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UTILIZATION OF BANANA STEM (Musa paradisiaca L.) As A RAW INGREDIENT FOR CHIP PRODUCTION: CONSUMER RESPONSE ANALYSIS AND ECONOMIC VALUE POTENTIAL

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ABSTRACT

Banana stem or banana pith (Musa paradisiaca L.) is an often underutilized part of the banana plant, despite its high content of dietary fiber and polyphenols. This study aims to process banana stems into flour and use it as a base ingredient for producing chips, as well as to evaluate the product's quality based on sensory aspects and economic feasibility. The research method involves the process of banana stems flour production, mixing it with tapioca flour in various proportions, and conducting organoleptic testing with 22 panelists, consisting of academics and the general public. The results indicate that the optimal formulation is achieved with a 50% banana stem flour and 50% tapioca flour ratio. Quality testing showed that 95.4% of panelists rated the chips as savory with a distinct banana stem flavor, 100% agreed the color was brown and met the standard, 100% found the texture to be crisp and crunchy, and 97% considered the oval shape ideal. From an economic perspective, the production of these chips incurs a cost of IDR 50,000 per batch, with a selling price of IDR 1,500 per package and a net profit of IDR 1,450,000 per month. SWOT analysis and business strategy indicate that banana stem chips have potential for development as a home-based industry product with promising market prospects. In conclusion, the utilization of banana stems as a base ingredient for chips not only provides an innovative food alternative but also offers a competitive economic value.

Keywords: Banana Stem, Chip, Flour, Food, Raw Ingredient.

INTRODUCTION

Indonesia, particularly the Special Region of Yogyakarta (DIY), possesses natural potential that supports the growth of various plant species, including banana plants, with a recorded 292 banana cultivars (Dinas Pertanian dan Pangan, 2021). The banana plant (*Musa paradisiaca*) is commonly found in home gardens, along the edges of rice fields, or in plantations. It thrives in both lowland and highland areas up to an altitude of 1,000 meters above sea level and prefers open environments with ample sunlight. Bananas are highly nutritious as a food source, providing essential vitamins, minerals, and carbohydrates (Ghag & Ganapathi, 2017).

The most widely cultivated banana variety in the Special Region of Yogyakarta (DIY) is the *Kepok* banana. This variety is one of Indonesia's primary local banana cultivars with high economic value (Wahyudi et al., 2022). The nutritional composition of bananas includes carbohydrates (22.84 g/100 g), providing approximately 370 kJ/100 g of energy, and

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they are considered one of the best sources of potassium (358 mg/100 g), fulfilling 8% of the recommended daily intake (Ranjha et al., 2020).

Jatimulyo Village, located in Bantul Regency, possesses significant potential for banana cultivation. Nearly every household yard, as well as the corners of rice fields and plantations, is planted with banana trees. In terms of utilization, the local community primarily makes use of the fruit, leaves, banana blossom, and pseudostem. For instance, the fruit can be consumed directly or processed into fried bananas, grilled bananas, banana chips, and other products (Silvestre et al., 2016; Netshiheni et al., 2019). The leaves are commonly used for food decoration by creating various folded designs and as natural food wrappers. Furthermore, banana by-products, such as peels, leaves, pseudostems, stalks, and flowers, hold substantial potential for various food and non-food applications (Padam et al., 2021).

The banana stem is the least utilized part of the plant. Traditionally, the local community has only processed it into *Tum* (a type of side dish prepared using a steaming technique and wrapped in banana leaves), but even this practice remains uncommon. More frequently, banana stems are either used as animal feed or discarded. Despite its potential, the banana stem has not been widely recognized as a valuable commodity, even though it is a rich source of dietary fiber and polyphenols, which offer significant health benefits (Bhaskar et al., 2012). Moreover, its high carbohydrate content makes it a promising alternative to rice, particularly given its substantial caloric value, which serves as an energy source. Although the banana stem has great potential for food processing, its low starch content necessitates blending with tapioca flour, which has a higher starch concentration, to improve its functional properties.

