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The addition of seaweed flour (*Kappaphycus alvarezii* (Doty) Doty ex Silva) and carrageenan on the preference level of freshwater pomfret meatballs

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ABSTRACT

This research aims to determine the effect of seaweed flour and carrageenan addition to freshwater pomfret meatball products which are preferred by panelists. This research was conducted in the fisheries technology laboratory of the Faculty of Fisheries and Marine Sciences, Padjadjaran University in December 2018. The method used in this research was experimental method with 15 semi-trained panelists and 3 treatments namely control treatment, carrageenan addition, and addition of seaweed flour based on pomfret surimi weight percentage. The parameters observed in the study were the hedonic test with organoleptic characteristic parameters including appearance, aroma, texture, and taste of pomfret meatballs, and folding test. The results showed that all treatments were still preferred by panelists, however the treatment of seaweed flour addition produced pomfret meatballs with a better level of preference compared to other treatments, with the average value characteristic of appearance 5.7; texture 8.2; taste 7.1; and aroma 7.1. The highest alternative was 7.49 and value of pomfret meatballs taste 0.43; the folding test result was equal to 4 which indicates that pomfret meatballs can be considered as elastic.

Keywords: Pomfret Meatballs, Carrageenan, Seaweed Flour, Hedonic Test, *Kappaphycus alvarezii*, *Sargassum polycystum*

1. INTRODUCTION

Freshwater fish in Indonesia are very diverse. They are spread in fresh waters such as rivers, swamps, reservoirs, and lakes. These fish species can be cultivated in ponds, floating net cages, and in “mina padi”. Fish species can be cultivated and developed very well, one of which is freshwater pomfret. Freshwater pomfret is one of the fishes produced by inland waters that has advantages such as rapid heavy growth.

Fish jelly is a form of diversification in serving fish as food. Fish jelly is a term used for food ingredients similar to jelly, which is made by cooking surimi or fish meat after being mixed and ground with salt and other spices. Processed products including fish jelly are nugget, meatballs, fish cake, sausages, “otak-otak”, dumplings, and “pempek”.

One of fish jelly products is fish meatballs. Fish meatballs are a form of diversification of processed products that use fish meat as the main raw material by adding tapioca flour and seasoning. Fish meatballs have smooth round shape, compact texture, are elastic and supple. The use of seaweed can be maximized by diversifying processed seaweed products which is one of the efforts to increase the usability and economic value of seaweed. One such diversification effort is by processing *Kappaphycus alvarezii* seaweed into flour, where seaweed in the form of flour can be developed into processed food products. Seaweed can increase fiber content, when compared with food from terrestrial plants (tubers, fruit, cereals, and beans), the total fiber content of seaweed is relatively higher.

Terrestrial plant derived fiber is usually more water-insoluble fiber, while some types of seaweed have higher water-soluble fiber than water-insoluble fibers, such as *Kappaphycus alvarezii* and *Sargassum polycystum*.

Carrageenan is a name for galactant polysaccharides which can be extracted from red algae (Rhodophyceae). The role of carrageenan is no less important when compared with agar and alginate. The addition of carrageenan can have many benefits, including gelling, stabilizing, emulsifying, suspending, and dispersing properties, therefore adding carrageenan needs to be added to the manufacture of fish meatballs instead of borax. Carrageenan has a hydrophilic property that can bind water and can stabilize the emulsion system on emulsion products. Based on its hydrophilic nature, the addition of carrageenan in the emulsion product will increase the continuous phase viscosity so that the emulsion stabilizes.

Until now freshwater pomfret is still not widely used as a processed product, whereas freshwater pomfret has been widely cultivated. Pomfret has several advantages such as its body length, it is quite large, the meat is savory, the meat is white, and it does not have many thorns. Pomfret processing needs to be done to further increase commercial value and increase selling prices. Furthermore, the addition of *Kappaphycus alvarezii* seaweed flour and carrageenan still need to be tested against the level of preference, which one is preferred for seaweed flour or carrageenan.

2. MATERIALS AND METHODS

2.1. Time and place of research

The research was conducted in December 2018. Organoleptic tests, and folding tests were carried out at the Fisheries Product Processing Laboratory, Faculty of Fisheries and Marine Sciences, Padjadjaran University.

2. 2. Tools and materials

Tools used include filters, small and large containers, trays, spatulas, food processors, knives, cutting boards, tablespoons, meat grinders, electric scales, gas stoves, calico cloths, and styrofoam. The ingredients used were freshwater pomfret, tapioca flour, *Kappaphycus alvarezii* seaweed flour, carrageenan flour, ice to taste, fine pepper, garlic, onion, and salt.

