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The Effect of Egg White Powder Concentration on The Quality of Meatballs Based on Surimi from Tilapia, Catfish and Pangasius

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ABSTRACT

Surimi is a processed freshwater fish product which is the main raw material for various food products, one of which is fish meatballs. The use of freshwater fish has disadvantages in terms of sensory characteristics, so it is necessary to add other ingredients. One of the additional ingredients that has great potential to affect the characteristics of fish meatball surimi is EWP. This study aims to determine the effect of EWP concentration in surimi from different types of freshwater fish on the characteristics of sensory properties, pH, and yield. The variations in EWP concentration used were 0%; 3% and 6%. Sensory testing included appearance, texture, taste, and aroma. The results showed that appearance, texture, taste and aroma had a significant effect with the best treatment of 0% EWP on catfish and pangasius meatball surimi and 3% EWP on tilapia meatball surimi. The effect of variations in EWP concentration on the pH value of fish meatball surimi did not have a significant effect. The best yield was obtained with the treatment of 6% EWP on each catfish, pangasius and tilapia surimi. The selected catfish and pangasius fish surimi meatballs were 0% EWP concentration while tilapia fish surimi meatballs were 3% EWP concentration because they provided the best meatball quality. The addition of EWP affected the appearance, taste, texture and aroma with the best treatment at a concentration of 3% EWP tilapia fish surimi meatballs and had no significant effect on the pH value, and the best yield at 6% EWP.

INTRODUCTION

Bangka Belitung as one of the provinces in Indonesia has very abundant fishery resource potential with capture fisheries production reaching 31.42% and aquaculture of 65.03% in 2020 (Dinas Kelautan dan Perikanan, 2022). Aquaculture products, including tilapia, pangasius, and catfish, are potential fishery commodities with a greater production volume

than captured fish. In 2020, the production of freshwater fish for consumption in Bangka Belitung Province reached 234,000 kg, with catfish, pangasius, and tilapia as the main components (Badan Pusat Statistik, 2021). This commodity is the backbone of the aquaculture sector in the region due to high market demand and its adaptability to the aquaculture environment. This potential makes tilapia, pangasius, and catfish an attractive alternative as a base for surimi compared to marine fish whose numbers have decreased and efforts to increase the value and diversification of fishery products.

Surimi is a processed fish product, especially freshwater fish, which is characterized by a chewy texture and neutral taste, making it the main raw material for various food products such as fish balls, fish sausages, or fish nugget products (Sari *et al*., 2021). The selection of freshwater fish as the main raw material in making surimi is due to the abundant production of freshwater fish farming compared to seawater fish capture fisheries (DKP, 2022). The use of freshwater fish in making surimi can produce products with less-than-optimal sensory values, especially in terms of appearance, texture, and aroma. According to Zhang *et al*. (2020), the sensory characteristics of surimi from freshwater fish tend to be less preferred due to low gel stability and water binding capacity. Therefore, the addition of additional ingredients such as egg white powder (EWP) or egg white flour can significantly improve the sensory quality of surimi through the gelation mechanism and increased elasticity (Rodriguez *et al*., 2019).

EWP contains albumin and globulin proteins that can interact with fish protein, form gels, and contribute to the organoleptic properties of processed fish products. EWP has properties that can bind proteins, and can also improve the texture of surimi (Agustini *et al*., 2021). EWP can also modify the texture properties by producing elastic gels at the modori stage during the heating process so that the quality of surimi remains in good condition. (Rahma, 2023). EWP can also modify the texture properties by producing elastic gels at the modori stage during the heating process so that the quality of surimi remains in good condition (Aini *et al*., 2022).

Previous studies on surimi from freshwater fish raw materials have been conducted. Sari *et al*. (2021) reported that different surimi raw materials affect the texture, taste, appearance, and color in organoleptic tests. Muttaqin *et al*. (2016) also reported that the addition of EWP and types of catfish, milkfish, and mackerel significantly affected the texture and aroma of surimi. The protein properties of EWP can make it a promising additive for making surimi. Previous studies using freshwater fish were limited to the use of only the main raw materials, the use of EWP additives in surimi was still limited. Based on this, it is necessary to study the effect of EWP on surimi from tilapia, catfish and pangasius fish on their sensory characteristics. This study aims to determine the effect of EWP concentration on surimi from different types of freshwater fish on the characteristics of pH sensory properties, and their yield. This study is expected to contribute to further understanding of the use of EWP in the context of local Bangka Belitung fish surimi. The results of this study are also expected to provide a strong basis for the development of processed fish products, especially freshwater fish, and innovative products that are in accordance with the needs of the local market in Bangka Belitung and provide added value for fish processing industry players in Bangka Belitung.

