




# Soaking Natrium Metabisulfit ( $\text{Na}_2\text{S}_2\text{O}_5$ ) at Different Concentrations Affects the Acceptability of Cakalang Fish Cookies (*Katsuwonus pelamis*)

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**Abstract.** Preparing tuna flour through heating causes a browning reaction due to the Maillard reaction (reaction between reducing sugars and amino acids accompanied by heating). Soaking tuna meat in sodium metabisulfite solution ( $\text{Na}_2\text{S}_2\text{O}_5$ ) at a higher concentration (0.5%) will inhibit enzymatic and non-enzymatic browning reactions (heating) better so that the color of tuna flour is brighter yellow than soaking with a lower concentration of  $\text{Na}_2\text{S}_2\text{O}_5$ . This study aims to determine the effect of  $\text{Na}_2\text{S}_2\text{O}_5$  soaking at different concentrations on the acceptability of tuna fish cookies. Experimental research, randomized complete block design (CRD), three treatments, F0 = control, immersion of fish meat in 0%  $\text{Na}_2\text{S}_2\text{O}_5$ ; F1 = immersion of 0.25%  $\text{Na}_2\text{S}_2\text{O}_5$  solution; F2 = immersion of 0.5%  $\text{Na}_2\text{S}_2\text{O}_5$  solution. Organoleptic test using a hedonic test (liking) with five scales, 30 semi-trained panelists, carried out at the Food Science Laboratory of the Nutrition Department of Kendari Health Polytechnic. The chemical composition of selected cookies, including protein, fat, carbohydrate, water content, and sulfite content, was measured at the Biology Laboratory of FMIPA UHO Kendari in May 2023. Data analysis used the SPSS program. It is known that panelists' acceptance of 3 treatments of skipjack fish cookies in the aspects of color, aroma, and texture shows no significant difference, while in the taste of cookies, there is a significant difference.  $\text{Na}_2\text{S}_2\text{O}_5$  can cause it to be a type of salt where a higher concentration (0.5%) makes the cookies taste savory. Based on color, aroma, texture, and taste attributes, F2 tuna cookies have the highest percentage compared to F0 and F1 treatments. Cookies F2 has a protein content of 6.90 g, fat of 8.90 g, carbohydrates of 25.80 g, and water content of 4.10%. and sulfite content <0.01%. It is expected that people can consume F2 skipjack fish cookie products; besides being liked, they also have a high nutritional content, especially carbohydrates, which are suitable for liver disease patients.

**Keywords:** cookies, skipjack tuna, sodium metabisulfite.

## 1. Introduction

Skipjack (*Katsuwonus pelamis*) is one type of fish with good nutritional content, having a protein content of 20.15%; fat 3.39%, carbohydrates 2.35%, ash 1.94% and water 73.03%. The fifteen different types of amino acids that make up skipjack protein are

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nine of them essential and six of them non-essential [1]. In line with the statement [2] that skipjack has a high protein content ( $24.13 \pm 2.01\%$ ). Not much fat is present, and most of the fatty acid composition is made up of omega-3 fatty acids, which are very beneficial to health. In addition, skipjack is rich in essential minerals in the human body, such as Fe, Cu, and Zn (24.05, 5.04, and 6.89 mg/kg-1, respectively).

In skipjack, the white meat and red meat each have advantages and disadvantages. Skipjack white meat contains higher protein and is less prone to rancidity, but high histamine levels. Whereas in the red meat, the histamine content is lower than the white meat, because the red meat of tuna has a higher content of Trimethyl Amine Oxide (TMAO), which functions to inhibit the process of histamine formation. The red color of fish meat is due to the content of myoglobin and hemoglobin, hemoproteins composed of myoety proteins, globin and heme structures, which are prooxidant and rich in fat, this causes easy rancidity caused by oxidation of fat in red fish meat [3].