2. 3. Research method

This research consists of two stages, namely the production of pomfret surimi and the production of fish meatballs with the addition of carrageenan flour and seaweed flour (*Kappaphycus alvarezii*).

Making surimi begins with making the filet then skinned, after that the meat is washed and minced using meat grinder. The next process of washing, according to Parmanto (2012), is that the meat that has been minced is washed with ice water 5-10 °C twice with a ratio of water and fish meat 4:1, meat and ice water are stirred periodically for 15 minutes, then filtered with calico cloth and in the last washing added salt (NaCl) 0.3%, then filtered again.

The next step is making fish meatballs with meat that has been already produced into surimi. Pomphrey which had been "surimi" then weighed 200 g, then added with carrageenan flour and seaweed flour and adding spices. After that it is mixed into a food processor, then printed and boiled. The research method used was the experimental method, with 15 semi-trained panelists and 3 treatments namely: control treatment, carrageenan addition 0.50%, and addition of seaweed flour (*Kappaphycus alvarezii*) 0.50% of the weight of pomfret surimi. The parameters observed in the study were organoleptic characteristics with hedonic tests which included appearance, aroma, texture, and taste of "pempek" catfish, and folding test.

2. 4. Data analysis

Organoleptic test data were analyzed using Friedman non-parametric 2-direction statistics to determine panelists' acceptance of the organoleptic characteristics of pomfret meatballs with the addition of carrageenan flour and seaweed flour. The decision of the panelists on the preferred product criteria is carried out in pairs (Pairwise Comparison). Then it is done by the Bayes method. The Bayes method is used to determine the best treatment. Bayes method is one of the techniques used to carry out analysis in the best decision making from a number of alternatives or treatments by considering criteria.

3. RESULT

3. 1. Appearance

The appearance of pomfret meatballs has a very important influence on color and shape. Color reflects light on the surface that is captured by the sense of sight and transmitted by the nervous system. Color changes can also be determined by making chemicals and reforming an enzyme into a pigment. When cooking color from a food ingredient or product it will change. The following is the average value of the appearance of pomfret meatballs which can be seen in Table 1. The average value of appearance in the control treatment is 6.6 with a median value of 7 (likes) with a fairly round and white shape. Addition with starch flour is 7.9 with a median value of 7 (likes) round shape and colored meatballs white. The addition of seaweed flour is 5.7

with a median value of 7 (likes) the shape is rather round and slightly brownish in color caused by the color of the seaweed flour which is slightly brownish. Overall, all treatments are still favored by panelists.

Table 1. Average Value of Appearance of Pomfret Meatballs.

Treatment	Median	Appearance Mean Value
Control	7	6.6
Carrageenan	7	7.9
Seaweed flour	7	5.7

The statistical test results showed that the treatment with the addition of carrageenan flour and seaweed flour was significantly different. This is because the color appearance of the addition of carrageenan flour and seaweed flour is different. The color appearance of the addition of carrageenan is white like fish meatballs in general, while the color appearance of the addition of seaweed flour is brownish white so that the color of the treatment with the addition of seaweed flour is not like the appearance of the color of fish meatballs in general. In the process of making the carrageenan flour and seaweed flour is different.

Carrageenan flour is done through the extraction process, where the extraction process can change the color of flour to white. In the soaking stage of seaweed (*Kappaphycus alvarezii*) soaked by a solution of potassium hydroxide, so that the stage undergoes a bleaching process to reduce the color of the powder, so that the color of the carrageenan flour will later be white. This is different from seaweed flour which does not go through the extraction process and at the time of soaking or bleaching which aims to oxidize some pigments to be whitish and soft, the color of the seaweed flour is dull white due to the presence of dirt on the seaweed.

In general, on pomfret meatballs from this study with the addition of carrageenan flour it had these criteria, because carrageenan flour is white so the shape of the pomfret meatballs is not dull. But it is different from the treatment with the addition of seaweed flour, because seaweed flour has a slightly dull color on the flour, so the color of the pomfret meatballs using seaweed flour becomes a bit dull. However, the appearance of the pomfret meatballs is still accepted by the panelists.

3. 2. Aroma

The aroma is related to the senses of smell. Besides, the aroma determines the delicacy of a food ingredient. The delicacy of a food is determined by the aroma factor. The results of the observation of the aroma of freshwater pomfret meatballs with the addition of seaweed flour and carrageenan can be seen in Table 2.