METHODS

Time and Place

This research was conducted from November 10, 2023 to November 24, 2023.

Materials and Tools

The materials used include freshwater fish, namely catfish, tilapia, pangasius fish, ice cubes, water, salt, sugar, STTP (Sodium Tripolyphosphate), sodium bicarbonate, EWP (Egg White Powder). The equipment used includes containers, trays, cutting boards, spoons, knives, tweezers, meat grinders, filter cloths, presses, rinse containers, filter containers, strainers, and thermometers.

Research Procedures

This research consists of 2 stages which include (1) Making Surimi and (2) Making Surimi Meatballs.

(1) Making Surimi

Catfish, pangasius and tilapia from traditional markets that have been separated from bones, skin and head are ground. The resulting meat is washed (leached) on each fish meat with ice water at a ratio of 1: 3 for 15 minutes, each repeated three times. In the last wash, water is added with salt as much as 0.3% of the weight of the fish meat. The meat sample is then wrapped in gauze and pressed to separate the meat from the remaining washing water. Then added 3% granulated sugar, 0.2% sodium tripolyphosphate (STPP) and EWP varied with concentrations of 0%, 3% and 6%. The resulting catfish, pangasius and tilapia surimi is molded using a tray and analyzed for pH and yield values, then frozen for 7 days to be used as an ingredient for making meatballs.

(2) Making Surimi Meatballs

Catfish, pangasius and tilapia surimi as much as 250 g each were mixed with 3% salt and 30% cold water, then homogenized. The formation of surimi meatballs was done using hands and spoons with a diameter of 25-30 cm. The last process was boiling at a temperature of 40°C and 90°C for 20 minutes each until the meatballs floated. The meatballs were then cooled at room temperature until the temperature dropped. The surimi meatball samples were then subjected to a hedonic test, involving the assessment of appearance, aroma, taste, and texture by 30 panelists.

Analysis Procedure

The analysis procedure in this study consisted of 3 stages, namely (1) pH value analysis (2) yield value analysis (3) hedonic test value analysis which included appearance, aroma, taste and texture of the 0%, 3% and 6% EWP treatments.

(1) pH Value Analysis

Measurement of pH in catfish, pangasius and tilapia surimi by taking a sample of fish that has undergone a mixing stage of 1 gram then adding 100 ml of water and then homogenizing using a spoon for ≤ 2 minutes. The pH measuring instrument, namely the pH meter, is then dipped into the sample for several minutes, showing a pH value <7 means acidic and pH> 7 means alkaline.

(2) Yield Value Analysis

Calculation of yield according to Supit *et al*. (2021), is done by comparing the weight of surimi with the weight of the whole and expressed as a percentage. The yield calculation formula is as follows:

$$\text{Yield formula} = \frac{\text{Surimi Weight (g)}}{\text{Whole fish weight}} \text{ x } 100\%$$

(3) Hedonic Test Analysis

Organoleptic testing is a subjective assessment involving a number of panelists to assess the suitability of a fishery product for public consumption. This testing process is carried out by 30 semi-trained panelists by comparing existing products with the specifications listed on the assessment sheet, then providing an assessment. The assessment is carried out with the

highest and lowest value ranges of each specification, namely 9 and 1. The results of the assessment are then processed to calculate the standard deviation and standard deviation, so that a range of values can be obtained that indicate whether the product is suitable or unsuitable for consumption.

Data Analysis

The experimental design used was a Completely Randomized Design (CRD). Evaluation of pH data, yield, and hedonic tests covering appearance, taste, texture and aroma involved EWP as a treatment.

Hypothesis:

H_0 : Differences in EWP concentrations do not affect the appearance, taste, texture and aroma of catfish, pangasius and tilapia surimi.

H_1 : Differences in EWP concentrations affect the appearance, taste, texture and aroma of catfish, pangasius and tilapia surimi.

The test results were analyzed using SPSS software, by applying ANOVA analysis of variance. This analysis was then continued with the Honestly Significant Difference (HSD) test for parametric data. Meanwhile, for non-parametric data, analysis was carried out using the Kruskal-Wallis test, which was then continued with the Mann-Whitney test.

