

DEVELOPMENT OF STEAMED BROWNIES BASED ON ARROWROOT POWDER AS AN INNOVATIVE GLUTEN-FREE PASTRY PRODUCT: SENSORY QUALITY

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Abstract. This study aims to develop steamed brownies based on arrowroot powder as an innovative gluten-free pastry product and to determine the resulting sensory quality. This product development is motivated by the increasing public demand for gluten-free food products and the use of local food ingredients, particularly arrowroot powder (*Maranta arundinacea* L.), as an alternative to wheat flour in bakery and pastry products. This study used an experimental method with a descriptive quantitative approach. Steamed brownies were made using arrowroot starch as the main ingredient to replace wheat flour. The data collection of this study was carried out through sensory (organoleptic) testing involving panelists and assessing several aspects such as color, aroma, texture, and taste. The data obtained were analyzed quantitatively and descriptively to determine the panelists' acceptance of arrowroot starch-based steamed brownies. The results showed that steamed brownies made using arrowroot starch produced a gluten-free product with good sensory characteristics and were acceptable to the panelists. The product had an attractive brown color, a distinctive chocolate aroma, a relatively soft texture, and a taste favored by the panelists. These results indicate that arrowroot starch has good potential as an alternative ingredient to wheat flour in the development of gluten-free pastry products. This research is expected to support the use of local food ingredients and encourage innovation in healthier and more value-added pastry products.

Keywords: arrowroot starch, gluten-free, innovative pastry, sensory quality, steamed brownies

INTRODUCTION

The bakery and pastry industry is a culinary sector that continues to grow along with increasing public interest in innovative and value-added food products (Sari et al., 2026). Products such as cakes, cookies, and brownies serve not only as desserts but have also become part of the modern lifestyle. Brownies are a popular product due to their distinctive chocolate flavor, soft texture, and ease of creation with various additional ingredients. Brownies are generally made using wheat flour, which contains gluten, a protein resulting from a combination of glutenin and gliadin that plays a role in forming the elastic structure of the dough, resulting in a stable texture (Suyatno et al., 2025). However, not everyone can consume gluten, especially those with celiac disease or gluten sensitivity,

which can cause digestive disorders (Suesilowati et al., 2024). This situation has driven a growing demand for gluten-free food products along with increasing public awareness of a healthy lifestyle.

One alternative ingredient that has the potential to replace wheat flour is arrowroot starch (*Maranta arundinacea* L.), a local food ingredient characterized by its white color, fine texture, easy digestion, and gluten-free nature (Ramadhani & Rahmawati, 2022). Utilizing arrowroot starch can also support national food diversification and reduce dependence on wheat imports, while providing economic value for local communities (Praseptiangga et al., 2023). In developing bakery products based on alternative ingredients, steamed brownies are a potential product due to their softer texture and relatively simple manufacturing process (Anggareta, 2022). Furthermore, arrowroot starch has the ability to form a gel, potentially producing the desired texture in brownies (Pertiwi et al., 2023). However, the use of arrowroot starch as a complete substitute for wheat flour can affect product characteristics, particularly texture, taste, aroma, and color, which are important factors in consumer acceptance.

Although several studies have examined the use of alternative ingredients in bakery products, the development of arrowroot starch-based steamed brownies as a gluten-free product has not been widely conducted in depth, especially those that comprehensively review sensory quality. Therefore, further research is needed to determine the sensory characteristics and consumer acceptance of arrowroot starch-based steamed brownies. Based on this description, this study aims to develop arrowroot starch-based steamed brownies as an innovative gluten-free pastry product and evaluate sensory qualities including color, aroma, texture, and taste, so that a food product can be produced that is not only healthy but also has a good level of acceptance in the community.

LITERATURE REVIEW

Brownies are a popular pastry product originating from the United States, characterized by a dense texture, strong chocolate flavor, and a distinctive aroma that is loved by many (Karimah et al., 2024). Over time, brownies have evolved, not only by baking but also by steaming, known as steamed brownies. Steamed brownies have a softer and moister texture because the cooking process uses hot steam, which allows the dough to cook evenly without over-drying (Wijana, K. A. A., & Koeswriyono, D. P., 2025). The main ingredients used in making brownies include wheat flour, eggs, sugar, fat, and chocolate, each of which plays an important role in shaping the product's structure, flavor, aroma, and moisture (Wijana, K. A. A., & Koeswriyono, D. P., 2025). Steamed brownies also have the advantage of being easy to make because they don't require an oven. However, when developing alternative ingredients, careful attention must be paid to the formulation balance to avoid a crumbly or overly dense texture.

Arrowroot powder (*Maranta arundinacea* L.) is a local food ingredient derived from tuber plants and has great potential as an alternative to wheat flour (Setyaningrum, N. M. A., & Adi, A. C., 2022). This starch is characterized by its white color, very fine texture, and good gel-forming ability when heated with water. In addition, arrowroot starch is easily digested, making it suitable for consumption by various age groups, including individuals with digestive disorders (Marjan, L. U., 2022). The main advantage of arrowroot starch is that it does not contain gluten, so it can be used in the development of gluten-free food products for people with gluten intolerance or celiac disease (Azizah, L. I. A., & Rahmawati, F., 2025). The use of arrowroot starch also supports food diversification based on local resources and has the potential to increase the economic value of domestic commodities.

Gluten-free food products are foods that do not contain the protein gluten, commonly found in wheat, barley, and rye. These products were originally developed for people with celiac disease, an autoimmune disorder that causes intestinal damage due to gluten consumption (Izzati, M. L., 2025). However, in recent years, gluten-free products have gained increasing popularity among the general public because they are considered healthier and easier to digest (Waziroh et al., 2023). Gluten-free product development typically involves replacing wheat flour with alternative ingredients such as rice flour, corn, cassava, sorghum, or starch from tubers such as arrowroot. However, the absence of gluten can affect the product's structure and texture, requiring precise formulation to maintain good product quality and consumer acceptance (Waziroh et al., 2023).

