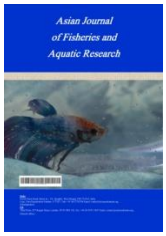

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The Effect of Adding Catfish Bone Flour on the Preference Level of Catfish Meatballs

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Catfish is a commodity in great demand by the Indonesian people because it is easy to process. The utilization of fish bone waste is not optimal because many people only use meat. Fish bones can be processed into flour as a food additive with high calcium. This research aims to determine the appropriate percentage of catfish bone flour added to catfish meatballs and its effects on the preference level among the panelists. This research was conducted at the Fishery Product Processing Laboratory, Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran. This research used an experimental method with 5 treatments of adding catfish bone flour into catfish meatballs: 0%, 5%, 10%, 15%, and 20%. The assessment of the level of preference was carried out by 20 semi-trained panelists. This research observed the organoleptic attributes (appearance, aroma, taste, and texture) and physical characteristic (folding test). Statistical analysis of this research used non-parametric statistics such as Friedman test, followed by a multiple comparison test, and determined the best treatment using the Bayes method. The results of statistical analysis and Bayes showed that the addition of 10% catfish bone flour to catfish meatballs was the best treatment preferred by the panelists.

Keywords: Catfish; fish bone flour; fish meatballs; preference level.

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1. INTRODUCTION

Catfish (*Clarias* sp.) is one of the freshwater fish favored by the people of Indonesia. Catfish has a characteristic of taste, affordable price, neutral aroma, and meat without fine spines, so it can be used as raw material for processed fishery products [1]. Catfish production from 2015-2018 continued to increase; in 2018, it was 1,027,032 tons, but in 2020 it decreased due to the covid-19 pandemic to 347,511 tons, according to statistical data Ministry of Marine Affairs and Fisheries Republic of Indonesia 2021. Other freshwater fish production in 2020 found 127,892, making catfish production superior to other freshwater fish.

Catfish meat is a part that is often used as processed food [2]. The processing triggers the existence of waste that has not been utilized optimally, such as fish bones. Fishbone waste is one of the fisheries wastes whose utilization is not optimal. This is because many fishery processing industries only use meat to produce fishery waste. The edible portion of fish is 65%, meaning that fish produce 35% of waste [3] and 30% of this waste is skin and bone [4]. Fishbone waste has the potential to be used as raw material for a processed product that is beneficial to the human body, such as increasing the calcium content in the body.

Fish bones are solid waste containing elements of calcium, phosphorus, and collagen protein-forming materials [5]. The high calcium content of fish bones shows that it can be used as a source of calcium [6]. Fish bones can be processed into flour first so that when applied, it is easier and can be added to processed foods. Fishbone flour can be added as a fortify in processing products already known to the public.

Food fortification is the addition of micro and macronutrients to a food product that is usually consumed to maintain or increase the food product's nutrition [7]. The primary purpose of fortification is to increase the consumption of added nutrients. Fortification has a clear goal because it can develop a food product that is used as a source of nutrients needed by the community to improve community nutrition [8].

Processed fishery products that have the opportunity to be developed to add nutritional value are fish balls [9]. The advantage of fish balls over other fish jelly products is that fish balls are easy to find and favored by people of all ages [10]. Fish balls are food products that are round in shape, produced from a mixture of fish meat and starch flour or added with permitted food ingredients.

Fortification of the addition of catfish bone flour to catfish meatballs will affect the level of preference. According to research by Rochima [11], increasing the addition of bone flour will result in a slightly chalky aftertaste due to calcium and phosphorus. Adding bone flour can also affect a less compact texture, making it harder and less flat [12]. The fortified products produced must be liked by consumers, so this research needs to be carried out to find the best composition for adding fishbone flour.

2. MATERIALS AND METHODS

2.1 Time and Place of Research

This research was carried out in June-July 2022. The formulation of adding catfish bones flour into catfish meatballs and the assessment of the level of preference was carried out at the Fishery Product Processing Laboratory, Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran.

2.2 Materials

The research materials used were catfish bones, catfish meat, tapioca flour, shallots, garlic, pepper, salt, and ice cubes. The tools used in this research are gas stoves, digital scales, cutting boards, pressure cookers, blenders, sieves, electric ovens, knives, containers, food processors, and pans. The tools used for product assessment are score sheets and paper plates.

2.3 Research Methods

The method used in this research is an experimental method, with 5 treatments of adding catfish bone flour into catfish meatballs, namely 0%, 5%, 10%, 15%, and 20%. The assessment of the level of preference using a hedonic scale was carried out by 20 semi-trained panelists [13]. These panelists are students of the Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran.

