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Improving Nutritional Profile and Consumer Acceptance of Siomay Stuffing Through Integration of Mackerel Meat (*Rastrelliger SP.)* and Yellow Potato Flour (*Solanum Tuberosum L.*)

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KEYWORDS
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ABSTRACT
Siomay, a popular Indonesian snack traditionally made with high-fat chicken or beef fillings, can be made healthier by using mackerel fish instead. This modification, combined with the addition of potato starch, aims to improve the nutritional profile of siomay while maintaining its appeal to consumers, as mackerel is both tasty and nutritious. This study aims to improve the nutritional profile and consumer acceptance of siomay filling through the integration of mackerel meat and potato starch. Data were analyzed using a Completely Randomized Factorial Design with two factors (mackerel meat and potato starch) mixed in different proportions in the siomay filling dough. Parameters tested included nutritional composition (protein, fat, carbohydrate, fiber, and mineral), physicochemical properties (texture, color, and aroma), and consumer acceptance test using a hedonic scale. The results showed that the most preferred treatment was K2D2 (14g mackerel meat and 20g potato starch), which was 5.6±1.5. The nutritional content of the siomay filling preferred by the panelists increased (water 29.07 g, protein 12.89 g, fat 3.65 g, ash 3.41 g, sugar 1.35 mg, vitamin B1 0.26 mg). However, the carbohydrate content decreased to 50.98 g, compared to the content of siomay filling without the addition of yellow potato starch (56, 74 g). This study shows that mackerel flour and potato starch can potentially be used to improve the nutritional profile and consumer acceptance of siomay filling.

1. Introduction

Siomay is a popular and well-loved traditional Indonesian food that is shaped into a wrapper and filling. Conventional siomay filling generally consists of minced beef, chicken, or shrimp and has a limited nutritional profile. The wrapper for the siomay filling can be a wonton skin wrapper that is shaped to taste or wrapped in bitter melon skin. This study aims to improve the nutritional profile and consumer acceptance of siomay filling through the integration of mackerel meat and potato

starch (Sumartini et al., 2021). Mackerel is known as mackerel fish, which is classified as an economically important fish, and its potential catch has increased every year. This fish has a fairly excellent and savory taste, so the public favors it widely.

In Indonesia, mackerel is primarily processed in the form of pindang fish and salted fish. This is due to a lack of public attraction to consume mackerel Thariq et al., (2014). In some countries it is reported that processed mackerel, known as mackerel fish, is processed with a variety of preparations in the form of salted fish or marinated with vinegar, dried fish, smoked, surimi or processed in the form of canned fish, canned, (Hedges & Haard, 1997; Moon et al., 2020); Mackerel pâté, Mackerel sausages, Mackerel fish balls, Mackerel fish fingers (Mišurcová et al., 2017; Nowacka et al., 2023).

According to the Food Security Agency of Yogyakarta Province (2013), mackerel has a fairly high nutritional composition, namely every 100 g of mackerel meat contains 76% water content, 22 g protein, 1 g fat, 20 mg calcium mineral, 200 mg phosphorus, 1 g iron, 30 SI vitamin A and 0.05 mg vitamin B1. Next, Giri et al. (2015), reported that Indian mackerel (Rastrelliger kanagurta) contains 79.63% water content, 18.28% protein, 2.02% fat, 1.00% ash, 155.00 mg/100g phosphorus, 26.00 mg/100g calcium, and 2.10 mg/100g iron.

The other nutritional content in mackerel is unsaturated fat with omega-3 and omega-6 content, which is suitable for disease prevention, able to improve fat levels in the body, and provide nutrients to the brain (Fitri & Purwani, 2017). Mackerel is one of the high-fat fish in the form of omega-3 fatty acids, especially eicosatetraenoic acid (EPA) and docosahexaenoic acid (DHA). A 100g serving of mackerel provides about 2-3g of omega-3 fatty acids, including 0.4-0.6g EPA and 0.6-0.8g DHA (Tacon & Metian, 2013).

Nutritional content The filling of mackerel siomay is complete with the addition of yellow potato flour, because yellow potatoes provide basic nutrients such as carbohydrates, dietary fiber (skin), several vitamins, and minerals (for example, potassium, magnesium, iron) (Hatmi et al., 2021; Kiranawati et al., 2021). The addition of colored potatoes plays an important role in increasing the role in the production of antioxidant defense systems by providing essential antioxidant nutrients, such as vitamins, β-carotene, polyphenols, and minerals. This can help reduce the incidence of various chronic and acute disease processes (such as hypertension, heart disease, cancer, neurodegenerative diseases, and other diseases) (Zaheer & Akhtar, 2016) In making siomay filling, the addition of potato starch functions as a binder, because potato starch also has a very high content of amylose and amylopectin of 21% and 79%, which has good water absorption to emulsify the substances in the flour tapioca.

