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Sensory and Proximate Test of the Red Snapper *Lutjanus* sp. Bone Meal Biscuits

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ABSTRACT

The Red snapper (*Lutjanus* sp.) is a type of demersal fish with white flesh and high value. The red snapper has not been optimally utilized; one of the uses of this fish is making fish bone meal biscuits by diversifying fish bone meal products into biscuits. This research aimed to determine the characteristics of the red snapper bone meal biscuits based on chemical and sensory composition. The research method used was the experimental method of processing fish bone meal biscuits using 300 grams of wheat flour and 10 grams of fish bone meal and baking them at a temperature of 120°C for 25 minutes. The test parameters included proximate analysis, calcium, and organoleptic parameters, namely color, texture, taste and smell. The analysis results showed that the red snapper (*Lutjanus* sp.) bone meal biscuits contain 42.67% calcium, 4.19% ash, 21.50% fat, 27.50%water content,7.93% protein, and recoded values of 3.97 for color sensor, 4.67 for taste, 3.63 for smell,and 4.33 for texture.

INTRODUCTION

The potential for the red snapper is very large, namely 312,945 tons, with an increase of 4.32%. This fish is very liked by people inside and outside the country. A fish individual has a bone content of 12.4% of its body weight. This fish also contains vitamins such as B3, niacin, B12, B6, protein, phosphorus, vitamin D, and potassium. Additionally, tuna and snapper also contain choline, vitamin B1 (thiamin), magnesium, vitamin B2 (riboflavin), iodine, and calcium, which are very beneficial for the human body. In general, the fish bones consist of calcium and phosphorus compounds. The minerals phosphorus and calcium both have important roles for the living organisms.

Phosphorus is found in countless animals and plants and can be found in body fluids and almost all food. For bone formation, phosphorus plays a role in the process of muscle contraction with medication or food supplements, this is called phosphate. Calcium per day intake for each age group is different; for toddlers aged 7-11 months, it is 260mg/day; for children aged 1-3 years, they need 700mg of calcium/day; for children aged 4-8 years, they need 1000mg/day, and for children aged 9- 18 years, a dose of 1,300mg/day is required. Whereas, those with an age range from 19-50 years old, they need 2,500mg/day, and for pregnant women, a dose of 1200mg/day is required, and 2000mg/day for those aged 51 years and over **(Global, 2024)**. It is worth noting that, an excess calcium can cause hypercalcemia which can cause bones to become weak and can reduce kidney and heart function, constipation or difficulty defecating. While, calcium deficiency during growth can cause impaired bone growth, osteoporosis, and osteomalacia

On the other hand, phosphorus is found in foods such as eggs, milk, fish, beef, and poultry. Fish bones are the raw material for making fish bone meal for the human consumption, and the fish bones used are markedly fresh and have not experienced inflammation. Fish bones are processed into fish bone meal, which has an economic value. This fish bone meal can be used in various products such as animal feed, food, and drinks. Among the snack foods made from the red snapper bone meal are the biscuits. Biscuits represent a snack that everyone likes because they are delicious, and small & easy to carry anywhere. Biscuits are crunchy snacks made from wheat flour with other additional ingredients and then baked and can be stored for a long time **(Handayani*et al.*, 2020)**. Biscuits are a type of snack that is very popular with all levels of society, from children to adults.

Many types of biscuits have been developed to produce quality products from both nutritional and sensory aspects. Apart from having a delicious taste, biscuits are also available in various types, flavors, and shapes **(Muzaki *et al.*, 2021)**.The types of biscuits that are widely available on the market are cookies, sandwiches, low calorie, low fat, low sugar, baby and toddler biscuits, and crackers, while biscuits with special specifications, namely containing calcium, are not often found in the market.

Based on the aforementioned explanations, it was necessary to conduct a research on processing the red snapper fish bones into a fish bone meal and then incorporate it into biscuit food products, and subsequently determine the chemical composition of calcium and the sensory content in the processed products.