RESULTS

Yield

Yield is the ratio of the weight of the meat to the weight of the whole fish used. The calculation of fish yield is used to estimate the amount of fish body parts that can be used as surimi making ingredients. The results of the weight yield of fish to become fish meat mash can be seen in Table 1.

Table 1. Yield of Surimi Production with The Addition of EWP

No	Treatment	Catfish			Pangasius			Tilapia		
		0%	3%	6%	0%	3%	6%	0%	3%	6%
1	Initial weight of fish	1,400 g	1,700 g	2,000 g	1,500 g	1,600 g	1,400 g	1,500 g	1,600 g	1,600 g
2	Weight after filleting	550 g	588 g	805 g	677 g	798 g	550 g	580 g	550 g	570 g
3	Leacthing lll	373 g	364 g	370 g	380 g	306 g	373 g	226 g	312 g	461 g
4	Final weight	290 g	297 g	523 g	247 g	334 g	290 g	212 g	304 g	367 g
Yield Value		20.71%	17.47%	26.15%	15.86%	19.12%	20.10%	14.10%	18%	35.62%

Test pH

The pH value is an indicator of the acidity level of a product. pH measurement has a significant impact on the organoleptic properties, food safety, and overall stability of the product. The pH value of catfish, pangasius and tilapia surimi meatballs can be seen in Figure 1.

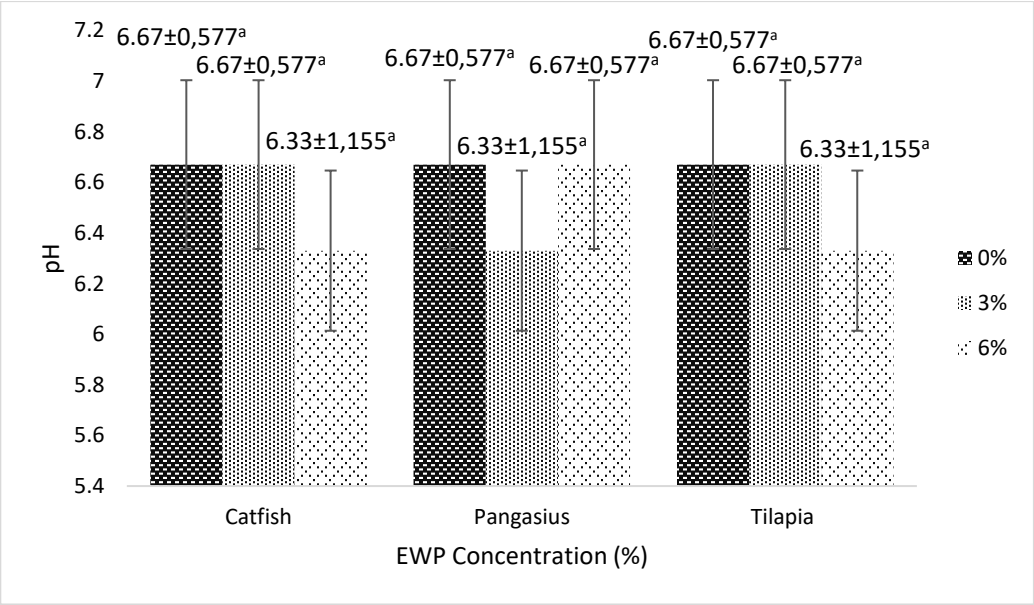

Figure 1. pH Value of Surimi from Different Types of Fish and EWP Concentrations

Appearance

Appearance plays a critical role in assessing the quality of a food ingredient. In addition, this factor also affects the extent to which the product is attractive to panelists. The appearance value of catfish, pangasius and tilapia surimi meatballs produced can be seen in Figure 2.

