to enhance the flavor and texture of the product. In Trial 2, the proportions of garlic powder and onion powder were increased, and the amount of rice flour was slightly reduced while maintaining the same basic preparation procedure. This adjustment aimed to enhance the flavor and improve the eating quality of the crackers. Although the second trial produced better results compared to the first, the product still required improvement in taste and texture. Finally, Trial 3 further adjusted the ingredient proportions by increasing the seasonings and reducing the flour content while modifying the drying and molding process. The result produced crackers with improved crispiness, balanced flavor, and more acceptable texture. Among the three trials, Trial 3 obtained the most desirable characteristics and was selected as the final formulation for sensory evaluation. Each trial was carefully documented until the most suitable formulation and preparation process were achieved, supporting the development of a potential market-ready Banana Heart Bud crackers product.

Materials Used in the Preparation of the Product – The materials used in the preparation of Banana Heart Bud *(Musa acuminate Colla)* Crackers consisted of both the ingredients required for the formulation and the tools and equipment necessary to ensure accurate measurement and proper processing. The study utilized banana heart bud as the primary ingredient, which was combined with rice flour, garlic powder, onion powder, black pepper, iodized salt, and water to produce the mixture used in forming the crackers. The banana heart bud served as the core raw material of the product, while rice flour acted as the base ingredient that helped bind the mixture and create the structure of the crackers. Seasonings such as garlic powder, onion powder, black pepper, and iodized salt were added to enhance the flavor and improve the overall palatability of the product. Oil was used during the frying process to achieve the desired crisp texture of the crackers.

To ensure consistency and proper preparation, several tools and equipment were utilized during the production process. A chopping board and kitchen knife were used to cut and prepare the banana heart bud. Measuring cups and measuring spoons were used to obtain accurate amounts of ingredients, while a mixing bowl served as the

container for combining the ingredients into a uniform mixture. A steamer was used to cook the molded mixture before the drying process. A molder was utilized to shape the mixture into uniform portions, and a cooling rack or tray was used during the sun-drying process to remove excess moisture from the product. Finally, a frying pan or stove was used to fry the dried crackers, and the finished product was allowed to cool before packaging. These materials supported the standardized preparation of Banana Heart Bud crackers by ensuring proper measurement, preparation, processing, and cooking to produce a crisp and acceptable snack product.

Table 1

Sensory Evaluation of Heart Bud (Musa acuminate Colla) Crackers

Sensory parameters	T1	T2	T3
Appearance	6.3	7.4	8.3
Aroma	6.2	6.6	7.2
Texture	6.1	7.5	8.4
Taste	5.5	6.8	8
Mean	6.02	7.07	7.9

Legendary: 1.00-1.89= Dislike Extremely, 1.90-2.78= Dislike Very Much, 2.79-3.67= Dislike Moderately, 3.68-4.56= Dislike Slightly, 4.57-5.45= Neither like nor dislike, 5.46-6.34=Like Slightly, 6.35-7.23= Like Moderately, 7.24-8.12=Like Very Much. 8.13-9.01=Like Extremely

Table 1, presents the distribution of the respondents who participated in the sensory evaluation of the Banana Heart Bud *(Musa acuminate Colla)* crackers. A total of thirty (30) evaluators were selected through purposive sampling and were composed of three equal groups: ten (10) faculty members, ten (10) students, and ten (10) community residents from Barangay Cagbunga, Gainza, Camarines Sur. Each group represented 33.33% of the total participants, indicating a balanced composition of evaluators. This table is important because it shows that feedback on the product's appearance, taste, texture, and aroma was obtained from different sectors, allowing the study to capture varied perceptions and preferences for a more reliable assessment of the overall acceptability of the Banana Heart Bud crackers.

Appearance - The sensory evaluation results of the Banana Heart Bud (*Musa acuminate Colla*) crackers showed that the appearance scores for each treatment were T1 = 6.3, T2 = 7.4, and T3 = 8.3 based on the 9-point Hedonic Scale. These results indicate that the visual quality of the product was generally acceptable across all treatments, with T3 obtaining the highest mean score for appearance. The results demonstrate a clear improvement in appearance from T1 to T3 (6.3 → 7.4 → 8.3), suggesting that the later formulation produced crackers with better visual appeal. This improvement may be attributed to better thickness consistency, more uniform color, and improved crispness of the final product after steaming, drying, and frying. These visual characteristics are important in snack products because consumers often judge the quality and attractiveness of food based on its appearance before tasting it.