The use of mackerel and yellow potatoes as siomay filling is an effort to innovate products and display uniqueness, which is expected to eliminate boredom in consumers when choosing products that are not unique Yanuar & Harti (2020). This study was carried out with different concentrations of mackerel meat, namely 7g, 14g, and 28g, and yellow potato starch, namely 15g, 20g, and 25g, to determine whether or not there was an effect on the nutrition of the siomay filling produced based on the characteristics of the nutritional content and acceptability of the panelists. The benefits of this research are expected to be information and innovations for the public related to the addition of potato flour and mackerel meat to siomay fillings, which can have a positive impact on consumer health.

2. Materials and Methods

Materials and Tools

Fresh mackerel, tapioca flour, yellow potato starch, salt, sugar, and pepper are the raw materials used in making mackerel siomay filling. Meanwhile, basins, choppers, pots, scales, spoons, plates, knives, placemats, and stoves are the tools used.

Making Mackerel Siomay Filling and Data Analysis

Mackerel is washed and filleted. Mackerel fillets weighing 7.14 and 28 g are mixed with other ingredients and mashed using *choppers*. Then add yellow potato flour weighing 15.20, and 25g then mash it again using *a chopper*. The dough that has been crushed is molded and steamed at a temperature of 1000C for 10-15 minutes. After the dough was hardened, it was lifted and drained on a plate, cooled at room temperature, and an organoleptic test was carried out with 30 semi-trained panelists. Then, a proximate test was carried out to determine the nutritional content of the siomay filling after adding mackerel meat and yellow potato flour at different concentrations.

The data obtained was analyzed using a Factorial Complete Random Design with three replicates. The combination of treatments is as seen in the 1.

Table 1 Design the Combination of Treatments used

Mackerel meat (gr)	Yellow Potato Flour (gr)		
	15	20	25
7	D1K1	D1K2	D1K3
	D1K1	D1K2	D1K3
	D1K1	D1K2	D1K3
14	D2 K1	D2K2	D2K3
	D2 K1	D2K2	D2K3
	D2 K1	D2K2	D2K3
28	D3K1	D3K2	D3K3
	D3K1	D3K2	D3K3
	D3K1	D3K2	D3K3

The addition of mackerel meat and yellow potato flour to make mackerel siomay fillings is K1D1 (7g meat and 15g flour), K2D1 (7g meat and 20g flour), K3D1 (7g meat and 25g flour), K1D2 (14g meat and 15g flour) K2D2 (14g meat and 20g flour), K3D2 (14g meat and 25g flour), K1D3 (28g meat and 15g flour), K2D3 (28g meat and 20g flour), K3D3 (28g meat and 25g flour), K0D0 (control). The determination of the best concentration of siomay filling with the addition of mackerel meat and potato starch from the 10 treatments was carried out organoleptic tests using the hedonic method to measure with the score of sensory response or the panelist's perception of a product, with a total of 30 panelists. The parameters tested are appearance, aroma, taste, and texture.

3. Result and Discussion

Nutritional Content of Mackerel

The nutritional content of mackerel is needed as a potential and healthy food. Innovation efforts on the use of mackerel meat as siomay filling are carried out to provide a variety of processed fishery products by looking at the number of mackerel, catches in Indonesian waters, and the form of processing that is still limited. The results of laboratory analysis (Table 2) m show that mackerel meat contains high nutritional value and has the potential to be used as a mixed ingredient in processed food products.

Table 2 Nutritional Content of Mackerel Meat

Components of analysis	Result (%)	Method of Analysis
Water	54,81	AOAC
Protein	30,97	Kjeldahl
Fat	6,85	AOAC
Kabohydrate	4,89	Luff schoorl
Ash	2,48	AOAC

Nutritional Content of Yellow Potato Flour

The use of potatoes can be done by making flour. Where potato starch can be added to several other types of food products to enrich the nutrients in these food products. In addition, potatoes in flour form have more shelf life, so they can be used anytime and anywhere (Dery et al., 2021).

