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The Effect of Tilapia Meat Flour Addition on the Preference level of Dried Sus

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ABSTRACT

Tilapia as a food ingredient has a high nutritional content, one of which is protein content. Tilapia meat can be processed into flour, which can then be used as an ingredient to increase the nutritional content of dried sus products. This study aims to determine the amount of tilapia meat flour added to produce dried sus that is most favored by panelists. The method used was an experimental method with 0%, 10%, 15%, and 20% tilapia meat meal addition. The parameters observed were the hedonic test and the proximate test. The results showed that the addition of tilapia meat flour to the most preferred dry sus was the 15% treatment with an average value of appearance of 8.0; aroma of 7.7; texture of 8.4; taste of 7.9; criterion weight of 0.57 and alternative value of 8.8. The resulting proximate test is water content of 4.86; ash content of 2.91%; protein content of 12.35%; fat content of 31.95%; and carbohydrate content of 45.52%.

INTRODUCTION

Indonesia has the potential for abundant freshwater fish resources, with aquaculture playing an important role in meeting domestic consumption fish needs. The fish consumption level of Indonesians is still low compared to other Southeast Asian countries. One fish that has the potential to be developed is Tilapia, which is a commodity in high demand by consumers (Agustin *et al.* 2020). Data from the Ministry of Maritime Affairs and Fisheries shows that Indonesia's tilapia production in 2021 reached 1.35 million tons with a value of IDR 33.62 trillion, experiencing a growth of 9.63% compared to 2020.

Tilapia is favored by the public because of its white meat, and soft, chewy, thick, and neutral taste, making it easy to process into various products (Simanullang, 2021). Tilapia is also fast breeding and has a relatively low price, making it easily accessible to the community (Yoswaty *et al.* 2022). Tilapia fish has a high nutritional content, especially protein reaching 43.76%, as well as fat 7.01% and ash 6.80% (Souhoka *et al.* 2019), and Tilapia fish meat can be processed into

flour with the advantages of being easy to store, durable, enriched with nutrients, and easily mixed into various food products (Mahendra *et al.* 2019).

Fishmeal commonly known today comes from processing residues such as heads, offal, gills, and scales used for making fish feed, but the utilization of fishmeal for food is still underdeveloped (Manteu *et al*. 2017). Tilapia meat meal can be an alternative food ingredient that has a longer shelf life, high economic value, and good nutritional content, especially protein 71.02%, fat 4.46%, ash 9.64%, and water 9.83% (Manteu *et al*. 2017). Tilapia flour can be used to increase the nutritional content of food products such as dry milk.

Dry Sus or Choux Paste is one type of pastry that has the characteristics of a savory taste, crispy texture, and lightweight (Wahyuningtyas *et al.* 2020). Dried Sus has been widely recognized by people in various circles as a companion food when drinking coffee or other drinks, especially among teenagers today. In general, dry sus on the market has a relatively low protein value, namely (7.50%) (Manopo, 2019).

The purpose of this study was to determine the amount of tilapia meat flour addition to produce dry sus that was most favored by panelists. The level of liking can be measured using the organoleptic test through the sensory organs, to determine the amount of Tilapia fish flour added to the dry sus (Rokhana & Bebilla, 2016). The proximate test includes water content, ash content of the protein room, fat content, and carbohydrate content.

LITERATURE REVIEW

Tilapia is a freshwater fish that is popular in the community due to its high nutritional content, with protein ranging from 17.5-34% and excellence in good amino acid completeness (Susanti *et al*. 2021). Although tilapia has great potential to be processed into various food products, its processing is still limited to traditional methods such as frying and grilling. In one of the efforts to increase fish consumption, good processing is needed, by processing tilapia into fish meat flour which can be used as an additional raw material in processed food products.