Histamine levels are used as an indicator of the quality and food safety of tuna products, because high histamine causes toxic effects in humans [4]. Fish biogenic amines, such as histamine, are generated by microbes with decarboxylase activity. These substances are normally eliminated from the body by oxidases in the gastrointestinal system; nevertheless, ingestion of these compounds through food can be hazardous in some situations due to alcoholism, enzyme deficiencies, or the use of monoamino oxidase antidepressants [5]. So that to prevent rancidity in red meat and histamine formation in skipjack, it is necessary to carry out a processing process that aims to increase its economic value and durability [6].

Tan et al. stated that the addition of ascorbic acid and/or sodium metabisulfite ( $\text{Na}_2\text{S}_2\text{O}_5$ ) significantly ( $p < 0.05$ ) reduced the brown discoloration of thermally processed green coconut water [7]. Sodium metamethabisulfite is about 35 times more effective than ascorbic acid, so it can be suggested as a useful way to prevent browning and rancidity in thermally treated green coconut water.

The addition of sodium metabisulfite must be in accordance with the standards applied by BPOM No. 36 of 2013 which does not exceed  $200 \text{ mg}^{-1}/\text{kg}$  for food products. If exceeding the maximum limit causes an allergic reaction (Trianawati, et al., 2022).

The concentration of sodium metamethabisulphite had an effect in reducing the moisture content, ash content and red color intensity of pumpkin flour. Water absorption, protein content, and lipid content were unaffected by the concentration of sodium metamethabisulfite. The amount of time spent soaking affected the amount of  $\beta$ -carotene, fat, ash, and crude fiber that was reduced and increased in solubility and dispersion power. On the other hand, the amount of protein and water absorbed were unaffected by the soaking period (Rahayu and Lestari, 2020).

Skipjack is a perishable food, without proper handling, after approximately 8 hours of fishing the fish begins to undergo changes that show signs of damage. To reduce losses, especially when fishing is abundant, it is necessary to process through diversification of processed fish. Diversification of processed fish aims to increase the economic value of fish, with changes in taste, aroma, shape, texture and aims to preserve fresh fish (Mughtar, et al., 2022).

One of the diversifications of processed fish is the making of cookies by utilizing fish meat. Sweet-tasting pastries, cookies are created by combining eggs, oil, powdered sugar, and wheat flour. After that, they were formed, spread out on a baking sheet

coated with margarine, and cooked in the oven. The characteristic of cookies is dry and crispy, cookies or pastries are one of the snacks whose maturation process is by baking [10].

Research result's [11] showed that the use of tuna in making cookies as much as 20% had the highest protein content, which amounted to 9.1% per 100 grams. Based on the explanation, the goal of this study is to examine how different sodium metabisulfite soaking concentrations affect the chemical makeup and acceptance of tuna cookies.

## 2. Methods

Type of experimental research, complete randomized design (RAL) design. with three (3) types of treatment. In this study, cookies were made by adding tuna flour. Where before making flour, tuna meat is soaked in sodium metabisulfite solution ( $\text{Na}_2\text{S}_2\text{O}_5$ ) at three different concentrations for 20 minutes. Treatment F0 = control, immersion of fish meat in 0% sodium metabisulfite; F1 = immersion of fish meat in 0.25% sodium metabisulfite; F2 = immersion of fish meat in 0.5% sodium metabisulfite.

Organoleptic test using hedonic test (liking) with 5 scales (5 = very like, 4 = like, 3 = somewhat like, 2 = dislike, 1 = very dislike), semi trained panelists as many as 30 people, carried out at the Food Science Laboratory of the Nutrition Department of Kendari Health Polytechnic.

Measurement of protein, fat, carbohydrate, fat content, water content and sulfite content in the most preferred cookies, at the Biology Laboratory of FMIPA Haluoleo University Kendari. The research was conducted in May 2023. Organoleptic test data (hedonic test) was analyzed using Kruskal wallis test. Data on protein, fat, carbohydrate, fat content, water content and sulfite content were analyzed descriptively. This research was conducted after obtaining an ethical clearance letter from the Ethical Commission for Health Research (KEPK) of the Regional Board of the Association of Public Health Experts of Southeast Sulawesi Province, Number 77/KEPK-IAKMI/VI/2023.