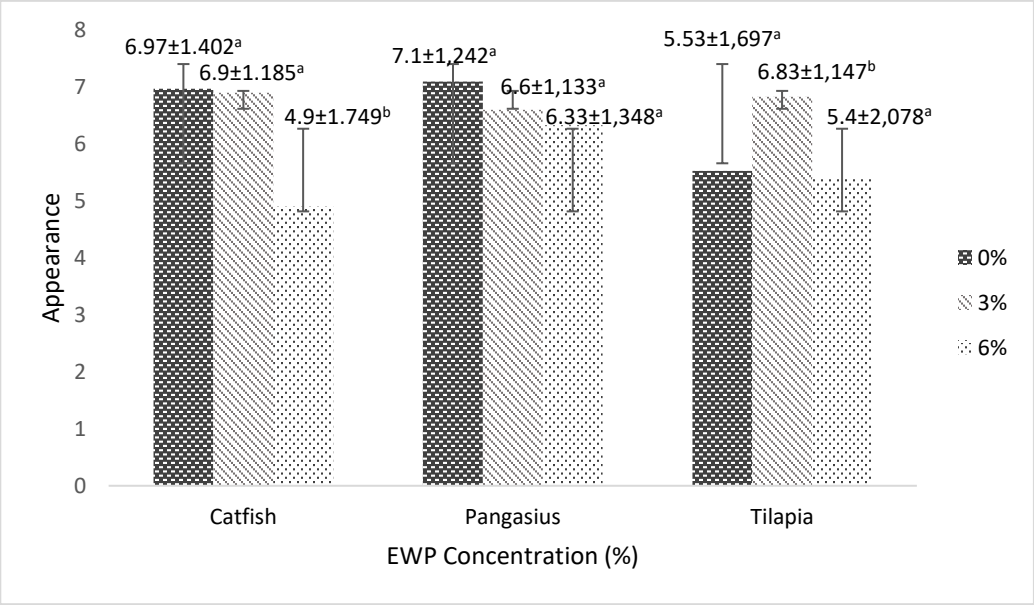

Figure 2. Appearance Value of Surimi Meatballs from Different Types of Fish and EWP Concentrations

Flavor

The taste of food products plays a crucial role in shaping panelists' preferences for a product and is the main factor determining sensory appeal. The success of a product is often closely related to the quality of taste that can satisfy the tastes of panelists. The taste value of catfish, pangasius and tilapia surimi meatballs produced can be seen in Figure 3.

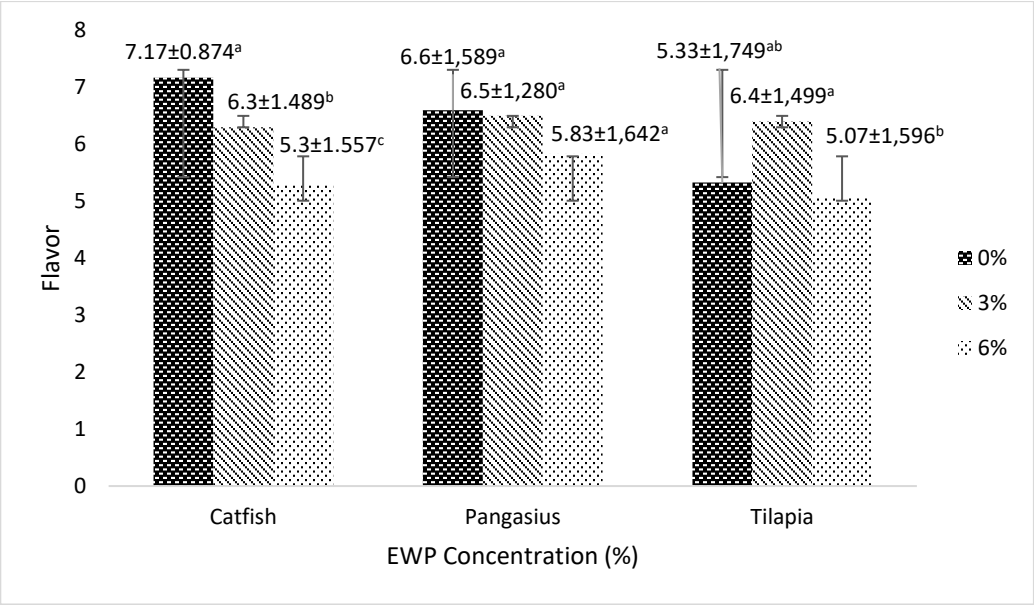

Figure 3. Taste Value of Surimi Meatballs from Different Fish Types and EWP Concentrations

Texture

Texture is a very important property of food products, especially for soft foods and chewy textured foods. This texture quality plays a major role in shaping the consumer's sensory experience of food products. The texture value of catfish, pangasius and tilapia surimi meatballs produced can be seen in Figure 4.