Notably, this process aimed to add an economic value and provide an added value to the fish bone waste, making it a desirable and diversified food product for the public.

MATERIALS AND METHODS

1. Making fish bone meal biscuits

a. Research methods

The study used the laboratory experimental research methods to make and test samples of the red snapper bone meal biscuits. The tools and materials used in making the red snapper bone flour biscuits were cake molds, digital ovens, scales, jars/plastic. The ingredients needed to make biscuits were the red snapper bone meal, wheat flour, eggs, vanilla, powdered sugar, and powdered milk.

b.Research steps

Making biscuits with the addition of the red snapper fish bone meal was carried out via the following steps: powdered sugar, eggs and margarine were beaten with a mixer for 5 minutes, then the red snapper bone meal and 10 grams of wheat flour were added, followed by stirring until evenly mixed. After that, the dough was molded to a uniform size and baked at 120^0C for 25 minutes, once cooked, removed and cooled and then analyzed.

The prepared fish bone flour biscuits were tested for sensory attributes and proximate composition. Sensory tests, including evaluations of color, taste, smell, and texture, were carried out by 25-30 panelists who filled in the provided scoresheets. Proximate tests, which included measurements of water content, calcium content, ash content, fat content, and protein content, were conducted in the laboratory, and the results were recorded (Fig. 1).

c. Data collection

Below are two data collection tables: one for recording sensory test results (Table 1) and another for recording the proximate test results (Table 2). Sensory data collection using shoresheets was distributed to 25 panelists. The design was as follows:

Table1. Sensory testing of the red snapper (*Lutjanus* sp.) bone meal biscuits

Sample	Parameters											
	Color			Taste			Smell			Texture		
	U1	U2	U3	U1	U2	U3	U1	U2	U3	U1	U2	U3
The red snapper fish bone flour biscuits	4,2	3,9	3,81	4,41	4,8	4,8	3,63	3,46	3,80	4,36	4,67	3,96
average results	11,91/3=3,97			14,01/3=4,67			10,89/3 = 3,63			12,99/3 = 7,93		

Information: U= test

Criteria for color analysis using 25 panelists: 5: pure white; 4: a bit bright; 3: white yellowish yellow; 2: light brown, and 1: dark brown. Criteria for texture analysis using 25-30 panelists: 5: very crispy; 4: crispy; 3: rather hard; 2: hard, and 1: very loud. Criteria for odor analysis using 25 person panelists: 5:very fishy smell; 4: fish smell; 3: medium fish smell; 2: fish smell and1: fish smell. Criteria for taste analysis using 25-30 panelists: 5: very tasty; 4: delicious; 3: not good; 2: not good, and 1: not very good.

The proximate testing results were obtained through laboratory sample analysis, following the research procedures for the proximate testing. The tests were repeated three times, and the average was calculated. The results are depicted in Table (2).

Table 2. Proximate testing of the red snapper (*Lutjanus* sp.) bone meal biscuits

Sample	Parameters														
	Protein			Fat			Ash			Calcium			Water content		
	U1	U2	U3	U1	U2	U3	U1	U2	U3	U1	U2	U3	U1	U2	U3
The red snapper fish bone flour biscuits	7,99	8,81	6,99	21,50	20,80	22,2	4,17	4,10	4,3	42,67	42,34	43,1	27,50	27,65	27,4
average results	23,79/3= 7,93			64,5/3=21,50			12,57/3 = 4,19			128,01/3=42,67			82,5/3=27,50		

Information: U= test

d. Observation

Observations made in this research included proximate biscuits consisting of water, ash, protein, fat and calcium content. Organoleptic observations included color, texture, taste, and smell. The The data were analyzed quantitatively and they were plotted in a graphical form (Fig. 2), followed by a discussion regarding the results obtained in the study. The research results obtained were adjusted to the 2011 Indonesian national standard adhering to the guidelines of**FAO (1972)** including fat, protein, and water content.

e. Sampling

In this study, only 1 sample was used, namely the red snapper bone meal biscuits; several parameters were addressed to examine the red snapper bone meal biscuits (*Lutjanus* sp.), and each parameter was determined thrice. The following parameters were examined: the water content, ash content, protein content, calcium content, and fat content, in addition to the sensory parameters, viz. color, taste, texture, and smell.