2.3.1 Preparation of catfish bone flour

Catfish bone flour is made by using the fish bone making procedure [14]. Fresh fish bones are used in the preparation of flour. Catfish bones

were cut, and then washed with potable running water, steamed for 10 minutes, cleaned again using running water, then boiled for 60 minutes at 100ºC, then cut the bones into small pieces, put in a pressure cooker for 180 minutes at 121ºC, then dried using an oven at 120ºC for 50 minutes, grind the fish bones using a blender and then sieve using a sieve with mesh size of 80.

2.3.2 Preparation of catfish meatballs

The fresh catfish is washed cleaned using potable running water. The meat is separated from the bones and skin, the fish meat in the form of a fillet is crushed with a meat grinder, and the meat is mixed with salt and ice using a food processor until the dough is sticky, then add flour and other spices. Maintain a maximum temperature of 10ºC, and the dough is crushed by hand. The mold is soaked in warm water at 40-70ºC for 10-20 minutes, then boiled in boiling water at 90-100ºC until the meatballs float, then drained until cool.

2.4 Parameters Observation

The parameters observed for the treated catfish meatballs were organoleptic and physical. The organoleptic parameters observed included appearance, aroma, texture, and taste using the 9-point hedonic test (level of preference). The physical parameter observed was the folding test.

2.4.1 Preference level (Hedonic test)

The hedonic test is a way to determine the level of preference for an object to be studied. Parameters observed were aroma, texture, color, and taste in catfish meatballs. The hedonic scale starts from 1-9, which is very much dislike (1), dislike (3), neutral (5), like (7), and very like (9) (Soekarto, 1985). Parameters observed were aroma, texture, color, and taste in catfish meatballs.

2.4.2 Folding test

The folding test is used to determine the strength and elasticity of the gel and is commonly used in industry because it is simple and fast [15]. Testing is done by the folding test, which can determine the level of elasticity. The folding test method for fish balls uses SNI (Indonesian National Standard) 2732.6.2009, with scale starts from 1-5, which is crushed when pressed by a finger (1), cracked when folded once (2), slightly cracked when folded once (3), does not crack when folded once (4), does not crack when folded once folded twice (5).

2.5 Data Analysis

The hedonic test assessment data (preference level) was analyzed statistically using the non-parametrically such as the Friedman test to determine the effect of treatment on the level of preference for catfish meatballs produced. If the treatment has an effect, then the analysis is continued with a multiple comparison test. Then determine the best treatment of adding catfish bone flour to catfish meatballs based on 4 parameters using the Bayes method [16]. Friedman test with the following formula:

$$X^2 = \frac{12}{NK(k+1)} \sum_{d=1}^{k} (Rj)^2 - 3N(K+1)$$

Description:

X^2 = Statistic Friedman test
N = Repetition
Rj^2 = Total ranking of each treatment
K = Treatment

If there are the same numbers, the correction factor (FK) is calculated using the following formula:

$$FK = 1 - \frac{\sum T}{NK\,(K2-1)} \qquad Ho = \frac{X2}{FK}$$

Description:

T = N (t^3-t)
t = The number of observations that are the same for one rank
N = The number of the same observation values for one rank with the same t value

Multiple comparison test is defined by the following formula:

$$|Ri - Rj| \leq Z \left[1 \frac{a}{k(k+1)}\right] \sqrt{\frac{bk(k+1)}{6}}$$

Description:

$|Ri - Rj|$= Difference in average ranking
Ri = Average rating from sample to i
Rj = Average rating from sample to j
α = Experiment wise error rate at 0,05

b = Amount of combined observation data
k = Number of treatments
Z = Values in Table Z for Multiple Comparison

3. RESULTS AND DISCUSSION

3.1 Preference Level

3.1.1 Appearance

Appearance parameters is a consideration for panelists in assessing a food product. Assessment of the level of preference for appearance includes color, size, shape, texture, level of purity, and product carbonation [17].

Based on the results of statistical analysis in Table 1, it shows that the addition of catfish bone flour had no effect on the level of preference for the appearance of catfish meatballs. This is because the bone flour produced was slightly brownish white so that the catfish meatballs produced have a relatively the same color, which was opaque white and had an imperfect round shape. The appearance of catfish meatballs added with catfish bone flour is presented in Fig 1.