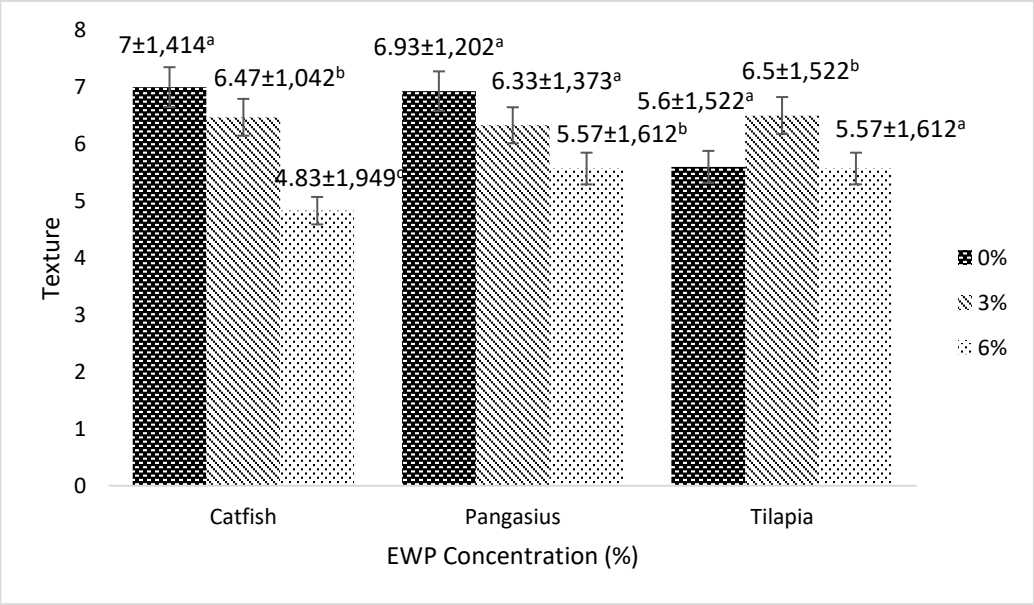

Figure 4. Texture Value of Surimi Meatballs from Different Types of Fish and EWP Concentrations

Aroma

Aroma plays a major role in creating a satisfying sensory experience for panelists, a distinctive aroma can make a product more attractive to consumers. The aroma value of catfish, pangasius and tilapia surimi meatballs produced can be seen in Figure 5.

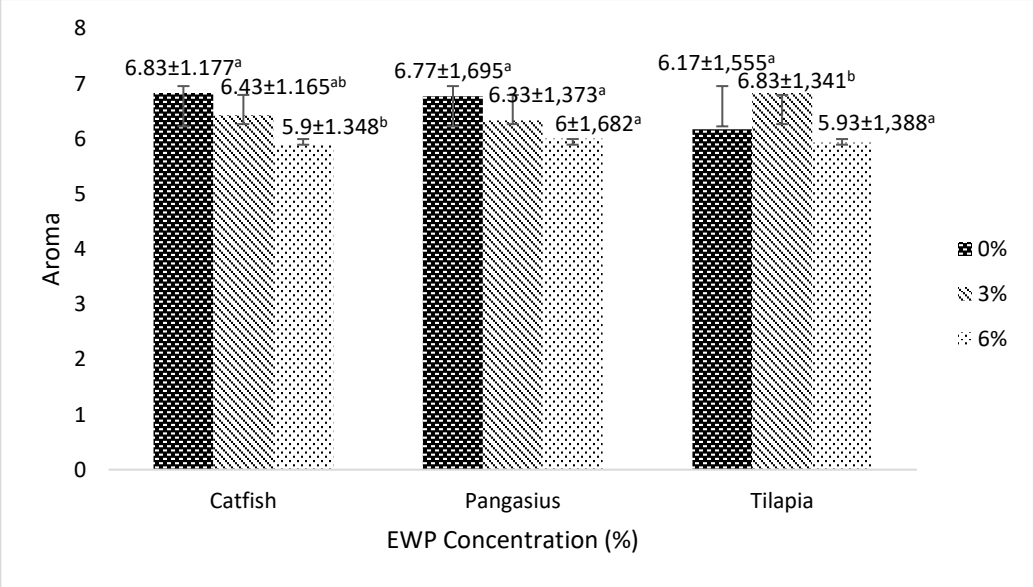

Figure 5. Aroma Value of Surimi Meatballs from Different Types of Fish and EWP Concentrations

