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## Bun Cheese Sausage: Protein Source Snack Made From Mackerel And Bogor Taro Flour Substitution


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**ARTICLES**

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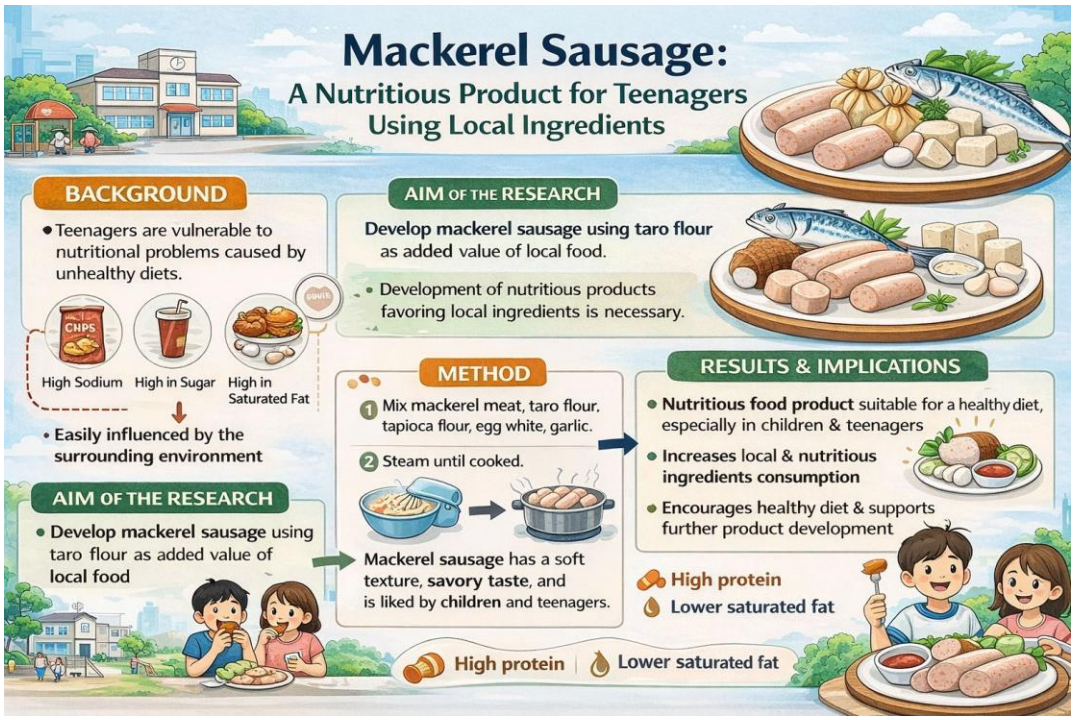
**ABSTRACT**

*Teenagers, especially school children, are very vulnerable to various nutritional problems caused by unhealthy diets. Moreover, eating patterns in teenagers are very easily influenced by the surrounding environment. As we know, it is currently easy to find snacks that are high in sodium, high in sugar, and high in saturated fat, which can have bad consequences for the health of children and teenagers in the future. For this reason, it is necessary to develop nutritious food products that favor local food ingredients. Mackerel provides essential nutrients and is a source of high protein with lower saturated fat content compared to other animal protein sources. This research aims to develop sausage from mackerel with talas flour as an added value of local food. Mackerel sausage with taro flour is made by mixing mackerel with various ingredients such as taro flour, tapioca flour, egg white, garlic, then steamed until cooked. The results showed that mackerel sausage has a soft texture and savory taste that is liked by various groups, especially children and teenagers. Processing mackerel into sausage can also increase the consumption of this food and encourage a healthy diet. Mackerel sausage is one of the food product developments that should be further developed to support a healthy diet, especially in children and teenagers.*


**Key Messages:**

- Development of mackerel and taro flour sausage provides a nutritious, high-protein alternative to combat unhealthy snacking habits in teenagers.
- Utilizing local food ingredients like mackerel and Bogor taro flour adds value to the product and encourages a healthier diet for children and teenagers.

## GRAPHICAL ABSTRACT




## INTRODUCTION

Every individual has a most valuable asset, one of which is health. In the midst of a fast-paced and often irregular modern era, maintaining health is a challenge in itself. A healthy menu high in protein is an effective way to support optimal health. Protein plays a crucial role in various physiological functions of the body and is also classified as a primary macronutrient (1). Protein also has an important role in the transportation of iron within the body. A lack of protein in the body causes delayed iron transportation, leading to iron deficiency and anemia (2). In early childhood, a lack of protein causes motor delays, which can affect self-confidence and social interactions (3). Meanwhile, inadequate protein intake in teenagers can result in Chronic Energy Deficiency (CED), which leads to weight loss due to a lack of stored energy in the body (4).