In product development, visual attributes such as color, shape, and texture play an important role in influencing consumers' first impressions and willingness to try a new product. Crackers that appear evenly shaped, thin, and golden-brown are generally perceived as crisp and of higher quality. Therefore, the improved appearance of the product in Treatment 3 likely contributed to its higher acceptability among the evaluators. The importance of appearance in food acceptability is supported by previous studies. According to Sánchez and Barrachina (2021), visual attributes significantly influence consumer perception of food quality and can affect purchasing decisions. Similarly, Relloso (2025) emphasized that the visual appeal of a developed food product—such as color, uniformity, and presentation—plays a significant role in shaping consumer acceptance and overall product evaluation during sensory testing. This supports the finding that the higher appearance rating of Treatment 3 reflects improved visual acceptability, which may enhance consumer interest and increase the product's potential as a marketable snack item (Relloso, 2025).

Aroma - The sensory evaluation results for the Banana Heart Bud *(Musa acuminate Colla)* crackers showed that the aroma scores for each treatment were T1 = 6.2, T2 = 6.6, and T3 = 7.2 using the 9-point Hedonic Scale. Based on the hedonic interpretation, these mean scores fall within the "Like Slightly" to "Like Moderately" categories, indicating that the respondents generally had a favorable perception of the aroma across all treatments. Among the three formulations, Treatment 3 obtained the highest aroma rating, while Treatment 1 received the

lowest mean score. The gradual increase in scores from T1 to T3 suggests that the adjustments made in the ingredients and processing methods improved the aromatic quality of the crackers. The higher aroma rating in T3 may be attributed to the balanced combination of banana heart bud and seasonings such as garlic powder and onion powder, which contributed to a more pleasant and appealing smell during frying and tasting.

This result indicates that aroma played a supportive role in the overall sensory acceptability of the product. Although the differences among treatments were not extremely large, the increasing scores suggest that improvements in formulation and processing helped enhance the aromatic profile of the crackers. Aroma is an important sensory attribute because it influences the consumer's expectation of flavor and quality even before the product is tasted. A pleasant smell can stimulate appetite and increase interest in trying the product. The importance of aroma in food acceptability is supported by previous studies. Research by Spence et al. (2015) explains that aroma significantly contributes to flavor perception and can influence consumer preference and eating behavior. Similarly, studies in sensory science indicate that aroma-related cues play an essential role in shaping the overall eating experience and product quality perception. These findings support the result that the improved aroma score of Treatment 3 indicates a more appealing sensory profile, which contributes to the overall acceptability and potential market appeal of the Banana Heart Bud crackers.

Texture - The sensory evaluation results for the Banana Heart Bud *(Musa acuminate Colla)* crackers showed that the texture scores for each treatment were T1 = 6.1, T2 = 7.5, and T3 = 8.4 based on the 9-point Hedonic Scale. These ratings indicate that respondents generally liked the texture of the product across all treatments, with scores ranging from "Like Slightly" to "Like Very Much." Among the three formulations, Treatment 3 received the highest mean score for texture, followed by Treatment 2, while Treatment 1 obtained the lowest rating. The data show a noticeable improvement from T1 to T3 (6.1 → 7.5 → 8.4), suggesting that the later formulation produced a more desirable crispness and mouthfeel. This improvement may be attributed to adjustments in ingredient proportions and the drying process, which contributed to a thinner, crispier cracker after frying.

Texture is a critical sensory attribute for snack products such as crackers because consumers generally expect them to be crunchy and crisp. Products with a firm and crispy texture are often associated with freshness and better eating quality. Therefore, the higher texture rating in Treatment 3 indicates that this formulation achieved the most acceptable crispness and mouthfeel among the samples evaluated by the respondents. The importance of texture in snack acceptability is supported by previous studies. Research by Weng and Du (2020) explains that crispiness plays a major role in consumer satisfaction with snack foods, as crunchy textures are often associated with higher product quality. Similarly, Xie et al. (2021) emphasized that texture-related sensory perception significantly influences consumer preference and overall food acceptability. These findings support the results of the study, showing that the higher texture score of Treatment 3 contributed to the improved sensory acceptability of the Banana Heart Bud crackers and strengthened their potential as a desirable snack product.