The average value of scent in the control treatment was 7.3 with a median value of 7 (likes) with strong aroma specific to the aroma of fish, addition of carrageenan flour which was 7.4 with a median value of 7 (likes) smelled of strong aroma, specific aroma fish, the addition of seaweed flour is 8.2 with a median value of 9 (very like) with a stronger fish aroma. The

results of the Friedman statistical test showed that all the treatments were not significantly different, meaning that all they had the same level of preference for the aroma of pomfret meatballs. The addition of carrageenan flour and seaweed flour did not affect the fish meatballs produced, so that overall all treatments were still favored by panelists.

Table 2. Average Value of Aroma of Pomfret Meatballs

Treatment	Median	Aroma Mean Value
Control	7	7.3
Carrageenan	7	7.4
Seaweed flour	9	8.2

Volatile compounds contained in materials have an influence on the aroma characteristics of a product. The aroma characteristics of a material and the volatile components contained in it are one of the important factors in determining the quality of a food ingredient. The components of aroma can also influence the organoleptic characteristics of a food so that in the end it also gives a role in the level of acceptance and consumption of the final product. These volatile compounds come from groups of hydrocarbons, ketones, aldehydes, alcohols, compounds containing sulfur and nitrogen, heterocyclic and ester compounds. Certain aromas produced from the formation of these volatile compounds have been considered as an opportunity that can be used to improve the organoleptic characteristics and quality of the processed fishery products. Simple processing such as boiling done on making meatballs using freshwater pomfret will certainly result in changes in the volatile components and chemical composition compared to the pomfret fish which are still fresh.

The contents of *Kappaphycus alvarezii* compounds include phenolic, flavonoids, tannins, alkaloid groups, and a combination of several sulfite groups. A little protein content in seaweed causes fishy aroma on seaweed not sharp. The protein content of seaweed is 5.12%. The protein content in seaweed flour is 2.15% while the protein content in carrageenan flour is 2.80%. So, the aroma of the addition of carrageenan and seaweed flour was not significantly different from the control treatment.

3. 3. Taste

Taste is an important factor in determining a decision for consumers to accept or reject food. The following is the average value of the results of observations of the taste of freshwater pomfret meatball with the addition of carrageenan and seaweed flour, which can be seen in Table 3. The average value of added flavor using carrageenan flour is 6.5 with a median value of 7 (likes) with tasty and savory taste, while the addition using seaweed flour shows an average value of 7.1 with a median value of 7 (likes)/good with the dominant taste of fish and also savory. The control treatment obtained an average value of taste which is 4.9 with a median value of 5 (neutral / normal) with a good taste. Amino acids in seaweed consist of mono-amino acids of 70% of total nitrogen and amino acids of 3% - 20% of total nitrogen. Amino acids that

are commonly found in seaweed and in greater amounts are glutamic acid, alanine, glycine, proline, and aspartic acid. Seaweed provides tasty taste due to the presence of high glutamic acid (Wong *et al.*, 2000). Thus the addition of carrageenan flour and seaweed flour gives a savory flavor. Reduced fish taste is also caused by the use of fish surimi on meatball products.

The final product of surimi has a tasteless taste that makes it possible to give the flavor as desired. Non-volatile flavor compounds influence the flavor characteristics of a product and usually originate from compounds with free amino acid groups, peptides and nucleotides. Each commodity in general also has a different flavor composition.

Table 3. Average Value of Taste of Pomfret Meatballs

Treatment	Median	Taste Mean Value
Control	5	4.9
Carrageenan	7	6.5
Seaweed flour	7	7.1

Freshwater pomfret is a good source of animal protein. Analysis of amino acid profiles can provide important information about the overall amino acid composition which can also affect the taste characteristics of the samples analyzed. Amino acids and peptides play a direct role in the flavor of fishery products.

Taste is a combination of aroma and taste (sour, sweet, bitter, and salty). Food taste is influenced by the components contained in food, such as protein, fat, and carbohydrates that make up it. The taste of this pomfret meatball is savory and also liked by panelists. Fat affects taste, because fat has components that will cause a flavor of food. Pomfret contains 1.7 g of fat, the protein content is 19 g. Taste is influenced by the constituent components of foods such as protein, fat, and vitamins. Factors that affect taste are chemical compounds, temperature, consistency, and interaction of food with other flavor components, and the type and duration of cooking. Overall, all treatments are still favored by panelists.