Mackerel is a type of fish commonly found in Indonesian waters. Many Indonesians are fond of this fish because mackerel has quite high nutritional value, a delicious and savory taste, and an affordable price. The nutritional content in 100 g of mackerel is quite high, namely 21.30 g of protein and 3.40 g of fat (5). Mackerel also contains omega-3 fatty acids and DHA, which are good for children's brain and social development (6). The processing of mackerel is still relatively high among the public, whether consumed directly or used as raw material for processed foods. However, fresh mackerel is highly perishable, requiring further processing to maintain its nutritional value. Mackerel can be processed into other forms such as stick snacks (7).

Taro root (*Colocasia esculenta L. Schott*) is a food ingredient with good nutritional content. The macronutrients and micronutrients present in taro root include carbohydrates, protein, fat, crude fiber, thiamine, niacin, riboflavin, vitamin C, iron, phosphorus, and calcium. Taro root has the potential to be processed into flour because it has small starch granules ranging from 0.5 to 5 microns (8). Taro flour can be used as an ingredient for making new products or as a substitute for conventional flours. Taro flour has a considerable water absorption capacity, which helps maintain flavor, improve palatability, and extend the shelf life of meat-based and other products, such as whipped toppings, sausages, chiffon, desserts, angel cake, and sponge cake (9).

One of the meat products that is well-received and quite popular among the public is sausage, especially among children. Sausage is a trendy food alternative that children like (10). The naming of sausages usually comes from the composition used, such as chicken sausage, fish sausage, and beef sausage. Fish sausage is a processed fish product made from fish paste mixed with flavorings, which is then stuffed into sausage casings (11). Taro root and mackerel can be processed into delicious and tasty food products, one of which is sausage. The combination of these two ingredients is expected to increase the nutritional value of the sausage and provide more benefits. The background of this research is to provide a healthy, high-protein snack for school children to meet their protein needs.



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## METHODS

This research is an experimental study, a type of quantitative research using a Completely Randomized Design method with one factor of treatment formulation. Formulation F1 has a ratio of tapioca flour to Bogor taro flour of 2% : 3%, and F2 is 1% : 4%, as follows:

Table 1. Sausage formula with the addition of mackerel and Bogor taro flour

| Ingredients | Treatment | | |
|---|---|---|---|
| | F0 (g) | F1(g) | F2(g) |
| Mackerel | 100 | 100 | 100 |
| Tapioca Flour | 30 | 20 | 10 |
| Bogor Taro Flour | 0 | 30 | 40 |

The ingredients used in this study were egg whites, garlic, sugar, black pepper, oregano, ice cubes, quick-melt cheese, sausage casings, oyster sauce, and sesame oil. Meanwhile, the tools used in this study were a cutting board, knife, bowl, spatula, steamer, plate, chopper, piping bag, serving plate, and vacuum plastic. The sausage-making process includes making the dough, shaping the dough, and steaming.

This study consisted of 27 semi-trained panelists who are students of the Food Service Industry Management and Nutrition program. The organoleptic test and sausage formulation were carried out at the GG Kulinari Kitchen, Vocational School of IPB University, Jl. Lodaya No. 38, RT.02/RW.06, Babakan, Central Bogor District, Bogor City, West Java. The research was conducted from February to April 2025.

The process of making buncheese sausage based on mackerel with the addition of Bogor taro flour consists of several stages. The sausage-making procedure can be seen in Figure 1.

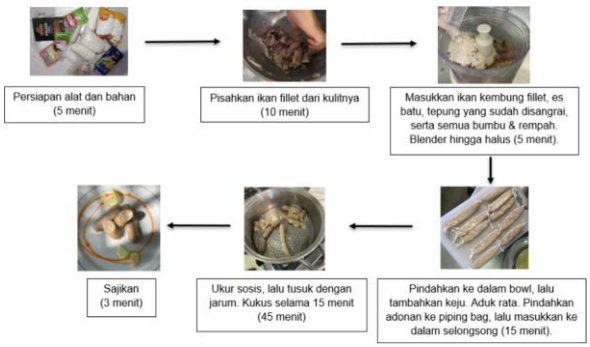


Figure 1. Sausage making procedure

## RESULTS

### Hedonic Test

In the organoleptic test, panelists were asked to express their personal responses regarding the appearance, color, taste, aroma, and texture of the buncheese sausage. These responses were in the form of impressions of the level of liking or disliking (hedonic scale). In the hedonic test for this sausage product, the hedonic scale used was 1 = strongly dislike, 2 = dislike, 3 = slightly dislike, 4 = slightly like, 5 = like, and 6 = strongly like. The analysis results showed that there were significant differences ($p<0.05$) in the appearance and taste indicators. The results of the hedonic test for buncheese sausage can be seen in Table 2.