Chips are among the most popular snacks across all age groups due to their savory taste and affordability (Adirestuty et al., 2021). Moreover, chips (*krupuk*) serve as both a snack and a complementary side dish when consumed with rice (Sadiq et al., 2021). One of the potential ingredients for chip production is banana stem, which can be utilized as a local food commodity with competitive market potential while also contributing to food security (Lau et al., 2021). Moreover. this ingredient also fulfills the halal requirement, the use of halal ingredients further enhances consumer confidence in this product (Setiawan et al., 2024). Establishing banana stem chips as a home-based industry can not only improve household income but also enhance competitiveness in the global market.

In industrial development strategies, fostering innovative and creative home-based industries involves utilizing underutilized natural resources to create valuable and functional products (Setiawan et al., 2025). Processing banana stems into chips represents an approach to repurposing an often-discarded part of the banana plant. The development of alternative food products derived from various plants in Indonesia can contribute to food security while simultaneously expanding opportunities for micro, small, and medium enterprises (MSMEs).

RESEARCH METHODOLOGY

Ingredients

The primary raw ingredient used is banana stem, selected from healthy plants with a white color and no reddish spots. The stem is then processed into flour. The banana stems are sourced from Jatimulyo Village, Bantul Regency. Additional supporting ingredients include tapioca flour (250g), garlic (10g), shallots (10g), pepper (1/4 tsp), eggs (2), salt (20g), granulated sugar (10g), slaked lime (50g), water (50ml), and cooking oil (1/2 liter).

Banana Stem Flour Processing

The process of producing banana stem flour begins with peeling, cleaning,

and finely grating the banana stem. The grated stem is then soaked in water mixed with slaked lime, drained, and sun-dried until completely dry. Subsequently, the dried stem is ground into flour and sieved to achieve a fine consistency.

Figure 1. Process of Making Banana Stem Chips

The banana stem flour is mixed with tapioca flour and other ingredients, including pepper, garlic, shallots, sugar, salt, eggs, and water, until a uniform dough is formed. The dough is then placed into ¼ kg plastic containers and sealed. Subsequently, it is boiled for 60 minutes until fully cooked and its color changes. Once cooked, the dough is removed, cooled for 12 hours, and then thinly sliced into 2–3 mm pieces using a chip slicing machine. The sliced dough is then sun-dried for approximately two days until completely dry. Finally, the dried chips are deep-fried until fully cooked and attain a golden-brown color.

Experimental Design

In this study, repeated trials (pre-experiment) were conducted. This stage was conducted to obtain better banana stem chips. The pre-experiment stage was conducted 3 times, such as:

1. The first pre-experiment was carried out on November 4th, 2024, using 500 grams of banana stem flour without a mixture of tapioca flour.
2. The second pre-experiment was conducted on November 6th, 2024, using 375 grams of banana stem flour and 125 grams of tapioca flour.
3. The third pre-experiment was conducted on November 8th, 2024, using 250 grams of banana stem flour and 250 grams of tapioca flour.

RESULTS AND DISCUSSION

The preparation of banana stem chips follows the standard recipe for making chips in general. However, this study made slight modifications to the processing and ingredients used. Using the standard general recipe for banana stem chips resulted in chips that did not expand properly and had a bitter taste. After conducting three experimental trials and referring to the percentage and categories of the banana stem chip quality test, the formulation consisting of 50% banana stem flour and 50% tapioca flour was established as the standard recipe for banana stem chips.

Banana Stem Chips Quality

In this study, a quality test of banana stem chips was conducted, evaluating aspects such as taste, color, texture, and shape. The testing took place from November 12-14, 2024, with 22 panellists consisting of culinary faculty members, students, and the public. The tabulation of the quality benchmark data for the banana stem chips can be found in Table 1.