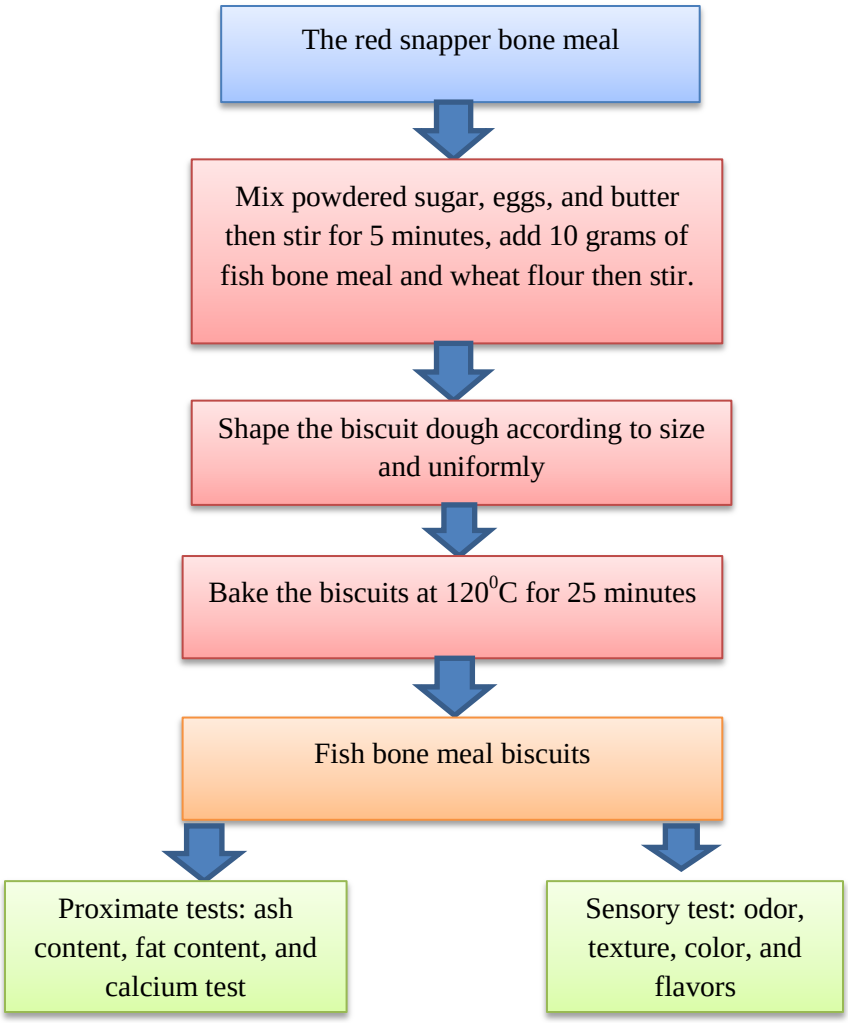

Fig. 1. Flow diagram for making the red snapper fish bone flour biscuits
information; Raw material; Process; Product; Analysis

2. Water content

The porcelain cup was dried in the oven for 30 minutes at a temperature of 100^{0}C, then it was cooledin a desiccator and weighed. Subsequently, the sample weighing 1-2 grams was placed in a porcelain cup and dried in an oven at a temperature of 105°C to 110°C for 3 to 5 hours, depending on the material. After drying, it was cooled in a desiccator for 15 minutes, then reweighed along with the porcelain cup. The water content was calculated using the formula:

$$\text{Water content (\%)} = \frac{A-B}{C} \times 100\ \%$$

Note: A: weight of empty cup (g)
B : weight of cup + initial sample (g)
C: weight of cup + dry sample (g)