Fish meat meal, which has a high protein content of around 71% (Handajani & Widodo, 2010), can be applied in various low-protein food products, such as dried sus. Dry sus is a processed product that is favored by many people and is made from wheat flour with the majority of nutritional content, namely carbohydrates (Wahyuningtyas *et al.* 2020). The addition of tilapia meat flour to dry sus can increase protein content, and affect the appearance, aroma, texture, and taste of the final product. Several studies have been conducted to explore the potential of adding fishmeal to this food product. Asih & Arsil (2020) added cork fish flour to make choux pastry. Ihsan (2020) added anchovy rice flour to make dry eclairs. Putri *et al.* (2020) fortification of tilapia fishmeal in making crackers. Ariana & Nani (2023) made puff pastry with tilapia flour substitution.

METHOD

Tools and Materials

The ingredients used in this research are tilapia meat, wheat flour (Blue Triangle), margarine (Simas), water, chicken eggs, salt (Bintang), and baking powder (Koepoe-koepoe). The tools used consisted of knives, cutting boards, pans, measuring cups, 100 mesh sieves, grinders, gas stoves, syringes, baking sheets, ovens, stopwatches, digital scales of 0.1 g accuracy, basins, piping bags, mixers, thermometers, Teflon and serving plates.

Stages of research

The stages carried out in this study include making Tilapia fish meat flour, and making dry sus with the addition of Tilapia fish meat flour (carried out at the Fishery Products Processing Laboratory, Faculty of Fisheries and Marine Sciences, UNPAD. The next stage is the proximate content testing stage. (Conducted at the Food Technology Laboratory, Pasundan University, Bandung). Tilapia fish samples weighing 5kg were obtained from the Ciparanje Inland Fisheries Area. The process of making Tilapia meat flour refers to Sari et al. (2014) and dry sus refers to Asih and Arsil (2020).

Material Formulation

The percentage amount of tilapia meat flour addition is based on the percentage of the amount of wheat flour and is divided into four treatments, namely: A (0%), B (10%), C (15%), and D (20%). The formulation of dry sus ingredients of tilapia meat flour can be seen in Table 1.

Table 1. Formulation of Dry Sus with Tilapia Meat Flour Addition

Material	Treatment of Tilapia Meat Flour Addition			
	A (0%)	B (10%)	C (15%)	D (20%)
Wheat Flour (g)	150	150	150	150
Tilapia Meat Flour (g)	0	15	22,5	30
Margarine (g)	125	125	125	125
Salt (g)	2	2	2	2
Water (ml)	245	245	245	245
Chicken egg (grain)	3	3	3	3
Baking powder (g)	5	5	5	5

Description: Treatment A: 0% tilapia meat meal.
Treatment B: 10% tilapia meat meal.
Treatment C: 15% tilapia meat meal.
Treatment D: 20% tilapia meat meal.

Research Method

The research method was an experimental and descriptive method consisting of 4 treatments with 20 semi-trained panelists as replicates. The parameters observed were the hedonic test and the proximate test. The hedonic test includes appearance, texture, aroma, and taste. The proximate test included

moisture content and ash content by the gravimetric method, protein content by the Kjeldhal method, fat content by the Soxhlet method, and carbohydrate content by the difference method) on the most preferred dry sus and without adding tilapia meat flour.

Data Analysis

Organoleptic test data (hedonic test) were analyzed using a two-way analysis of variance Friedman test with Chi-squared test and Bayes method to determine the best decision. Proximate test results (moisture, ash, protein, fat, carbohydrate) were analyzed descriptively and compared with biscuit quality requirements based on the Indonesian National Standard (SNI).

RESULT AND DISCUSSION

Hedonic Test

The level of liking or acceptance of a product can be measured by conducting an organoleptic (hedonic) test which aims to determine the level of preference for the appearance, aroma, texture, and taste of a product. Organoleptic characteristics consist of 9 (very like), 7 (like), 5 (neutral/usual), 3 (dislike), and 1 (very dislike). The hedonic test results are presented in Table 2.