Table 1. Banana Stem Chip Benchmark

Value	Taste	Color	Texture	Shape
3	Savory, typical of banana stems	Brown	Crispy and crunchy	Oval
2	Salty, typical of banana stems	Black	Less crispy and less crunchy	Elongated
1	All criteria not met	All criteria not met	All criteria not met	All criteria not met

The processed banana stem chips will undergo quality testing by panellists or respondents. Product testing with panellists is essential to assess consumer acceptance of the product and can serve as an evaluation for improvements in product development (Khosyiati et al., 2024). The results of the respondents' assessments are presented in Table 2.

Table 2. Data on the Results of Banana Stem Chip Quality Tests

Panelists	Aspect assessed			
	Taste	Color	Texture	Shape
1	3	3	3	3
2	3	3	3	3
3	2	3	3	3
4	3	3	3	3
5	3	3	3	3
6	3	3	3	3
7	2	3	3	3
8	3	3	3	3
9	3	3	3	3
10	3	3	3	3
11	3	3	3	3
12	2	3	3	2
13	3	3	3	2
14	3	3	3	3
15	3	3	3	3
16	3	3	3	3
17	3	3	3	3
18	3	3	3	3
19	3	3	3	3
20	3	3	3	3
21	3	3	3	3
22	3	3	3	3
Total	63	66	66	64

After conducting a series of quality tests on banana stem chips, a percentage analysis was conducted for four main aspects, namely taste, color, texture, and shape. The results of the percentage calculation of the quality test for the taste aspect of banana stem chips using the following formula:

1. Taste Quality of Banana Stem Chips

$$N = \frac{\sum X}{SMI} \times 100\%$$

$$N = \frac{63}{66} \times 100\% = 95{,}4\%$$

Visualization of the percentage results of the banana stem chip taste quality test can be seen in Figure 2.

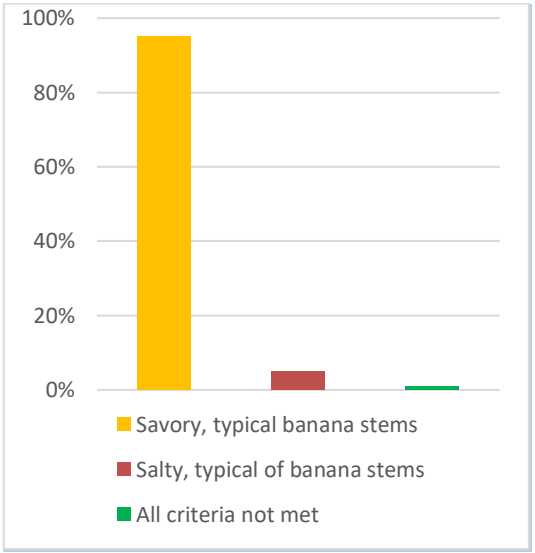

Figure 2. Percentage Diagram of Taste Quality of Banana Stem Chips

Based on the calculation of the quality test for the taste of banana stem chips, a percentage of 95.4% was obtained, which can be categorized as "very good." This indicates that, in terms of taste, the banana stem chips almost meet the standard criteria for chips, as they possess a savory flavor with a characteristic taste of banana

stem. This savory flavor is achieved through the combination of ingredients and seasonings such as salt, pepper, and sugar. In addition to acting as a natural preservative, sugar also functions as a flavor enhancer, a nutritional value booster, a color modifier (through caramelization), and a thickening agent. The characteristic taste of the banana stem is derived from the banana stem itself, which has a slightly bitter and fibrous taste. The bitterness of the banana stem is caused by the presence of *tannins* and *polyphenols*. However, to reduce this bitterness, a special processing technique is required, which involves soaking the banana stem in a limewater solution.

2. The Quality of Banana Stem Chips Color

$$N = \frac{\sum X}{SMI} \times 100\%$$

$$N = \frac{66}{66} \times 100\% = 100\%$$

The diagram depicting the percentage results of the color quality test for banana stem chips is shown in Figure 3.