DISCUSSION

Yield

The yield results showed that the highest surimi yield value was found in the 6% EWP treatment (Table 1). This is because the addition of EWP can increase the mass or weight of surimi. EWP is a protein source that can replace some of the protein in surimi, thereby increasing the total mass or weight of the final product. EWP protein can interact with surimi protein, form a gel, and retain water, which can increase the mass of surimi (Firmansyah *et al*., 2022). According to Lee *et al*. (2020), egg protein has a high-water binding capacity, which can significantly increase the yield of processed meat and fish products. The increase in mass or weight of surimi can also occur due to the absorption of water by EWP protein, thereby increasing the water binding capacity in the product and can contribute to increased weight (Hartati *et al*., 2021). In addition, research by Chen *et al*. (2019) shows that the addition of functional proteins such as EWP not only increases the yield but also improves the texture and stability of the final product through gelation and water retention mechanisms.

Test pH

The results of the analysis of variance showed that the EWP treatment had no significant effect on the pH value of catfish, pangasius and tilapia surimi (Figure 1). This shows that with the difference in EWP treatment of 0, 3 and 6%, there was no difference in the pH of catfish, tilapia and pangasius surimi. According to Syamsir *et al*. (2022), the optimum pH value for the formation of surimi gel ranges from 6.5-7.5. In this pH range, myofibrillar proteins in surimi can form a stable gel structure due to the interaction between ionic and non-ionic groups in the protein polypeptide chain (Agustini *et al*., 2021). In addition, research by Dewi *et al*. (2020) showed that the addition of additional ingredients such as EWP tends not to change the pH significantly, but plays a greater role in improving the gel stability and texture of the final product. This shows that pH is not the main factor influenced by EWP, but rather its ability to improve the physical and sensory characteristics of the product.

Appearance

The results of the Kruskal Wallis analysis showed that the EWP treatment had a significant effect on the appearance value of catfish, pangasius and tilapia meatballs (Figure 2). The highest preference score for the appearance of catfish and pangasius surimi meatballs was obtained in the 0% EWP treatment. This is because the 0% EWP concentration provides the results that best match the panelists' preferences regarding the appearance of catfish and pangasius surimi meatballs because without the addition of EWP, the original characteristics of fish surimi are more dominant. Catfish and pangasius have yellowish-white meat caused by the high fat content of the meat so that the appearance of catfish and pangasius meatballs has a neater and more attractive appearance because it has a brighter color (Sari *et al*., 2017). According to Wang *et al*. (2020) the color of processed fish products is greatly influenced by the natural composition of fish meat, including its fat and protein content, which significantly affects the visual perception of consumers. In addition, Kumar *et al*. (2018) stated that the use of additional ingredients such as EWP can change the natural appearance of the product, so that in some types of fish with attractive meat colors, the addition of these ingredients can actually reduce panelists' preferences for the appearance of the product.

In tilapia surimi meatballs, the highest preference score for appearance was in the 3% EWP treatment. This is because the addition of EWP at this concentration makes a positive contribution to the appearance of tilapia surimi meatball products. EWP can improve the texture and elasticity of tilapia surimi meatballs, creating a more visually appealing appearance. According to Smith *et al*. (2021), egg protein, including EWP, has excellent emulsification and gelation capabilities, which contribute to improving the appearance of processed meat and fish products. In addition, the unique characteristics of EWP such as water binding and gel-forming abilities can have a positive effect on product appearance (Wulandari *et al*., 2022). Research by Rodriguez *et al*. (2020) also shows that the use of additives such as EWP not only improves the physical properties of the product but also provides better visual appeal to consumers.