Table 2. Average Results of the Dry Sus Hedonic Test in Each Treatment.

Observation	Average Treatment of Tilapia Fish Meat Flour Addition			
	0%	10%	15%	20%
Appearance	7,3a	7,5a	8,0a	6,5a
Aroma	7,2a	7,3a	7,7b	6,3ab
Texture	7,0a	7,2a	8,4b	6,9ab
Taste	7,3a	7,4a	7,9b	6,4ab

Appearance

The results of the Friedman test statistical analysis in Table 1, show that the addition of tilapia meat flour has no significant effect or does not make a difference to the level of panelist preference on the appearance of the dry sus produced. The 15% treatment of tilapia meat flour addition has the highest average value of appearance with an average of 8.0 with a bright appearance, brownish yellow color, intact and fluffy shape (Figure 1). The addition of 20% tilapia meat flour has the lowest average value of appearance with a value of 6.5 with the same appearance as the other treatments. In line with research Putri's (2020), the appearance is not significantly different in each treatment, with an average value of bright, golden yellow, and attractive appearance. This is due to the tilapia meat flour used is yellowish white or almost the same as the color of the ingredients used, so it does not change the appearance of each treatment.

A (0%) B (10%) C (15%) D (20%)

Figure 1. Dry Sus with the Addition of Tilapia Meat Flour

The distinctive yellow color on the surface of the dried sus is obtained from the eggs used as ingredients because natural pigments in eggs such as xanthophyll, lutein, and zeaxanthin can provide a yellow color and control the color of food products (Wulandari, 2022). The brownish color on the surface of the dry sus is caused by the Maillard reaction, which is a process between the reducing sugar content and the amine groups of the protein during baking that produces a brown color or melanoidin (Ridhani, 2021). Dry sus contains high carbohydrates from wheat flour (Yanti *et al.* 2020), as well as proteins from wheat flour, tilapia meat flour, and eggs (Wulandari, 2018), which react during baking to produce a brown color through the Maillard reaction (Widowati, 2010).

Aroma

The results of the statistical analysis of the Friedman test in Table 1, show that the addition of tilapia meat flour has a significant effect on the level of panelist preference on the aroma of the dry sus produced. The control treatment has an average value of 7.2 producing a strong and roasted margarine aroma. The 10% treatment had an average value of 7.3, producing a typical margarine aroma, roasted and no fish aroma. The 15% treatment has the highest average value on the aroma of dry sus and is significantly different from the other treatments, which is 7.6, producing a distinctive aroma of margarine, roasted, and a little fish aroma. While the addition of tilapia meat flour as much as 20% has the lowest average value of aroma, namely 6.7, producing a distinctive aroma of margarine and fish aroma.

The aroma characteristics of a product are influenced by volatile compounds contained in the ingredients used, such as wheat flour, eggs, margarine, and tilapia meat flour, giving rise to a distinctive aroma (Putri, 2020). Food products containing fish can produce a certain aroma caused by volatile compounds from fatty acid oxidation, such as aldehydes, ketones, alcohols, hydrocarbons (aromatics), and esters contained in tilapia meat flour (Pratama *et al.* 2018). Eggs and margarine also contain volatile compounds such as aldehydes, alcohols, and esters that can give bread, milk, and butter a distinctive aroma (Demirkol *et al*. 2016). The baking process can produce aromatic volatile compounds through the Maillard reaction between gluten and amino acids (proteins), producing aldehydes, ketones, and aromatic compounds that give dry sus its characteristic aroma (Markowicz, 2012).

Texture

The results of the Friedman test statistical analysis in Table 1, show that the addition of tilapia meat flour has a significant effect on the level of acceptance of panelists on the texture of the dry sus produced. Based on the assessment of panelists, the control treatment and 10% treatment had an average value of 7.0 and 7.2. The 15% treatment has the highest average value on the texture of dry sus and is significantly different from the other treatments, which is 8.4, producing a crispy and hollow texture of dry sus. The addition of tilapia meat flour as much as 20% has the lowest average value of texture, namely 6.9, producing a dry sus texture that is less crispy, dense, and slightly hollow.