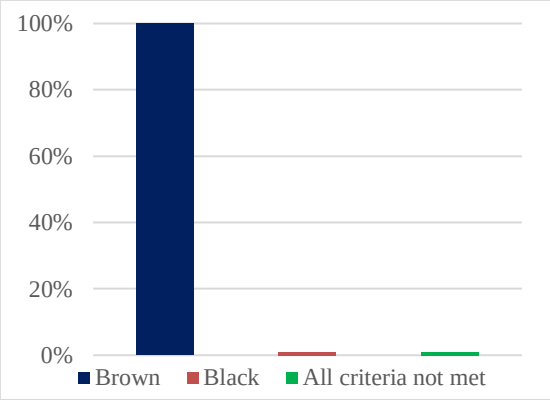

Figure 3. Percentage Diagram of Banana Stem Chip Color Quality

Based on the quality test calculation of the banana stem chips from the color aspect, a percentage of 100% was obtained, which falls into the "excellent" category. This indicates that, in terms of color, the banana stem chips meet the established standards, exhibiting a brown color derived from the use of brown banana stem flour. The brown color is caused by the presence of phenolic compounds, which, when exposed to air, result in a browning effect on the banana stem when peeled or cut. Additionally, the brown color of the banana stem chips is also influenced using sugar and the heating process, which causes the sugar to caramelize and produce a brown color. The diagram depicting the texture quality test results for banana stem chips is shown in Figure 4.

3. Texture Quality of Banana Stem Chips

$$N = \frac{\sum X}{SMI} \times 100\%$$

$$N = \frac{66}{66} \times 100\% = 100\%$$

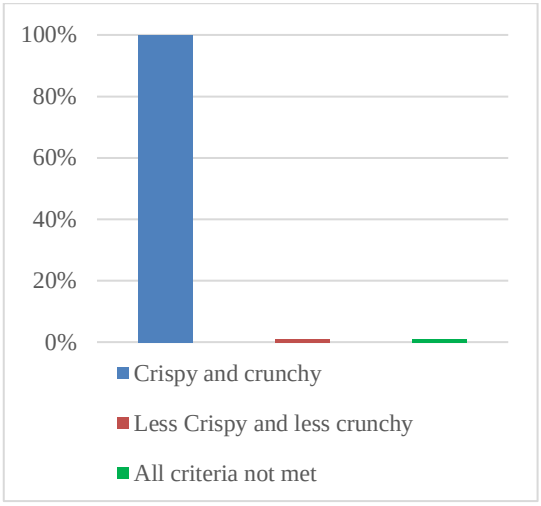

Figure 4. Percentage Diagram of Texture Quality of Banana Stem Chips

Based on the quality test calculations of the banana stem chips from the texture aspect, a 100% percentage was obtained, indicating that it falls under the "excellent" category. This demonstrates that, in terms of texture, the banana stem chips meet the quality standards for chips, as they possess a crispy and crunchy texture. The crispy and crunchy texture of the banana stem chips is influenced by the ingredients used in their production, particularly the leavening agents. The leavening agent used in the production of banana stem chips is eggs. Furthermore, when assessed through touch and sight, the texture of the banana stem chips is rough and fibrous. The rough and fibrous texture is caused by the characteristics of the banana stem, which contains a significant amount of fiber. The percentage diagram of the quality test for banana stem chips is shown in Figure 5.

4. Quality of Banana Stem Chips Shape

$$N = \frac{\sum X}{SMI} \times 100\%$$

$$N = \frac{64}{66} \times 100\% = 97\%$$

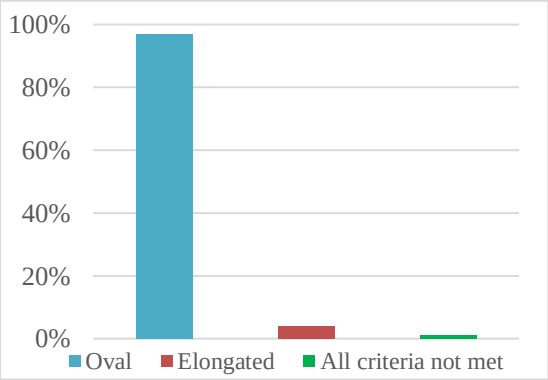

Figure 5. Percentage Diagram of Banana Stem Chip Shape Quality

Referring to the calculation of the quality test based on the shape aspect, a percentage of 97% was obtained, indicating that the product is in very good condition. This shows that, in terms of shape, the banana stem chips nearly meet the standard quality criteria for chips, as they are oval-shaped. The oval shape is achieved using a ¼ kg mold/plastic. The use of this oval mold ensures uniform thickness and size.