Table 3 Nutritional Content of Yellow Potato flour

Components of analysis	Result (%)	Method of Analysis
Water	5,83	AOAC
Protein	6,07	Kjeldahl
Fat	0,31	AOAC
Kabohydrate	87,34	Luff schoorl
Ash	0,45	AOAC
Sugar	6,17	AOAC
Vitamin B1	2,86	AOAC

Organoleptic Texture Parameters

The highest average value of the texture of mackerel siomay filling with the addition of mackerel meat and yellow potato flour was found in the K2D2 treatment (14 g of mackerel meat and 20 g of yellow potato flour), which was 5.6±1.5. The lowest average value was found in the K0D0 treatment (0 g of mackerel meat and 0 g of yellow potato flour), which was 4.3±1.1. The results show that the addition of mackerel meat and yellow potato flour results in its own attractiveness for consumers in texture parameters. The higher the concentration of adding mackerel meat and yellow potato starch, the denser the texture of the siomay filling, so it is less preferred by the panelists (Kohyama, 2020; Nawaz et al., 2021; Nuryadi et al., 2020).

Organoleptic Color Parameters

The highest average value of the panelists' preference for the color of mackerel siomay filling with the addition of mackerel meat and yellow potato flour was found in the K2D2 treatment (14 g of mackerel meat and 20 g of yellow potato flour), which was 5.3±1.7. However, the lowest average value of the panelists' preference was found in the K3D1 treatment (7 g of mackerel meat and 25 yellow potato flour), which was 4.0 ±1.7. In these results, it can be said that the addition of yellow potato flour and mackerel meat is less and less showing the panelists' response to dislike the color parameters. The addition of yellow potato flour mackerel meat to the mackerel siomay filling causes its appearance to be light brown or even dark brown. This is due to the influence of the addition of meat which when boiled will give off a brown color.

Organoleptik Parameter Aroma

The highest average score of the panelists on the aroma of mackerel siomay filling with the addition of mackerel meat and yellow potato flour was found in the K2D2 treatment (14 g of mackerel meat and 20 g of yellow potato flour), which was 5.6±1.3. However, the lowest average value for aroma was found in the treatment of K0D0 (0 g of mackerel meat and 0 g of yellow potato starch), which was 4.1±1.3. Based on these results, it shows that the addition of mackerel meat and yellow potato flour results in its own attraction for consumers in aroma parameters. The higher the concentration of yellow potato starch and mackerel meat used, the more it affects the aroma of each treatment used.

Organoleptic Taste Parameters

The highest average value of mackerel siomay filling with the addition of mackerel meat and yellow potato flour was found in the K2D2 treatment (14 g and 20 g of yellow potato flour), which was 5.5±1,1,8. The lowest average value was found in the K0D0 treatment (0 g of mackerel meat and 0 g of yellow potato flour), which was 4.2±1.2. In the notation K1D2 and K2D2, there is no real difference, but K2D2 with other treatments is significantly different. Based on these results, it shows that the higher the addition of mackerel meat and yellow potato flour, the less favored by the panelists. The addition of mackerel meat and yellow potato flour to the mackerel somay filling with a balanced formulation caused the desired taste by the panelists.

Nutritional Content of Mackerel Dumpling Stuffing

- **Carbohydrate Content**

  The carbohydrate content of 56.74 in mackerel siomay filling products without the addition of mackerel meat and yellow potato flour was higher (>) than that of siomay filling with mackerel meat and yellow potato flour. This also happened in the research Ramadhani & Murtini (2023), which stated that the difference in carbohydrate content between the best choice siomay and the control siomay was due to the proximate analysis, the carbohydrate nutrient content produced was the carbohydrate content that had undergone the processing process so that the carbohydrate content was lower. The control siomay is calculated using the Food Ingredient Composition List which is a calculation of food nutrients based on raw materials that have not undergone the processing process.