The addition of tilapia meat meal up to 15% resulted in an optimal texture, which was crunchy and hollow, as the interaction between fish protein and gluten was good. However, the addition of fishmeal up to 20% caused the texture to be less crispy and dense. This is due to the excessive concentration of fish meal, which can result in an imbalance in the dough composition and reduce the air space needed to produce a hollow texture. As a result, excess moisture can make the product mushy, resulting in a less crispy and dense texture. According to Winarno (2004), excessive addition disrupts chemical and physical interactions in the dough, thus inhibiting cavity formation. In addition, tilapia protein has a more complete amino acid profile and lower water-binding ability than gluten, leading to a more crumbly texture (Turchin *et al.* 2009).

Cavities in dried sus are affected by ingredients such as baking powder, eggs, water, and flour. Baking powder contains sodium bicarbonate and acidifying ingredients that react to produce CO2 gas during baking, making the dough expand and form voids (Mubarok, 2020). Eggs contain lecithin and proteins that help form the hollow structure (Cauvain & Young, 2006), while water helps develop gluten from flour, creating a light and hollow structure (Wilderjans *et al.* 2013).

Taste

The results of the statistical analysis of the Friedman test in Table 1, show that the addition of tilapia meat flour has a significant effect on the level of acceptance of panelists on the taste of the dry milk produced. The average value of dry sus flavor ranged from 6.4 to 7.9. The highest average value of 7.9 was found in the dry sus treatment with the addition of 15% tilapia meat flour, with a slightly sweet, slightly salty, and umami (savory) taste. The lowest average value of 6.4 was found in the dry sus treatment with the addition of 20% tilapia meat flour, with a slightly salty and umami flavor that was strong but still preferred. The taste of dry sus in the 15% treatment is the most preferred treatment because the mixing changes the taste of dry sus to umami (savory).

The sweetness of the dried sus occurs due to the Maillard reaction between amino acids from tilapia flour protein and reducing sugars from wheat flour. The salty taste comes from salt containing sodium chloride and also functions as a flavor generator in other ingredients (Wicaksono, 2019). Umami flavor is caused by the

concentration of protein from wheat flour, fish flour, and electrolytes from salt (Romagny *et al*. 2017). Non-volatile compounds such as free amino acids, peptides, and nucleotides affect flavor characteristics, whereas free amino acids and glutamic acid salts contribute to umami flavor (Pratama *et al.* 2023). The flavor value of a food product is influenced by the mixing reaction of ingredients, adhesive/binder properties, chemical compounds, process temperature, concentration of ingredients, and the interaction of flavor components.

Decision Making with the Bayes method

The results of the weight of the criteria in determining the preferred treatment by considering the criteria of appearance, aroma, texture, and taste of dried sus tilapia meat flour. The results of the calculation of the weight of the criteria with the Bayes method are in Table 3.

Table 3. Decision matrix of tilapia fish meat flour dry sus assessment with Bayes method

Treatment (%)	Criteria				Alternative Value
	Appearance	Aroma	Texture	Taste	
0	7,00	7,00	7,00	7,00	7,00
10	7,00	7,00	7,00	7,00	7,00
15	9,00	8,00	9,00	9,00	**8,8**
20	7,00	7,00	7,00	7,00	7,00
Criterion Value	0,15	0,13	0,16	**0,57**	

Based on the calculation of criteria weights, taste has the largest value compared to appearance, aroma, and texture. This shows that even though other criteria are considered good if the taste is not liked, the product will be rejected by consumers. Flavor is the most dominant sensory attribute in determining consumer preference and satisfaction (Moskowitz *et al*. 2012). In the development of new food products, flavor is often the key factor most considered, as flavor reflects the quality of raw materials, processing, and proper formulation (Breslin, 2013). A preferred flavor will encourage consumers to repurchase the product in the future.