5. Based on the percentage of the results of the banana stem chip quality test in taste, color, texture, and shape aspects, the survey results can be seen in Figure 6.

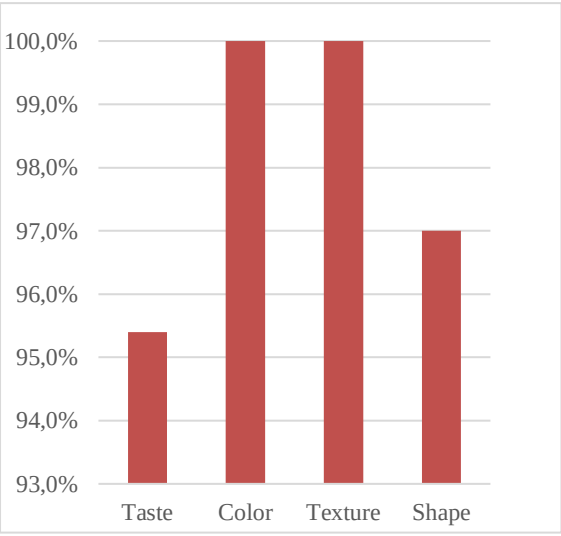

Figure 6. Percentage Diagram of Banana Stem Chip Quality

Based on the collective results of the quality tests for banana stem chips, the findings indicate that 95.4% of the samples met the quality standards for taste, placing it in the "very good" category. For color, 100% of the samples were rated as "excellent," and the same percentage (100%) in the texture aspect. Regarding shape, 97% of the samples were classified in the "very good" category.

Cost and Price Calculation

The product offered is Banana Stem Chips, with an estimated cost of IDR 1,000 per package, which will be sold for IDR 1,500. This results in a profit of IDR 500 per package. Referring to the analysis in Table 3, the profit for a day, assuming 100 packages are sold, is IDR 500 x 100 packages, resulting in IDR 50,000. Therefore, the average monthly profit (calculated based on 30 effective days) is 30 x IDR 50,000, totalling IDR 1,500,000. This profit will be reduced by several costs, including ingredient costs of IDR 50,000 per production cycle. Thus, the net profit obtained each month is IDR 1,450,000.

Table 3. Production Cost Calculation

Ingredient	Price	Quantity	Price
Banana Stem	Free (found in nature and not fully utilized)	1000 gram	IDR -
Flour and Seasoning	IDR 50,000.00	1 x Production	IDR 50,000.00
Total Production Cost			IDR 50,000.00

CONCLUSION

Based on the findings of this study and the business potential of banana stem chips, it can be concluded that the production process begins with the preparation of banana stem flour, which is then mixed with tapioca flour and various seasonings to form a cohesive dough. The

dough is subsequently molded onto trays, followed by steaming, slicing, drying, and frying. The quality assessment conducted by 22 panelists across four aspects yielded the following results, including 95.4% for taste (savory and characteristic of banana stem chips) with a total score of 63, 100% for color (brown, meeting standard expectations) with a total score of 66, 100% for texture (crisp and crunchy) with a total score of 66, and 97% for shape (oval, considered ideal) with a total score of 64. The data indicate that the majority of panelists assigned the highest rating (3) for all aspects, with a few exceptions—panelists 3, 7, and 12 rated the taste aspect with a score of 2, while panelists 12 and 13 rated the shape aspect with a score of 2. The business potential of banana stem chips as a home industry is highly promising, given the strong market demand and relatively low competition. The estimated monthly profit is projected to reach IDR 1,450,000.

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