Flavor

The results of the Kruskal Wallis analysis showed that EWP treatment significantly affected the taste value of catfish, pangasius, and tilapia surimi meatballs (Figure 3). The highest preference score for the taste of catfish and pangasius surimi meatballs was obtained in the 0% EWP treatment. It is suspected that the addition of EWP at concentrations of 3% and 6% did not provide the desired contribution to the taste profile, so the treatment without EWP was considered to provide a taste that was preferred by the panelists. In addition, the natural characteristics of catfish and pangasius meat may be more dominant without the EWP mixture, providing a more authentic taste experience and in accordance with consumer preferences (Suyanto *et al*., 2021). Previous studies have also shown that the addition of additives such as EWP can cause changes in the taste profile of processed fish products, including the emergence of unwanted off-flavors (Muttaqin *et al*., 2016). According to Rahman *et al*. (2018), the addition of functional proteins such as EWP to processed fish products often affects the sensory balance, including taste, aroma, and texture, which can reduce consumer acceptance if not optimized. In addition, the addition of EWP at high concentrations can affect the chemical composition of the product, resulting in changes in color and texture that are less preferred by consumers (Agustini *et al*., 2021). The use of EWP must be optimized so as not to interfere with the sensory characteristics of the final product.

In tilapia surimi meatballs, the highest preference score for taste was in the 3% EWP treatment. It is suspected that the addition of EWP at a concentration of 3% can provide the

complexity of the resulting flavor. The additional protein content of EWP can provide a new dimension to the surimi flavor profile, creating additional softness and elasticity (Muttaqin *et al*., 2016). In addition, the interaction between the components in EWP with the basic surimi ingredients can improve the overall organoleptic quality, including a richer and more harmonious taste (Suryaningrum *et al*., 2019).

Texture

The results of the Kruskal Wallis analysis showed that the EWP treatment had a significant effect on the texture value of catfish, pangasius and tilapia meatballs (Figure 4). The highest preference score for the taste of catfish and pangasius surimi meatballs was obtained in the 0% EWP treatment. This is because the 0% EWP treatment may have a smoother texture and because it is the texture of the original fish (Lestari *et al*., 2021). According to Laksono *et al*. (2019) with the addition of EWP, the higher the hardness and bite test values will be, making the product more difficult to consume.

In tilapia surimi meatballs, the highest preference score for taste was in the 3% EWP treatment. This is because the addition of 3% EWP concentration can increase the strength of the surimi gel, thereby increasing its texture value. These results are in accordance with the research of Vonda & Onus (2021) which showed that the addition of 3% EWP to pomfret surimi can increase the strength of the surimi gel which is reflected in the increase in the texture and elasticity value of the surimi product. Texture is a property of an object that includes the elasticity and density of the product. This elasticity and density determine the panelists' acceptance of the texture of the resulting surimi product. According to research by Laksono *et al*. (2019), a good standard value for surimi texture can be obtained through optimization of the formulation of additional ingredients such as egg white powder (EWP) and sodium tripolyphosphate (STPP), which can increase the elasticity and density of the product to meet consumer preferences.

Aroma

The results of the Kruskal-Wallis analysis showed that EWP treatment had a significant effect on the aroma value of catfish, pangasius, and tilapia surimi meatballs (Figure 5). The highest preference score for the aroma of catfish and pangasius surimi meatballs was obtained in the 0% treatment. It is suspected that the addition of EWP will produce a fishy odor that is not liked by panelists. The interaction between EWP and other additives in the surimi formulation can create volatile compounds that provide a fishy aroma (Suyanto *et al*., 2021). In addition, research by Hassan *et al*. (2017) shows that the addition of ingredients such as EWP can affect the aroma profile of processed fish products, especially if the concentration is not optimized. Volatile compounds produced during the processing process can increase the intensity of undesirable aromas, such as fishy or rancid, thus affecting consumer acceptance.

The results of the Kruskal-Wallis analysis showed that the EWP treatment had a significant effect on the aroma value of tilapia fish meatballs. The results of the Mann-Whitney further test showed that the aroma values of the EWP treatments were significantly different from each other. The high aroma value in the 3% EWP treatment was due to the presence of specific compounds or components in EWP that positively interacted with the basic ingredients of tilapia surimi, increasing the complexity and intensity of its aroma. This process can improve the aroma profile and create the desired characteristics in surimi products (Wardani *et al*., 2018). According to Tanjung *et al*. (2020), egg white has properties as a binding agent, namely increasing other ingredients until they blend.

CONCLUSION

The addition of EWP affects the appearance, taste, texture and aroma with the best treatment at a concentration of 0% EWP for catfish and pangasius fish meatball surimi and a concentration of 3% EWP for tilapia fish meatball surimi. The effect of variations in EWP concentration on the pH value of fish meatball surimi did not provide a significant effect. The best yield was obtained at a treatment of 6% EWP for each catfish, pangasius and tilapia surimi.

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