3. Ash content

A crucible was prepared for ashing, then heated in a furnace at 100-105°C for 15 minutes, cooled in a desiccator, and weighed. A weight of 5g of the sample was put into a crucible, then burned using a gas burner until the smoke disappeared. For food ingredients with water content, an ashing process was conducted in two stages in the kiln until gray ash was obtained: 1) at a temperature around 300°C, and 2) at a temperature of 420- 550°C. The ashing time varied depending on the material and typically lasted 5- 7 hours. Then, the furnace was turned off. % ash = ash weight (g) / sample weight (g) x 100 or % ash = W2 – W0 X 100 W1 – W0

Where,

W0: weight of empty cup

W1: weight of cup + sample before ashing

W2: weight of cup + sample after ashing

4. Protein levels

Protein levels were analyzed using the Kjedahl method. A 0.1- 0.5g sample was put into a 100mL Kjeldahl flask, then 40mg HgO was added to 1.9mg K_2SO_4 and 2mL H_2SO_4. The destruction process (heating while boiling) was carried out for 1- 1.5 hours until the solution became clear. The solution that was no longer hot was added with 1-2mL of distilled water and 20mL of 40% NaOH, then distilled. The distillation results were collected in a 125mL Erlenmeyer flask containing a mixture of 5mL H_3BO_3 and 2-4 drops of indicator (2 parts 0.2% methyl red in alcohol and 1 part 0.2% methylene blue in alcohol). The diluted sample was added to 8- 10mL of NaOH-$Na_2S_2O_3$. Distillation was stopped after the distillate volume became 15mL, and then diluted to 50mL. The distillation result was titrated with 0.02 N HCl from the burette until it turned pink. The same treatment was also carried out for the blank. The total nitrogen content was calculated as follows:

N (%) = (A-B)x NHCl x 14 x 100

sample (mg)

Where,

Protein content = % N x Conversion factor

A = mL sample titration

B = mL blank titration

Conversion factor = 6.25

5. Fat content

Determination of the fat content was carried out using the Soxhlet method. The fat flask was dried in the oven for 1 hour (T = 100–105°C) then cooled in a desiccator for 15 minutes. A 2g sample was spread on cotton, then wrapped in a filter paper, and placed in a Soxhlet flask. The sample was extracted for 4- 5 hours with 150ml of a fat solvent in

the form of hexane. The extracted fat was dried in an oven at a temperature of 100-105°C for 60 minutes. The fat flask was cooled in a desiccator for 20-30 minutes and weighed.

6. Calcium levels

For the determination of calcium content **(Indonesian National Standards, 1992)**, samples containing 0.3 grams of solids were weighed and placed in a fessel tube; 5mL of HNO3 was added, and then heated in a microwave for 47 minutes. Subsequently, the fessel tube was allowed to cool for 3 hours. The sample was transferred into a volumetric flask, and 100mL of distilled water (aquabidest) was added, resulting in a colorless solution. The sample was then diluted to a specific volume (aliquot, 100mL). Next, the diluted sample was analyzed using an AAS (Atomic Absorption Spectroscopy) atomization flame at a wavelength of 422.7nm. The formula used for calculating the calcium level is as follows:

$$\%Ca = \frac{(read - blank) \times volume\ (L) X\ FP}{Mg\ sample}$$

7. Odor parameters

To determine the odor sensory parameter, the fish bone meal biscuits were put in a plastic clip, then prepared and filled in on a score sheet with odor analysis criteria using 25- 30 panelists, with 5: very fishy smell; 4: fish smell; 3: medium fish odor; 2: fish odor, and 1: fish smell.

8. Texture parameters

Determining the texture of fish bone meal biscuits was carried out using the fish bone meal biscuits which were inserted into a plastic clip, then a score sheet was made with several texture analysis criteria using 25-30 panelists, with 5: Like it very much; 4. like it very much; 3: neutral; 2: dislike, and 1: Don't like it at all.