Based on Bayes analysis, the 15% treatment of tilapia flour addition produced dried sus with the most optimal sensory characteristics and was favored by panelists. Although all treatments were still acceptable, the 15% treatment obtained the highest alternative score of 8.8, indicating the most suitable combination of appearance, aroma, texture, and taste. High taste, with optimal sensory characteristics, provides information for consumers to decide the feasibility of consumption (Suswanti, 2013). While the 0%, 10%, and 20% treatments have the same alternative value of 7.0, meaning that the level of acceptance is relatively the same, even though the characteristics are different because the Bayes method

considers the weighted priority of the criteria. Interactions between sensory characteristics can also influence each other and cover small differences in one criterion.

Chemical Test

Chemical tests include moisture content, ash content, protein content, fat content, and carbohydrate content in dry sus. Chemical tests were carried out on dry sus without the addition of Tilapia fishmeal and the most preferred dry sus by panelists was dry sus with the addition of 15% Tilapia fishmeal. The results of the chemical test are presented in Table 4.

Table 4. Dry sus chemical test results

No.	Analysis Parameter	Chemical Analysis Result (%)	
		Fishmeal 0%	Fishmeal 15%
1	Water Content	4,84	4,86
2	Ash Content	2,77	2,91
3	Protein Content	8,22	12,35
4	Fat Content	29,16	31,95
5	Carbohydrate Content	51,35	45,52

Notes: Assay per 100-gram sample

Water Content

Based on the observation results (Table 4), the moisture content of dried sus in the treatment without the addition of 0% tilapia meat flour is 4.84% and the moisture content of dried sus in the treatment with the addition of 15% tilapia fish flour is 4.86%. The resulting moisture content of the two dried sus treatments is still below the range of moisture content required by biscuit quality requirements based on SNI 01-2973-1992 which states that the maximum moisture content in biscuits is 5%, so the moisture content of the dried sus produced meets the SNI requirements.

The moisture content of dried sus with the addition of 15% tilapia meat flour tends to increase to 0.02%. This is thought to be because the starch in wheat flour has a lower ability to absorb and bind water than the protein from fish meat flour (Charoenphun *et al.* 2016). Thick dough due to reduced starch causes dry sus to expand less during molding, so that less water is evaporated during baking, resulting in a less crunchy texture (Wijayanti *et al*. 2014; Mardiah *et al.* 2019). The increase in moisture content can also be influenced by the initial condition of the moisture content of the raw materials (Pratama, 2011). Overall, the addition of tilapia meat flour decreases the ability to develop dry sus dough, resulting in a less crunchy final texture.

Ash Content

Based on the observation results (Table 4), the ash content of dried sus in the treatment without the addition of 0% tilapia meat flour was 2.77% and the moisture content of dried sus in the treatment with the addition of 15% tilapia meat flour was 2.91%. The ash content of the two treatments was higher than the ash content required by the quality requirements of biscuits based on SNI 01-2973-1992 which states that the maximum ash content of biscuits is 1.5%, so the ash content of the dried sus produced did not meet the SNI requirements.

The ash content of dried sus tends to increase with the addition of tilapia meat flour. This is caused by the content of various minerals in food ingredients, such as calcium, phosphorus, iron, sodium, potassium, and magnesium (Andarwulan, 2011). When processed into flour, these minerals will be concentrated, especially in tilapia meat flour (Winarno, 2004). Minerals are generally organically bound and heat stable, so they are not lost during roasting. The higher the concentration of tilapia meat meal, the higher the ash content produced in dried sus (Kartika, 2012).