- **Protein Content**
  The protein content of 10.21 in somay filling products without the addition of fish meat and yellow potato flour was lower (<) than in siomay filling with fish meat and yellow potato flour. This shows that the addition of mackerel meat and yellow potato flour is enough to add protein value in food even though it is not too much in terms of the quantity of addition. Although the value is quite far from mackerel meat and different from yellow potato flour, this is due to the cooking process in the dough with high temperatures which can reduce the protein value of the product.
- **Fat Content**
  The fat content of 2.53 in siomay filling products without the addition of fish meat and yellow potato starch was lower (<) compared to siomay filling with fish meat and yellow potato flour. The cooking process by boiling can minimize the fat content in the product. The fat content in the fish siomay filling has also met SNI 2013 with a maximum value of (≤) 20%. This fat content is also quite safe for children aged 4-6 years who are found in the daily AKG, which is 45 grams.
- **Water Content**
  The moisture content of 28.36 in mackerel siomay filling products without the addition of fish meat and yellow potato starch was lower (<) than that of siomay filling with fish meat and yellow potato starch. This shows that yellow potato starch is very good at binding the water content in the product because yellow potato starch itself has a water content of 5.83%. Nevertheless, the moisture content value has met the SNI 2013 with a maximum value (≤) of 60%.
- **Ash Content**
  The ash content of 2.16 in siomay filling products without the addition of fish meat and yellow potato flour was lower (<) than in siomay filling with fish meat and yellow potato starch. This shows that there is quite a lot of mineral content in yellow potato flour. Although the figure exceeds the SNI 2013, the ash content in the product does not reach 5% of the amount, so it is still safe for consumption. This is also related to Sari's research (2022). Namely, the high and low ash content in a product is influenced by the difference in mineral content in the food.
- **Sugar Content**
  The sugar content of 1.19 in siomay filling products without the addition of mackerel meat and yellow potato flour was lower (<) than in siomay filling with fish meat and yellow potato flour. This shows that the sugar content contained in siomay filling products is still limited to be safe for human consumption. According to research conducted by Nadhiroh (2022), the sugar consumption that humans can do in a day is only 50 g/day (4 tablespoons).
- **Vitamin B1 Level**
  Vitamin B1 (thiamine) 0.02 in siomay filling products without the addition of fish meat and yellow potato flour was lower (<) than siomay filling with mackerel meat and yellow potato starch. This is because the vitamin B1 content contained in siomay filling products is still at the safe limit for human consumption.

Research Limitations

This research has several limitations that need to be considered. The focus of the study was limited to the development of dumpling fillings only, without including other variations of processed

mackerel products. In addition, this study only used one type of fish, mackerel (Rastrelliger sp.), without comparing it with other types of fish. In terms of additional ingredients, this study only used yellow potato flour (Solanum tuberosum L.), without trying other flour variations. Organoleptic tests were conducted with 30 semi-trained panelists, which may not be fully representative of broad consumer preferences. The test parameters used were also limited to nutritional composition, physicochemical properties and consumer acceptance test, without covering other aspects such as shelf life or microbiological analysis. This research also used a limited concentration range for mackerel meat (7g, 14g, 28g) and yellow potato starch (15g, 20g, 25g), which may not include all possible optimal combinations. The processing method used was only steaming, without comparing with other processing methods. In addition, there was no discussion on the economic aspects or feasibility of large-scale production of the developed siomay fillings. Finally, the duration of the study was limited as there was no information on long-term studies related to product stability or long-term consumption effects. These limitations can serve as the basis for further research in the future to develop siomay fillings or other processed fish products more comprehensively.

4. Conclusion

Based on the results of the above study, it was concluded that the nutritional content contained in the siomay filling after the addition of yellow potato flour and mackerel meat increased (water 29.07, protein 12.89, fat 3.65, ash 3.41, sugar 1.35, vitamin B1 0.26) except, carbohydrate 50.98, compared to the content of siomay filling without the addition of yellow potato starch. In addition, it was also concluded that the best concentration of siomay filling with the addition of mackerel meat and yellow potato flour was obtained in the treatment of K2D2 (14g of mackerel meat and 20g of yellow potato starch), with hedonic values namely color (5.3), aroma (5.6), texture (5.6), taste (5.5), and nutritional content values namely vitamin B1 (0.26), sugar (1.35), protein (12.89), Water (29.07), Fats (3.65), Carbohydrates (50.98), Ash (3.41). Based on the research results, some suggestions for future research include product diversification by developing other mackerel preparations, as well as the use of other types of fish for more comprehensive results. Exploration of additional ingredients such as various flours can improve texture and nutritional value. Increasing the number of panelists in the organoleptic test is needed for more representative results. Future research should include testing a wider range of parameters, such as shelf life and microbiological analysis, as well as examining alternative processing methods. Economic analysis and long-term studies are also important to ensure safety and health benefits, as well as commercial viability (Gupta et al., 2021). These suggestions can make the research more comprehensive and applicable, making significant contributions to the food industry and public health.

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