Sensory quality is a crucial aspect in assessing food product quality because it is directly related to consumer acceptance. Sensory analysis is conducted to evaluate product characteristics based on human sensory responses, such as sight, smell, taste, and touch (Rita Hayati et al., 2025). The attributes assessed include color, aroma, texture, and taste, where color is the first impression that attracts consumers' attention; aroma influences the perception of taste; texture determines the sensation when consumed; and taste is the main factor in determining preference (Adawiyah et al., 2024). In this study, the sensory quality of arrowroot starch-based steamed brownies was evaluated through organoleptic testing to determine the level of panelist acceptance of the developed product so that it can be a basis for developing innovative and high-quality gluten-free pastry products.

RESEARCH METHOD

This study used an experimental method with a descriptive quantitative approach to assess the sensory quality of steamed brownies based on arrowroot starch as an alternative to wheat flour. The study was conducted through two main stages, namely the manufacture of steamed brownies and the implementation of sensory testing. The brownie-making process was carried out by mixing all ingredients according to the formulation, and then the dough was steamed until cooked. After cooking, the product was cooled at room temperature before sensory testing. Sensory testing was conducted using the hedonic method involving semi-trained panelists. Assessments were carried out on four sensory attributes, namely color, aroma, taste, and texture. The assessment scale used was a hedonic scale of 1–5, namely 1 (very dislike), 2 (dislike), 3 (quite like), 4 (like), and 5 (very like). The assessment data were analyzed descriptively and quantitatively by calculating the average value to determine the level of panelist acceptance of the product.

RESULT AND DISCUSSION

Sensory Test Results of Steamed Brownies Based on Arrowroot Starch

Table 1. Sensory Test Results of Steamed Brownies Based on Arrowroot Starch

No	Attribute	Average Panelist Rating	Category
1	Color	4,2	Like
2	Aroma	4,1	Like

3	Taste	4,3	Really Like
4	Texture	3,9	Like
	Total Everage	4,1	Like

Based on the sensory test results in Table 1, the arrowroot starch-based steamed brownies received an average total score of 4.1, categorized as "like." This score indicates that the product was well-received by the panelists and can be accepted as an alternative to non-wheat-based steamed brownies.

The taste attribute received the highest score of 4.3, categorized as "very like." The high score for this attribute indicates that the use of arrowroot starch did not compromise the flavor quality of the brownies. Panelists considered the resulting chocolate flavor quite dominant and had a good balance between sweet and savory. This demonstrates that the formulation of the ingredients used was able to produce a flavor that aligns with the characteristics of brownies in general. Taste is a key factor in determining consumer acceptance of a food product, so a high score for this attribute indicates that the arrowroot starch-based steamed brownies have the potential for widespread acceptance.

The color attribute received a score of 4.2, categorized as "like." These results indicate that the brownies have an attractive visual appearance and meet panelists' expectations for brownies. The resulting chocolate color is derived from the use of cocoa powder and a uniform steaming process. Color is the first impression consumers observe before tasting a product. Therefore, a high score for the color attribute indicates that the arrowroot starch-based brownies successfully delivered good visual appeal.

The aroma attribute received a score of 4.1, indicating a liking rating. The resulting chocolate aroma was quite strong and distinctive, creating a positive impression among panelists. A good aroma significantly influences consumers' initial perception of product quality. In this study, the use of cocoa powder and chocolate bars provided a familiar aroma, reminiscent of typical brownies. This indicates that substituting wheat flour for arrowroot starch did not significantly negatively impact the product's aroma characteristics.

The texture attribute received the lowest score, at 3.9, although it was still in the "like" category. This score indicates that the brownie texture was still acceptable to the panelists, although not as optimal as brownies made with wheat flour. The slightly denser texture is thought to be due to the absence of gluten in arrowroot starch. Gluten functions to form an elastic structure in dough, so its absence results in a denser product structure. However, arrowroot starch has a fairly good water absorption capacity, resulting in a soft, yet not too hard texture.

Overall, the research results indicate that using arrowroot starch as a substitute for wheat flour has good potential in the development of gluten-free steamed brownies. The average score for all attributes in the "like" category indicates that the product has quite good sensory qualities. These results demonstrate that arrowroot starch can be used as an alternative local food ingredient in the pastry industry. In addition to supporting food diversification, the use of arrowroot starch can also be a solution in the development of gluten-free products aimed at consumers with specific dietary requirements. However, the texture aspect still needs to be improved through formulation

modifications, such as adjusting the liquid composition, emulsifiers, or combining it with other binding ingredients to produce a brownie structure that more closely resembles wheat flour-based products. With further development, steamed brownies based on arrowroot starch have the potential to become an innovative product with high economic value and widespread acceptance.

CONCLUSION

Based on the research results, it can be concluded that the use of arrowroot starch as a substitute for wheat flour in making steamed brownies can produce products with good sensory quality and are acceptable to panelists. The sensory test results showed a total average value of 4.1 with a like category. The taste attribute obtained the highest value of 4.3 with a very like category, followed by the color attribute of 4.2 and aroma of 4.1 which are in the like category. Meanwhile, the texture attribute obtained a value of 3.9, which indicates that the product is still liked even though it has a slightly denser texture than brownies made from wheat flour. Overall, the research results indicate that arrowroot starch has potential as an alternative ingredient in the development of gluten-free steamed brownies. In addition to producing products that are acceptable to consumers, the use of arrowroot starch also supports the utilization of local food ingredients and the development of innovative pastry products with economic value.

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