Protein Content

Based on the observation results (Table 4), the protein content of dried sus in the treatment without the addition of 0% tilapia meat flour is 8.22% and the moisture content of dried sus in the treatment of 15% tilapia fish flour addition is 12.35%. The protein content of the two treatments has a difference when compared to the quality requirements of biscuits based on SNI 01-2973-1992 which states that the minimum protein content in biscuits is 9%, so the protein content of the dried sus produced is only the additional of 15% which meets the SNI requirements.

Tilapia meat flour which is rich in protein (71.02%) causes an increase in the protein content of dry sus. Tilapia flour contains myofibril, sarcoplasmic, and stromal proteins that are rich in essential amino acids, playing an important role in the physiological functions of the body (Pratiwi, 2013; Manteu *et al.* 2017). Tilapia meal protein has high biological value, is easily digestible, and is rich in micronutrients such as minerals and vitamins (Oluwamukomi and Adeyemi 2015). The more water that evaporates, the higher the measured protein content in dry sus (Pratama *et al*. 2014). Protein from tilapia flour can affect the characteristics of dried sus, but the amount of addition must be considered so that it is not too dominant (Oluwamukomi & Adeyemi, 2015).

Fat Content

Based on the observation results (Table 4), the fat content of dried sus in the treatment without the addition of 0% tilapia meat flour was 29.16% and the fat content of dried sus in the treatment with the addition of 15% tilapia fish flour was 31.95%. The fat content of the two treatments was above the range of fat content required by the biscuit quality requirements based on SNI 01-2973-1992 which

states that the minimum fat content in biscuits is 9.5%, so the fat content of the dried sus produced meets the SNI requirements.

The addition of tilapia meat meal to dried sus increases the fat content, especially unsaturated fatty acids such as omega-3 (EPA and DHA) which have many health benefits (Dewi & Putri, 2018). Although the roasting process may cause some of the unsaturated fatty acids to hydrolyze, the content is still higher than that of dried sus without the addition of fishmeal (Putri & Susanto, 2014). Tilapia fat also has a more balanced ratio of omega-3 and omega-6, important for heart health (Dewi & Putri, 2018). The addition of tilapia flour can also improve the organoleptic properties of dry sus, but the high-fat content is thought to be caused by the use of margarine and fat-rich eggs (Dewi & Putri, 2018; Ulfa *et al*. 2017).

Carbohydrate Content

Based on the observation results (Table 4), the carbohydrate content of dried sus in the treatment without the addition of 0% tilapia meat flour is 51.35% and the carbohydrate content of dried sus in the treatment with the addition of 15% tilapia fish flour is 45.52%. The carbohydrate content of the two treatments was lower than the carbohydrate content required by the biscuit quality requirements based on SNI 01-2973-1992 which states that the minimum carbohydrate content in biscuits is 70%, so the carbohydrate content of the dried sus produced did not meet the SNI requirements.

The low carbohydrate content of the dried sus can affect several product characteristics, such as a texture that is less sturdy and easily brittle, and a taste that is less sweet and savory. The color of this product also tends to be less brownish due to the low carbohydrate content. Some of the factors that cause this low carbohydrate content include the amount of wheat flour used which is not too much, the heating process which causes denaturation of carbohydrates, and the addition of tilapia meat flour which has a low carbohydrate content, which is around 1.2-2.5% (Manteu *et al.* 2017), with the focus of using tilapia flour more on protein. In addition, the processing process also plays a role in affecting carbohydrate content, where carbohydrates can break down into simpler compounds such as glucose and lactic acid (Irianto & Giyatmi 2009). The reduction of water content during processing can affect the measurement of carbohydrates and other proximate values, so these two factors explain the variation in carbohydrate values in processed products (Pratama *et al.* 2014).

CONCLUSION

The addition of Tilapia meat flour to all dry sus treatments is still accepted by panelists with the most preferred treatment being the 15% treatment which has an appearance value of 8.0; aroma of 7.7; texture of 8.4; taste of 7.9 with a moisture content of 4.86, ash content 2.91%, protein content 12.35%, fat content 31.95%, and carbohydrate content 45.52%.

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