Taste – The sensory evaluation results for the Banana Heart Bud *(Musa acuminate Colla)* crackers showed that the taste scores for each treatment were T1 = 5.5, T2 = 6.8, and T3 = 8.0 based on the 9-point Hedonic Scale. According to the scale descriptors, T1 falls within the "Neither Like nor Dislike" to slightly acceptable range, T2 falls under the "Like Slightly" category, while T3 approaches the "Like Very Much" level of acceptability. The results indicate a clear improvement in taste from T1 to T3 (5.5 → 6.8 → 8.0), suggesting that the adjustments made in the third formulation significantly improved the flavor balance and overall palatability of the crackers. The higher score of T3 implies that the combination of banana heart bud and seasonings such as garlic powder and onion powder produced a more appealing flavor that was preferred by the evaluators.

Taste is one of the most important sensory attributes influencing consumer acceptance of snack products. Consumers generally prefer snacks that provide a balanced and pleasant flavor, and improvements in seasoning and ingredient proportions can greatly enhance the eating experience. The higher taste rating obtained by Treatment 3 suggests that this formulation successfully achieved a more desirable flavor profile, making it more satisfying to the respondents compared to the earlier treatments. The importance of taste in food acceptability is

supported by previous studies. Research by Schneider and Pitt (2019) emphasizes that taste plays a central role in food preference and consumption behavior, as it directly influences consumer satisfaction and repeat purchase decisions. Similarly, studies on snack food products indicate that well-balanced seasoning and flavor significantly improve consumer liking and product marketability. These findings support the result that the improved taste score of Treatment 3 contributed to the higher overall acceptability of the Banana Heart Bud crackers and strengthened their potential as a marketable snack product.

Information, Education, and Communication (IEC) Material - The Information, Education, and Communication (IEC) material developed in this study took the form of a flyer intended to promote Banana Heart Bud *(Musa acuminate Colla)* Crackers and raise awareness about the product. The flyer was designed to provide concise and audience-friendly information about the crackers, including their origin, preparation process, nutritional value, and potential health benefits. The information was presented using a visually appealing layout with clear text and images to effectively communicate the product's value and attract the attention of potential consumers. The flyer served as both an educational and promotional tool targeted for distribution to key stakeholders such as local consumers, students, community members, small-scale food entrepreneurs, and local organizations who may support the adoption, production, and consumption of the product. To increase reach and accessibility, dissemination of the IEC material was planned through both physical distribution and digital sharing. Physical distribution may include community events, school activities, product demonstrations, and tasting activities, while digital sharing may involve institutional social media platforms, email communication, and local information channels. The development of the IEC material was intended not only to promote the product but also to translate the results of the research into a practical and community-oriented resource that supports awareness, knowledge dissemination, and potential adoption of the Banana Heart Bud crackers as an innovative and sustainable snack product. The IEC flyer contributes to making the product innovation more transferable and understandable to stakeholders by packaging key information in a format commonly used for public education and awareness-building, and recent public health literature recognizes print media as a practical channel that can shape awareness when integrated thoughtfully with other communication approaches (Kanchan et al., 2024).

4. Conclusions and Recommendation

This study successfully developed Banana Heart Bud *(Musa acuminate Colla)* Crackers through a research-and-development approach that documented a standardized production procedure and identified the necessary ingredients, tools, and equipment required for preparation. The step-by-step process from raw material preparation, mixing, steaming, sun-drying, and frying proved feasible and replicable for small-scale production and community-based food processing. The sensory evaluation results demonstrated that the developed crackers were generally acceptable to the thirty (30) evaluators in terms of appearance, taste, texture, and aroma. Among the three treatments, the third formulation obtained the highest overall ratings across most sensory attributes, indicating better flavor balance, improved crispiness, and more appealing appearance. These results suggest that adjustments in ingredient proportions and processing methods significantly influenced the sensory acceptability of the product. The development of the Information, Education, and Communication (IEC) material further strengthened the study by presenting the product innovation in a user-friendly format suitable for awareness building and knowledge dissemination. The IEC flyer supports potential adoption of the product by local communities, students, and small-scale food entrepreneurs interested in developing value-added food products using locally available resources.

Based on the findings of the study, it is recommended that future research conduct shelf-life testing to determine the storage stability and safety of the Banana Heart Bud crackers under different packaging and environmental conditions. Further studies may also explore additional flavor variations or seasoning formulations to enhance consumer appeal and improve market competitiveness. Increasing the number and diversity of sensory evaluators is also recommended to strengthen the reliability and generalizability of the acceptability results. A comprehensive nutritional analysis is likewise suggested to determine the detailed nutrient profile of the product and support potential health-related claims. Lastly, the developed IEC materials may be further enhanced into

digital formats, training modules, or community workshops to promote wider dissemination and encourage microenterprise development within local communities.

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