The addition of fishbone flour in each treatment did not significantly differ in appearance. This is because the fish bone flour produced in this research is slightly brownish-white in color, so the catfish meatballs' color was relatively the same. This was in line with research Saputra's [18], the results of the addition of tuna bone flour have no significant effect on the level of preference for the appearance of fish balls. Supported by research by Nur [19], the addition of patin bone flour did not affect the preference level for vermicelli.

The 10% treatment had the highest average value and the 20% treatment had the lowest average value. This happened because the fishbone flour was not evenly distributed in the dough and caused the brightness level to decrease [20]. The color change in catfish meatballs is thought to be because the resulting catfish bone flour is slightly brownish white. This brown color is influenced by the drying process in the oven so that the Maillard reaction occurs [21].

3.1.2 Aroma

The aroma's parameters can determine the food's delicacy [22]. Aroma assessment was done by smelling the product directly, with odors that the nose and brain can accept, namely sour, fragrant, rancid, and charred [21].

Table 1. Preference level in terms of appearance of catfish meatballs added with varying % of catfish bone flour

Catfish bone flour added (%)	Median value	Average
A (0)	7	6,6[a]
B (5)	7	6,5[a]
C (10)	7	6,7[a]
D (15)	7	6,3[a]
E (20)	7	6[a]

Note: The average value followed by the same letter was not significantly different according to the multiple comparison test with (P<0.05)

0% **5%** **10%**

15%

20%

Fig 1. The appearance of catfish meatballs added with varying % of catfish bone flour

Table 2. Preference level in terms of aroma of catfish meatballs added with varying % of catfish bone flour

Catfish bone flour added (%)	Median value	Average
A (0)	5	6,2[a]
B (5)	5	6,3[a]
C (10)	7	6,9[a]
D (15)	7	6,7[a]
E (20)	7	6,6[a]

Note: The average value followed by the same letter was not significantly different according to the multiple comparison test with (P<0.05)

The statistical analysis results in Table 2 show that the addition of catfish bone flour does not affect the level of preference for the aroma of catfish meatballs. This is because catfish bone flour has a neutral aroma and the fishy smell is not too strong but rather a characteristic odor of dry bones. The effect of the aroma on fish balls is caused by the presence of spices added to the fish ball mixture [23]. The preferred fish balls generally have a distinctive taste of the fish used in the dough [24].

Catfish bone flour can enhance the distinctive aroma of catfish. The aroma of this fresh fish comes from volatile components with compounds having six, eight, or nine carbons of alcohol, aldehyde, and ketone groups [25].

The addition of fish bone meal is increasing, and the distinctive aroma of the fish was getting stronger [20]. This resulted in a decreased preference for aroma in adding catfish bone flour to catfish meatballs. This is similar to research Maulida's [26], the increasing addition of yellowfin tuna bone flour, the level of preference for aroma decreases.

3.1.3 Taste

The taste parameter determines the level of consumer acceptance. If other result parameters are liked, but the taste parameter is not liked, then the product is rejected [13]. Taste assessment uses the sense of taste or tongue [20].

The statistical analysis in Table 3 shows that the addition of catfish bone flour affects the preference for the taste of catfish meatballs. The 10% treatment had the highest average value, meaning that the panel liked the addition of 10% fishbone flour to fish balls. This shows that the addition of fishbone flour has a good taste.

The panelists less favored the treatment of 15% and 20%. Increasing the addition of fishbone flour can reduce the taste of fish balls [11]. Increasing the concentration of fishbone flour will increase calcium and phosphorus content [27]. Calcium and phosphorus content causes the aftertaste to be slightly chalky [12]. The lime taste causes the level of taste preference to decrease due to the high calcium and phosphorus content [19].

3.1.4 Texture

Texture parameters can determine the panelists' acceptance of the level of elasticity or suppleness of food products [1]. Texture assessment is done by the sense of touch.

Table 3. Preference level in terms of taste of catfish meatballs added with varying % of catfish bone flour

Catfish bone flour added (%)	Median value	Average
A (0)	7	6,7[b]
B (5)	7	6,6[b]
C (10)	7	6,9[b]
D (15)	5	5,4[a]
E (20)	5	4,7[a]

Note: The average value followed by the same letter was not significantly different according to the multiple comparison test with (P<0.05)

Table 4. Preference level in terms of texture of catfish meatballs added with varying % of catfish bone flour

Catfish bone flour added (%)	Median value	Average
A (0)	7	6,4[b]
B (5)	7	6,5[b]
C (10)	7	6,6[b]
D (15)	5	5,3[a]
E (20)	5	4,6[a]

Note: The average value followed by the same letter was not significantly different according to the multiple comparison test with (P<0.05)

The results of the statistical analysis in Table 4 show that the addition of catfish bone flour has an effect on the level of preference for the texture of catfish meatballs. The 10% treatment had the highest average value, meaning that the panelists liked the addition of 10% fishbone flour to fish balls. This shows that the addition of 10% fishbone flour did not affect the texture of catfish meatballs.