9. Color parameters

Color determination was carried out using fish bone flour biscuits inserted into plastic clips, then a score sheet was prepared with several color analysis criteria using 25-30 panelists: 5: pure white 4; a bit bright; 3: white yellowish; 2: light brown, and 1: dark brown.

10. Flavors parameters

The taste of fish bone flour biscuits assessed using fish bone flour biscuits in a plastic clip, then a score sheet was made with several texture analysis criteria using 25-

30 panelists, for with 5 like it very much; 4: like it very much; 3 for neutral; 2 for dislike, and 1. for don't like it at all (**Rahman *et al.*, 2019)**.

11. Data analysis

The data were analyzed descriptively quantitatively by **(Indonesian National Standards, 2011)** tabulating the data then looking for the average value and presenting it in the form of Tables and graphs. The chemical composition of the biscuits was compared with the Indonesian national standards 01-2973-2011 concerning the quality of fish bone meal biscuits and sensory tests of the biscuits.

RESULTS AND DISCUSSION

1. Proteins

Protein is one of the nutritional contents found in fish. The protein content in fish is not only found in fish flesh but also in fish bones. Protein plays a role in the body's growth process and motor function in humans in this research. The average value of protein content in the red snapper bone meal biscuits is shown in Table (1), namely 7.93%. This protein content value is higher than the protein content value stated in the Indonesian national standards 2011. According to the **Indonesian National Standards (2011)**, the protein content of the commercial biscuits is 7%, and the biscuits must meet the biscuits requirements set by FAO. According to the **FAO (1972)**, the protein content of the biscuits is 8%. Fig. (1) illustrates the histogram depicting the expected increase (7.93%) in the protein content in the fish bone meal biscuits. This is due to the addition of eggs during the biscuit making process so that the protein from the eggs fills the biscuits and the biscuits' protein increases. The addition of certain ingredients that have high protein will increase the protein content of certain ingredients.

2. Water content

Based on data in Table (3), the average value of the water content in the red snapper bone meal biscuits is 27.50%. This water content value is higher than the compared water content value of the Indonesian national standards of 2011; meanwhile, the biscuits must meet the biscuits requirements set by the FAO. According to **FAO (1972)**, the maximum water content in the biscuits is 10%. Moreover, according to the Indonesian national standards of 2011, the maximum water content in biscuits is 5%. The increase in the water content value in this study may be attributed to the use of wheat flour, fish bone meal, and other ingredients added during the process of making the biscuits. **Kaliky (2022a)** elucidated that, adding certain ingredients to a product will increase the water content of the product.

It can be seen from Fig. (2) that the water content value is higher when compared with the parameters of protein, ash, and fat content. This shows that with a water content of this size, the increase in water content is inversely proportional to the value of fat, ash, and protein content. In this research, the wheat flour serves as a binder, as it has the ability to bind water. According to **Tha *et al.* (2019)**, the presence of gluten in wheat flour facilitates water binding, thereby reducing the overall water content in the material.

Table3. Proximate parameters

Parameter	Average value
Protein (%)	7,93
Water content (%)	27,50
Fat (%)	21,50
Ash (%)	4,19
Calcium (%)	42, 67

Source: Prepared by **Author (2024)**

3. Fat content

Fat is one of the most important ingredients in making biscuits. Using fat such as margarine in biscuit dough can produce a crispier texture. In Table (1), the biscuit fat is 21.50%, where the average fat value is higher when compared with the 2011 Indonesian national standards value for fat, while the biscuit must meet the biscuit requirements set by the FAO. According to the **FAO (1972)**, the fat content of biscuits is 0.75%. In this study, the fat value in biscuits is 1%. This variation in fat percentage was caused by the addition of butter during the biscuit making process so that the texture became brittle and soft. Usually fat is one of the important raw materials that is added to the dough. The more fat added to the dough, the more fragile the biscuits produced will be.

The function of fat in food is to improve the quality and savory taste. Almost all food products contain fat in varying degrees. In making biscuits, fat is very necessary. Fat functions as an energy reserve in the form of fat tissue, fat in food provides softness to baked cakes.