Table 2. Hedonic test results of buncheese sausage

| **Indicator** | **Formula 1** | **Formula 2** |
|---|---|---|
| Appereance | $4.74 \pm 0.859^{a}$ | $4.22 \pm 1.013^{b}$ |
| Color | $4.33 \pm 1.144^{a}$ | $4.07 \pm 1.107^{a}$ |
| Aroma | $4.52 \pm 0.849^{a}$ | $3.96 \pm 1.372^{a}$ |
| Taste | $4.15 \pm 1.064^{a}$ | $3.48 \pm 1.221^{b}$ |
| Texture | $4.19 \pm 1.039^{a}$ | $4.19 \pm 1.415^{a}$ |



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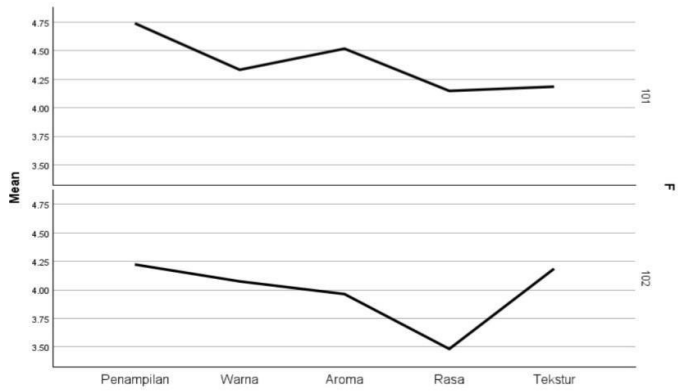


Figure 2. Graphic of buncheese sausage hedonic test results

## DISCUSSION

**Formulation of Buncheese Sausage Based on Mackerel with Bogor Taro Flour Substitution**

The formulation of buncheese sausage based on mackerel and substituted with Bogor taro flour was carried out using the *trial and error* method, aiming to ensure that the recipe formula using mackerel and the addition of Bogor taro flour obtained the best product results. This product is made with the basic ingredient of mackerel and the addition of Bogor taro flour, aiming to provide a healthy high-protein snack for school children so that it can meet the daily protein needs of school children.

The mackerel used as the basic ingredient in the sausage formulation was equal in each formulation, while the addition of Bogor taro flour was differentiated in each formulation. The working procedure in making buncheese sausage was carried out by filleting the mackerel, followed by separating the fish fillet from its skin. After that, insert the mackerel fillet, ice cubes, roasted flour, and all ingredients and spices into a blender, then blend until smooth. The next step is mixing the dough with cheese in a bowl, stirring evenly. After the dough is mixed evenly, transfer the dough to a piping bag, then put it into the sausage casing. When all the dough has been put into the casing, measure the sausages to the same length then pierce them with a needle. The final stage is steaming the sausage for 15 minutes.

The organoleptic test results showed that formula 1 (F1) with a ratio of tapioca flour and taro flour of 2% : 3% was preferred over formula 2 (F2) with a ratio of tapioca flour and taro flour of 1% : 4% in terms of appearance and taste, although there were no significant differences in color, aroma, and texture. This indicates that the use of taro flour in a higher percentage in formula 2 (F2) negatively affected the sensory characteristics of appearance, especially taste. Possibly, the high content of fiber and starch in taro flour causes a taste and appearance that is not as ideal as tapioca flour, which has neutral properties and high absorption capacity for additional flavors.

Based on research by Amelia L (12) on catfish sausage, it was found that the ratio of tapioca flour and Bogor taro flour of 2% : 8% in formula 5 (F5) produced the best chemical and sensory characteristics. The overall acceptance score reached 3.88% (liked), with a protein content of 15.61% and fat of 4.29%. The research shows that formulations dominated by taro flour can be well accepted if combined with suitable raw materials (catfish) and supporting measurements of other ingredients. However, in this study, the dominance of taro flour in F2 did not show an equally good level of acceptance. This could be due to differences in fish types, fat content, and a stronger fishy odor in mackerel.