### 2.1 Making Skipjack Fish Cookies

#### a. Tools and Materials

The equipment used in this study include: food scales, analytical balance, spatula, 100 ml beaker glass, steamer, knife, basin, mixer, spatula, plastic, rolling pin, stove cake mold, and oven.

Ingredients used: skipjack meat, sodium metabisulfite, distilled water, wheat flour, vanilla powder, baking powder, margarine, powdered sugar, milk powder, egg yolk.

Making tuna cookies starts with making tuna flour, in the following way.

1. Making tuna filet (separating the head, entrails, bones, skin), the fish is cleaned, washed and then weighed each skipjack meat as much as 116 grams for 3 (three) soaking treatments.
2. Preparation of 0%, 0.25% and 0.5% sodium metabisulfite solution.  
F0 = control treatment = immersion of skipjack meat filets in 1 liter of distilled water without the addition of sodium metabisulfite (0%).  
F1 = treatment 1 = immersion of tuna meat filets in 1 liter of distilled water + 0.029 gram of sodium metabisulfite (0.25%).

- F2 = treatment 2 = immersion of tuna meat filet in 1 liter of distilled water + 0.058 gram of sodium metabisulfite (0.5%).
3. Soak skipjack meat filets in each sodium metabisulphite solution for 20 minutes, drain and steam for 15 minutes, cool. for 20 minutes, drain and then steamed for 15 minutes, cool.
  4. Fish meat is then reduced in size by shredding. Next dried in an oven at 150oC for 25 minutes. The dried fish meat was pulverized with a blender and sieved using 80 mesh sieve, packed in vacuum plastic. The formulation of tuna cookies in this study can be seen in Table 1.

**Table 1.** Formulation of Skipjack Fish Cookies

Ingredients (gram)	F0 (0%)	F1 (0,25%)	F2 (0,5%)
Tuna flour	116	116	116
Wheat flour	250	250	250
Margarine	150	150	150
Refined sugar	100	100	100
Egg yolk	50	50	50
Maizena	10	10	10
Milk powder	5	5	5
Baking powder	1	1	1
Vanilla powder	6	6	6

Source:(Agustina & Astuti, 2015 C.E.) modified by the author

#### **b. How to make skipjack cookies**

1. Butter and powdered sugar are mixed using a mixer, add egg yolks, continue mixing until smooth.
2. Mix well all the flour, baking soda, milk powder, vanilla, tuna flour, then slowly add to the dough No.1, stir until evenly mixed.
3. Prepare plastic as a base to coat the dough, after that use a rolling pin to thin or flatten the dough by pressing and pushing so that a thin dough is obtained.
4. Print the biscuits using a cake mold.
5. Bake in a 160°C oven for 40 minutes until cooked, cool the biscuits, pack in plastic jars.
6. Conduct organoleptic testing to determine the acceptability of each cookie, and chemical composition testing of the most preferred treatment cookies.

### **3. Results**

#### **1. Acceptability Based on Color Aspects of Skipjack Fish Cookies**

Product F2 is the most popular tuna fish cookie, as indicated by the study's approval of color, as shown in Table 2.

**Table 2.** Acceptability of Tuna Fish Cookies Color

Category	F0		F1		F2		p
	n	%	n	%	n	%	
Very Favorable	2	6,7	8	26,7	10	33,3	p = 0,06
Like	8	26,7	13	43,3	12	40,0	
Somewhat Like	17	56,7	8	26,7	3	10,0	
Dislikes	3	10,0	0	0	5	16,7	
Strongly Dislike	0	0	1	3,3	0	0	
<b>Total</b>	<b>30</b>	<b>100</b>	<b>30</b>	<b>100</b>	<b>30</b>	<b>100</b>	

Table 2 shows that the percentage of panelist acceptance in the category of very like from the color aspect is 33.3% in the F2 treatment. The acceptance of panelists with the category of dislike from the color aspect is 16.7% in the F0 product. Based on the results of the Kruskal-Wallis test, the p-value = 0.06 was obtained. So, there is no difference in acceptance of the color of tuna fish cookies.