4. Ash content

Ash content is the mineral composition contained in a product. Based on the research results presented in Table (1), it can be observed that the average value for the ash content is 4.19%. This ash content value is higher compared to the ash content value listed in the Indonesian national standards 2011 for biscuits; however, the biscuit must meet the biscuit requirements set by the FAO. In this study, the ash content for biscuits is 1.5%. In Fig. (2), it can be seen that the high ash content will affect the protein content, water content, and fat content of the ash content. The ash content of a material describes the amount of minerals that are not burned into substances that can evaporate. According

to **Umiyati *et al.* (2023)**, the ash content is influenced by the mineral content contained in the raw material. Similar results are evident in the study of **Agu *et al.* (2023)**, elucidating that the greater the ash content, the higher the amount of unburned minerals in the material. This increase in ash content is caused by the presence of minerals from fish bone meal contained in the bone meal biscuits. According to research, the majority of the ash and mineral content in the fish bone meal originates from the middle part of the fish's body, resulting in a higher concentration of ash.

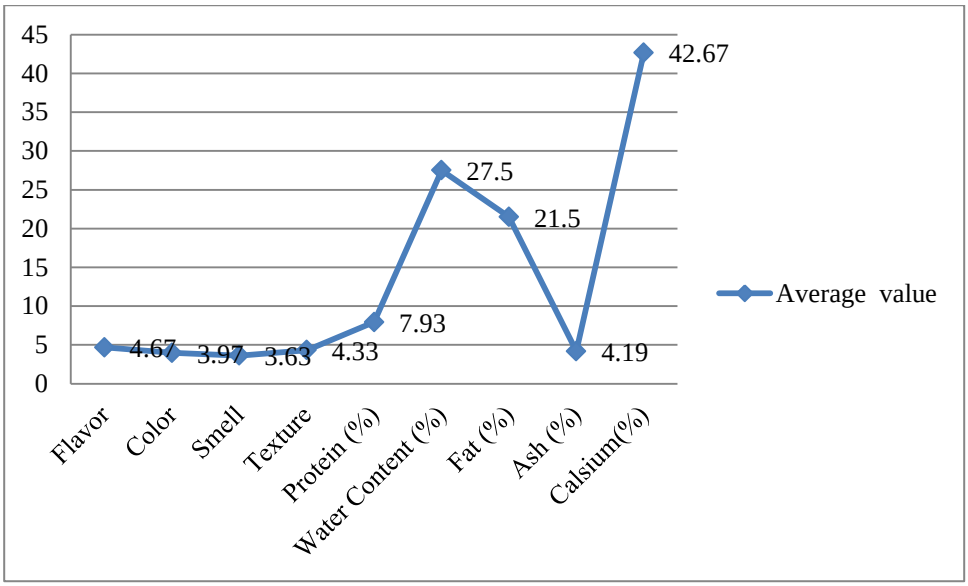

Fig. 2. Graph of sensory, proximate and calcium test parameters

5. Calcium in the product under study

Calcium is a mineral found in fish flesh but also in fish bones. The mineral calcium is needed by the body for the growth of bones and teeth. Calcium deficiency can result in bone loss, nervous system disorders, among others. Based on data tabulated in Table (1), the calcium level produced in the fish bone flour biscuits is 42.67%. The high calcium levels observed are believed to result from the process of making the fish bone flour biscuits, which include the addition of various other ingredients such as eggs. According to **Cheng *et al.* (2016)**, additional ingredients such as eggs, flavors, and composite flours can influence the calcium content of the biscuits. Table (2) reveals that the calcium levels are high. In their study, **Pascoal *et al.* (2023)** postulated that, biscuits are a baked product containing flour, sugar, baking soda, and water.