Research by Artiningsih *et al.* (13) showed that mackerel sausage with the addition of beet puree produced a protein content of up to 15.8% and fiber up to 1.91%, and could meet 11.3 - 12.2% of teenagers' protein needs and 2.5 - 3.2% of teenagers' daily fiber needs. In this study, the use of taro flour in the Buncheese Sausage research can also increase the fiber content and functional value of the sausage. However, sensory aspects remain a challenge that needs to be addressed so that the product remains well-liked by teenagers, who are more critical and selective about food. Formula 1 (F1) showed the best balance between nutritional value and sensory acceptance by the panelists, and is in accordance with the principle of local food diversification that is nutritious and practical.



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**Organoleptic Test of Buncheese Sausage Based on Mackerel and Bogor Taro Flour Substitution**

**Appearance**

Appearance is a very important aspect of food, as an attractive appearance will invite the panelists' appetite to try the product. The appearance of Buncheese Sausage is influenced by several factors such as the casing and the ingredients used. The average score in the hedonic test for the appearance of the selected Buncheese sausage formula (F1) is 4.74 and for the unselected formula (F2) is 4.22. It can be concluded that the panelists' level of preference for the appearance of Buncheese Sausage is 4 (slightly like).

**Color**

The color of the sausage is influenced by the concentration of mackerel, the use of ice cubes, and spices. The average score obtained in the hedonic test for the color of the selected Buncheese Sausage formula (F1) is 4.33 and for the unselected formula (F2) is 4.07. It can be concluded that the panelists' level of preference for the color of Buncheese Sausage is 4 (slightly like). This is directly proportional to research conducted by Usman J *et al.* (14), which states that mackerel sausage formulations with the addition of more tapioca flour will produce a darker color because some of the starch from the tapioca flour will react with the protein, thereby forming a brown color (8).

**Taste**

The taste of the Buncheese Sausage formulation is quite acceptable to the panelists. The average score obtained in the hedonic test for the taste of the selected Buncheese sausage formula (F1) is 4.15, which indicates that the panelists slightly like the taste of the sausage, and the average score for the unselected formula (F2) is 3.48, which means the panelists slightly dislike the taste of the sausage. This is directly proportional to research conducted by Rianti *et al.* (16), where catfish sausage using tapioca flour was preferred by panelists over catfish sausage using taro flour.

**Aroma**

Aroma is one of the organoleptic tests that uses the sense of smell. The average score in the hedonic test for the aroma of the selected Buncheese Sausage formula (F1) is 4.52, which means the panelists slightly like the sausage aroma, and for the unselected formula (F2) it is 3.96, which means the panelists slightly dislike the sausage aroma. This is because the addition of tapioca flour in F1 is greater compared to F2, so the fishy aroma from the mackerel is not as strong as the aroma in F2.

**Texture**

Texture plays a quite important role in both soft and crunchy foods because it can affect food acceptance by panelists. The texture of Buncheese sausage is acceptable and liked by the panelists. The average score in the hedonic test for the texture of Buncheese Sausage in the selected formula (F1) and the unselected formula (F2) is 4.19, which means the panelists slightly like the sausage texture. This is directly proportional to research conducted by Usman J *et al.* (14), where the mackerel sausage formula with the addition of more tapioca flour is more preferred by the panelists. The addition of tapioca flour makes the sausage texture denser and chewier because tapioca flour has the role of amylose and a high amylopectin content (2).

## CONCLUSION

Based on the results of the research and discussion that have been conducted, it can be concluded that the formulation of mackerel-based sausage with Bogor taro flour substitution has an effect on the sensory acceptance of the panelists, especially in terms of appearance, taste, and aroma. Formula 1 (F1) with a ratio of tapioca and taro flour of 2%:3% is preferred compared to Formula 2 (F2) which contains a higher amount of taro flour. This shows that although taro flour has advantages in terms of nutritional value, its use needs to be adjusted so as not to reduce the sensory quality of the product.

The results of this study are not entirely in line with previous research by Leona Amelia, which found that the dominance of taro flour could provide the best results in catfish sausage, indicating that the type of fish and the combination of other ingredients also influence the final result. Research by Artiningsih *et al.* (13) also supports that the addition of plant-based ingredients to mackerel sausage has the potential to increase nutritional



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content, yet attention to consumer acceptance is still required. Therefore, formulation F1 in this study can be considered the best choice because it is able to maintain a balance between nutritional value and the panelists' level of preference, as well as demonstrating the potential for developing nutritious local food products that are suitable for teenagers' tastes.

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## CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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