## 2. Acceptability Based on Aroma Aspects

Based on the results of the study of acceptance of the aroma of the most preferred tuna fish cookies are product F2, which can be seen in Table 3.

**Table 3.** Acceptability of aroma of skipjack fish cookies

Category	F0		F1		F2		p
	n	%	n	%	n	%	
Very Favorable	7	23,3	6	22,6	11	36,7	p = 0,293
Like	11	36,7	13	41,9	11	36,7	
Somewhat Like	7	23,3	8	25,8	7	23,3	
Dislikes	4	13,3	3	9,7	1	3,3	
Strongly Dislike	1	3,3	0	0	0	0	
<b>Total</b>	<b>30</b>	<b>100</b>	<b>30</b>	<b>100</b>	<b>30</b>	<b>100</b>	

Table 3 shows the percentage of panelist acceptance in the category of very like the aroma aspect, namely in the F2 treatment 36.7%. The acceptance of panelists with the category of dislike from the aspect of aroma is in the F0 product 16.6%. Based on the results of the Kruskal-wallis test, the p value = 0.293 was obtained so it can be concluded that there is no difference in acceptance of the aroma of tuna fish cookies.

## 3. Acceptability Based on Flavor Aspects

Based on the results of the study of acceptance of the flavor of the most preferred tuna fish cookies is product F2, which can be seen in Table 4.

**Table 4.** Acceptability of Tuna Fish Cookies Flavor

Category	F0		F1		F2		p
	n	%	n	%	n	%	
Very Favorable	3	10,0	6	20,0	14	46,7	p = 0,015
Like	11	36,7	14	46,7	7	23,3	
Somewhat Like	10	33,3	7	23,3	7	23,3	
Dislikes	5	16,7	2	6,7	1	3,3	
Strongly Dislike	1	3,3	1	3,3	1	3,3	
<b>Total</b>	<b>30</b>	<b>100</b>	<b>30</b>	<b>100</b>	<b>30</b>	<b>100</b>	

Table 4 shows the percentage of panelist acceptance in the category of very like from the aspect of taste, namely in treatment F2: 46.7%. The acceptance of panelists with the category of dislike from the aspect of taste is in product F0: 20%. Based on the results of the Kruskal-Wallis test, the p-value = 0.015 was obtained. So, it can be concluded that there are differences in acceptance of the taste of tuna cookies.

#### 4. Acceptability Based on Texture

Based on the results of the study of acceptance of texture on the most preferred tuna cookies is product F2, which can be seen in Table 5.

**Table 5.** Acceptability of Tuna Fish Cookies Texture

Category	F0		F1		F2		p
	n	%	n	%	n	%	
Very Favorable	1	3,3	6	20,0	9	30,0	p = 0,23
Like	8	26,7	11	36,7	9	30,0	
Somewhat Like	15	50,0	10	33,3	8	26,7	
Dislikes	5	16,7	2	6,7	3	10,0	
Strongly Dislike	1	3,3	1	3,3	1	3,3	
<b>Total</b>	<b>30</b>	<b>100</b>	<b>30</b>	<b>100</b>	<b>30</b>	<b>100</b>	

Table 5 shows the percentage of panelist acceptance with a similar category from the texture aspect, namely the 30% F2 treatment. The acceptance of panelists with the category of dislike from the texture aspect is in the 20% F0 product. Based on the results of the Kruskal-Wallis test, the p-value = 0.23 was obtained. So, there is no difference in acceptance of the texture of tuna fish cookies.

#### 5. Level of Favorability

Based on table 6, the average overall attribute combination (Overall) of tuna fish cookies that is most accepted and preferred by panelists is product F2, namely (3.95).

**Table 6.** Distribution Based on Level of Favorability

Category	Cookies		
	F0	F1	F2
Color	3,3	3,9	3,9
Aroma	3,6	3,8	4,1
Taste	3,3	3,7	4,1
Texture	3,1	3,6	3,7
<b>Total</b>	13,3	15	15,8
<b>Average</b>	<b>3,33</b>	<b>3,75</b>	<b>3,95</b>

The results showed that panelists most preferred product F2 (3.95). This is because the sodium metabisulfite concentration of product F2 is higher, which has a real effect on the quality of tuna fish cookies.