6. Flavor of the studied product

Taste is one part of the organoleptic test that is related to the sense of taste. Taste is a unity of interaction between the properties of aroma, taste, and texture which constitutes the entire food being assessed **(Asikin *et al.*, 2019)**. Based on Table (2) and Fig. (3), it is

evident that the taste value obtained is 4.67%, corresponding to the criterion of "really like" (score 4). This preference is attributed to the addition of essence and sugar to the fish bone flour biscuits, which has made the panelists interested in and fond of the biscuits. According to **Tingginehe *et al.* (2024)**, the taste can attract the panelists' tastes when giving an assessment. Apart from that, the addition of essence as an additional ingredient aims to improve the taste, texture, aroma, and to make the presentation of food more attractive. Moreover, there are also other additional ingredients such as wheat flour which can improve the texture and taste of biscuits. This is supported by the study of **Sur *et al.* (2020)**, who stated that the taste of biscuits can be influenced by the additional ingredients added to the biscuit dough.

Table 4. Sensory parameters

Parameter	Average value
Flavor	4,67
Color	3,97
Odor	3,63
Texture	4,33

Source: Prepared by Author (2024)

7. Color of the biscuits under study

Color has an important role in consumer choices in case of buying a food product, because unattractive colors reduce the consumer's acceptance of the product. In this study, the color value of the red snapper bone flour biscuits obtained was 3.97, indicating criterion 3 for liking biscuits. The color value of these bone flour biscuits can be seen in Table (2) and Fig. (3). It is assumed that when making fish bone flour biscuits, sugar and wheat flour (gluten) are added. When baked at 120°C for 25 minutes, it is expected that the gluten and sugar will react to produce a desirable color and texture in the bone meal biscuits.Apart from that, the addition of the fish bone meal also affects the color of the biscuits produced.

This was attributed to the addition of the white fish bone flour, which affected the color of the biscuits. Additionally, the inclusion of essence in the fish bone flour biscuits piqued the interest of the panelists. Based on the study of **Kaliky (2022b)**, the raw materials used influence the color of the food product produced.

Fig. 3. Fish bone meal biscuits

8. Odor of the processed product

Smell is an important parameter in determining the level of consumer's liking for a product. From the research results, the odor of the fish bone meal biscuits was scored with 3.63, which is included in the 3 like criterion (medium fish smell). The odor values of the fish bone meal biscuits can be seen in Table (2) and Fig. (3). The smell of the fish bone meal biscuits is classified as a medium odor. It is thought that when making the biscuits, the essence is added to reduce the fish smell in the biscuits. According to **Sunarharum *et al.* (2018)**, aromas that are considered acceptable by the nose include fragrant, sour, rancid, and floral notes.

This is suggested to be related to the aroma of the biscuits produced influenced by the ingredients used to make the biscuits such as vanilla, butter, and the fish bone meal added to the dough. According to **Purnamayati *et al.* (2019)**, the resulting aroma tends to be the same caused by the addition of the same biscuit making ingredients, so the resulting aroma also tends to be the same.

9. Texture of the tested product

Texture is one of the factors that influences consumers upon choosing a food product. Texture is important in both soft foods and crunchy foods. In this study, the texture value of the red snapper bone meal biscuits produced was 4.33, which is included in criterion 4, very like it. The texture value of this biscuit can be seen in Table (2) and Fig. (3). In this study, the texture of the biscuits produced was liked by the panelists since the concentration of the fish bone meal used is 5%, hence the biscuit texture is crispy.

If the concentration is increased, it will produce hard biscuits. According to studies, high levels of calcium and phosphorus in fish bone flour can affect the texture of the cookies, making them harder.

CONCLUSION

The red snapper bone meal biscuits produced in this study recorded proximate test values for the water content (27.50%), protein content (7.93%), fat content (21.50%), ash

content (4.19%), and calcium content (42.67%). While, the resulting sensory test value recorded a color value of 3.97, a taste value of 4.67, a smell value of 3.63, and a texture value of 4.33. For proximate testing, the results are considered good since they meet the SNI standards for biscuits.

CONFLICT OF INTEREST

The authors of this research paper declare that they have no potential personal or economic conflicts of interest with other individuals or organizations that could unduly influence the content of this manuscript.

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