The 20% treatment had the lowest average value, meaning that the panelists did not like it. The texture produced in the 20% treatment was more rigid than the other treatments. The increase in the addition of fishbone flour resulted in a hard texture. The addition of fishbone flour to food products can reduce gluten. Gluten plays an essential role in building dough structure [26]. The decrease in gluten is due to the presence of calcium and phosphorus so that the bonding power of the dough built by gluten is less fused, resulting in a more rigid and less flat texture [11].

3.2 Decision Making with Bayes Method

Bayes method is one of the techniques used to analyze the best decision-making from some treatments aimed at producing optimal results based on the highest value of each treatment [16].

The results of the calculation of the weight criteria for the appearance, aroma, taste, and texture of catfish meatballs can be presented in Table 5. Based on the calculation results, the appearance criteria weights have the largest value of 0.49. This figure shows that the panelists consider the appearance criteria more to assess catfish meatball products. Determination of the essential appearance criteria, followed by calculating the appearance of each treatment.

The results of calculating the weight of the criteria and determining the best treatment on the criteria for appearance, aroma, taste, and texture are presented in Table 6. Based on the results of Bayes' calculations, it is known that the addition of fishbone flour by 10% is the most preferred treatment with an alternative value of 7 and a priority value of 19.76. Priority values and alternative values are generated to make optimal decisions by considering various criteria [16].

3.3 Folding Test

The folding test is a physical test that aims to determine the level of elasticity [28]. Elasticity is the force required to return to its original shape. The folding test results are directly related to the gel's strength [23].

The results of statistical analysis showed that the addition of catfish bone flour affected the elasticity of catfish meatballs. Table 7 shows that treatment E has the lowest average value and is significantly different from treatments A, B, C, and D. This is due to the increasing addition of fishbone flour to reduce the elasticity of catfish meatballs.

Table 5. The weight value of the catfish meatball criteria

Criteria	Weighta of criteria
Appearance	0,49
Aroma	0,29
Taste	0,05
Texture	0,18

Table 6. The decision matrix for the assessment of catfish meatballs using the Bayes method

Treatment (%)	Criteria				Alternative value	Priority value
	Appearance	Aroma	Taste	Texture		
A (0)	7	5	7	7	6.43	18.14
B (5)	7	5	7	7	6.43	18.14
C (10)	7	7	7	7	7	19.76
D (15)	7	7	5	5	6.55	18.48
E (20)	7	7	5	5	6.55	18.48
Weight	0.49	0.29	0.05	0.18	0.35	1

Table 7. The average result folding test of catfish meatballs based on the addition of catfish bone flour

Addition catfish bone flour (%)	Median value	Nilai rata-rata
A (0)	4	$4,2^{b}$
B (5)	4	$4,3^{b}$
C (10)	4	$4,35^{b}$
D (15)	4	$4,15^{b}$
E (20)	4	$3,55^{a}$

Note: The average value followed by the same letter was not significantly different according to the multiple comparison test with (P<0.05)

The effect of the elasticity of fish balls is caused by the filler, water content, and protein; the more air that makes the elasticity will increase. Starch can bind water and, in hot water can form a gel [29]. Starch granules if expected to produce gelatinization. Gelatinized flour will act as a binder [30].

The addition of bone flour causes an anti-elastic reaction that reduces the elastic properties of gluten, causing a food product to harden [26]. This is due to the presence of calcium and phosphorus in fishbone flour resulting in a less compact dough that the resulting product is harder [12].

4. CONCLUSION

Based on the research results, it can be concluded that catfish bone flour affects organoleptic and physical characteristics of catfish meatballs as perceived by the panelists and the folding test, respectively. The calculation results of the Bayes method showed that the addition of 10% catfish bone flour was the best treatment preferred by the panelists. The results of the assessment of the average preference level of 10% treatment are appearance 6.7 (like), aroma 6.9 (like), taste 6.9 (like), texture 6.6 (neutral-like), and 4-fold test, 35 (no cracks when folded once).

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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