## 6. Chemical composition of tuna fish cookies

The results of the chemical composition test of tuna fish cookies most favored by panelists (F2) were conducted at the Chemistry Laboratory of the Faculty of Mathematics and Natural Sciences, Halu Oleo University, Kendari. The results of the chemical composition test of skipjack fish cookies can be seen in Table 7.

**Table 7.** Chemical composition of tuna fish cookies

Parameter (gram/100 g)	Content	Analysis Method
Protein	6,90	Kjeldhal
Fat	8,90	Soxhlet
Carbohydrates	25,80	Luff Schoorall
Water content	4,10	Gravimetri
Sulfite content	< 0,001	Spektrofotometri

As shown in Table 7, the results of the proximate analysis test and the content of water content and sulfite content in tuna cookies in 100 g are water content (4.10%), sulfite content (<0.001%), protein content (6.90%), fat content (8.90%), and carbohydrate content (25.80%).

## 4. Discussion

### 4.1 Acceptability of Skipjack Fish Cookies

#### a. Based on Color Aspect

The organoleptic test of the panelists' level of liking for color in Table 1, it shows that the highest score or the most preferred by the panelists was obtained in F2 with a percentage of 73.3% (n = 22) with a sodium metabisulfite concentration of 0.5% for a soaking time of 20 minutes, the panelists preferred treatment F2 because the resulting color was brighter and attractive to the panelists.

The concentration of sodium metabisulfite significantly influenced the number of panelists who liked the color of the tuna cookies. This is because sulfites can inhibit the browning reaction catalyzed by the phenolase enzyme and can block the reaction that results in the formation of 5 hydroxyl metal furfural compounds from D-glucose, which gives the cookies their brown color. This is in accordance with research [13], which stated that pumpkin flour with 0.3% sodium metabisulfite soaking gave the highest brightness value of 75.98%.

The organoleptic test on the control product (F0), the color of the cookies tends to be more brown, this is thought to be because the control treatment is not soaked in sodium metabisulfite solution which causes the intensity of the brown color to increase. So that panelists don't like the color of the cookies produced.

#### b. Based on Aroma Aspect

The results of the organoleptic test on the panelists' liking of the aroma are in Table 2. Shows that the highest score or the most favored by the panelists was obtained in F2 with a percentage of 73.4% (n = 22) with a concentration of 0.5% sodium metabisulfite with a soaking time of 20 minutes; this is following the research conducted by [14] the blanching process, the allinase enzyme which has a role as a catalyst in the reaction of S-alk(en)yl cysteine sulfoxides (ACSOs) compounds with oxygen to produce sulfenic acid, ammonia and pyruvate (which make the characteristic aroma and flavor of shallots) becomes inactive. The results of the organoleptic test on the aroma of cookies showed that the control treatment (F0) still had a distinctive aroma of tuna meat, causing panelists to dislike the product.

### c. Based on Taste Aspects

The results of the organoleptic test on panelists' liking of taste are in Table 10. shows that the highest score or the most preferred by panelists was obtained in F2 with a percentage of very like 70% (n = 21) with a concentration of sodium metabisulfite 0.5% soaking time of 20 minutes. This is because soaking is carried out during the F2 treatment, which significantly affects the taste of tuna cookies. This is in line with research conducted by [15], which states that sodium metabisulfite absorbed in foodstuffs becomes one of the organic preservatives in food, whereas sodium metabisulfite is a salt that can suppress the growth of microorganisms and make the taste and eat savory.

### d. Based on Texture Aspect

From the results of the organoleptic test on panelists' liking of the texture in Table 5. shows that the highest score or the most preferred by panelists was obtained in F2 with a percentage of 60.0% (n = 18) with a concentration of 0.5% sodium metabisulfite. This causes the water content to decrease so that the texture of tuna cookies is crisper. This is in accordance with the statement [16] who conducted research on wheat flour cookies with banana flour substitution that the ease of breaking is strongly influenced by water content. The less water content in a material makes the texture drier so that it will result in cookies that are more easily broken.

### e. Level of favorability

Based on the research conducted, it shows that the average number of scores, on the attributes of color, aroma, taste, and texture can be seen that the largest score is in treatment F2 with an average number of scores (3.95) which means that product F2 is preferred by panelists, compared to product F1 (3.73) and F0 (3.25).

## 4.2 Chemical Composition of Selected Skipjack Fish Cookies

### a. Protein

Based on the proximate analysis test results on tuna fish cookies (sodium metabisulfite concentration of 0.5% with a soaking time of 20 minutes), the protein content was 6.90 grams.

**b. Fat**

Based on the results of the proximate analysis test on tuna fish cookies products (sodium metabisulfite concentration of 0.5% with a soaking time of 20 minutes) produces fat content of 8.90 grams.

**c. Carbohydrate**

Based on the results of the proximate analysis test on tuna fish cookies (sodium metabisulfite concentration of 0.5% with a soaking time of 20 minutes) produced a carbohydrate content of 25.80 grams.

**d. Water content**

Based on the results of the proximate analysis test on the product of tuna cookies (sodium metabisulfite concentration of 0.5% with a soaking time of 20 minutes), the real effect produced 4.10%. while treatment F1 concentration of sodium metabisulfite 0.25% produces a moisture content of 6.80%. this is in accordance with the research conducted [17] that the higher the concentration of sodium metabisulfite ( $\text{Na}_2\text{S}_2\text{O}_5$ ), the lower the water content. The low water content is because sodium metabisulfite can damage the pumpkin (*Cucurbita moschata*) tissue.

**e. Sulfite content**

Based on the results of the proximate analysis test on the product of tuna cookies (concentration of sodium metabisulfite 0.5%) has a significant effect on producing sulfite levels ( $p < 0.01$ ), this is in accordance with the safe limit of sulfite usage according to BPOM No. 36 of 2013 which does not exceed 200 mg-1gr/kg for food products and if it exceeds the safe limit it will cause allergies. According to [18] that the higher the addition of sodium metabisulfite concentration, the higher the sulfite residue. (Tan et al., 2015) stated that sulfite is a strong inhibitor that is effective in inhibiting browning and has long been used in the food industry. However, excessive use is prohibited by WHO because it will have a negative impact, especially for people with asthma.

**5. Conclusion**

Based on the colour attributes of tuna cookies, the most preferred panellists are in treatment F2 with a sodium metabisulfite concentration of 0,5%. Based on the aroma attributes of tuna cookies, the panellists liked the treatment F2 with 0.5% sodium metabisulfite concentration the most. Based on the taste attributes of tuna cookies, the panellists liked the treatment F2 the most, with a concentration of sodium metabisulfite ( $\text{Na}_2\text{S}_2\text{O}_5$ ) at 0,5%. Based on the texture attributes of tuna cookies, the most preferred panellists were in treatment F2 with a sodium metabisulfite concentration of 0,5%. Based on the average level of overall attribute preference, the most preferred tuna fish cookies in terms of colour, aroma, taste, and texture are treatment F2, with an average value of 3.95.

Then, the proximate test results of tuna cookies in the F2 treatment are protein 6.90 grams, fat 8.90 grams, carbohydrates 25.80 grams, water content 4.10%, and sulfite content  $<0.01\%$ . The results of weighing the cookies of the three treatments F0, F1 and

F2, the average weight of cookies per piece is 6 grams, so that in 100 grams of tuna cookie dough ingredients, 15 pieces of cookies are produced. The relatively high carbohydrate content of tuna cookies (25.80 grams) is suitable for patients who need a high carbohydrate diet, one of which can be given to patients with liver disease, where high energy is needed to prevent the breakdown of body protein. The provision of high carbohydrates in liver disease patients aims to prevent weight loss or increase patient weight if the patient is underweight.

### Suggestion

It is anticipated that people would be able to eat skipjack fish cookies since, in addition to being tasty, they are abundant in nutrients, particularly carbs, which are beneficial for liver illness.

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