3. 4. Texture

Texture is one of the factors that can determine the level of preference of a panelist for a food product. Sometimes the texture is more important than the aroma, taste and appearance because it affects the image of the food. Texture assessment aims to increase panelist acceptance of elasticity. The results of the observation of the texture of pomfret meatballs with the addition of seaweed flour and carrageenan the average value can be seen in Table 4.

The panelists' assessment of the texture of pomfret meatballs is known that the highest average value is the addition of carrageenan flour and seaweed flour, with an average value of 7.1, with a median value of 7 (likes), that is with criteria that are solid, compact, and chewy with the addition of carrageenan flour and seaweed flour. While the lowest average texture value is 5.1 with a median value of 5 (neutral / normal), namely the criteria of solid, compact, and less elastic with the control treatment. This is because carrageenan and seaweed flour have

gelling properties. According to Hsu *et al.* (2001) the addition of kappa-carrageenan less than 2% in meat products significantly affected the increase in cooking yield, chewing power, and elasticity.

Table 4. Average Value of Texture of Pomfret Meatballs

Treatment	Median	Texture Mean Value
Control	5	5.1 a
Carrageenan	7	7.1 b
Seaweed flour	7	7.1 b

Seaweed flour and carrageenan flour also have the function of forming a gel, thickener, and stabilizer. Seaweed as one of the marine biological sources when it is processed will produce hydrocolloid compounds which are basic products (primary metabolic results). Hydrocolloid compounds are very necessary in a product because it functions as a gelling agent (gelling agent), stabilizer (stabilizer), emulsifier (emulsifier), suspension (suspending agent). In addition to the use of seaweed flour and carrageenan flour, the use of fillers namely tapioca flour also contributes to gel formation. The starch granules contained in tapioca will expand during the boiling process, until they reach the gelatinization temperature which makes the texture chewy and compact, and there is also the washing process of pulverized meat or surimi process in this study to optimize the texture of pomfret meatball products.

Surimi has important functional properties, namely the ability to form gels and their ability to hold water holding capacity. Surimi has properties that one of them is that it can form a gel that is elastic and strong with heat treatment. The flexible and elastic gel is formed if surimi is mixed with salt, which through the process of dozing will form a sol, and with formation and heating will form a gel.

The first surimi washing on surimi aims to remove sarcoplasmic protein, while the second washing is done by adding 0.3% salt from the weight of the meat to dissolve myofibril and activate the actomyosin sol. The process of leaching or rinsing can also interfere with gel formation so that the ability in gel formation is increased.

3. 5. Decision making with the Bayes Method

The calculation results in determining the best treatment by considering the appearance criteria, aroma, texture, and taste of pomfret meatballs are presented in Table 5. Based on the calculation of the weight of criteria starting from appearance, aroma, texture, and taste of pomfret meatballs, it was found that taste assessment was an important criterion that determines the final decision of the panelists in the selection of pomfret meatball products with criteria weight value of 0.48.

This shows that even though other judgments are good but if the taste of fish meatballs is not liked by the panelists, then the product will be rejected by the panelists. This proves that the taste criteria are the most important ones that determine the final decision of the panelist. Non-

volatile flavor compounds provide an influence on the flavor characteristics of a processed product usually from the free amino acid group, peptides, and nucleotides.

Table 5. Decision Matrix for Assessment of Pomfret Meatballs by the Bayes Method

Treatment	Criteria				Alternative value	Priority Value
	Appearance	Aroma	Texture	Taste		
Control	7	7	5	5	5.77	0.28
Carrageenan	7	7	7	7	7.07	0.35
Seaweed flour	7	9	7	7	7.49	0.37
Criteria Value	0.15	0.21	0.17	0.48	20.33	1.00

The taste is the most important criterium of a product. Although other criteria are better, but if the taste of pomfret meatballs is not liked by the panelists, the product will be rejected by the taste criteria, the most important thing in the main consideration in choosing a product. The calculation with the Bayes method shows that the treatment that gets the highest alternative value is 7.49 which has a priority value that is equal to 0.37 with the addition of seaweed flour. Addition with carrageenan flour obtained an alternative value of 7.07 which has a priority value of 0.35. The control treatment has the lowest alternative value which is equal to 5.77 and has a priority value of 0.28. The highest alternative value by considering criteria can be used to analyze the best decisions. But overall the control and addition of carrageenan treatment is still favored by panelists.

3. 6. Folding Test

Physical testing is done by folding test, with the purpose to determine the level of elasticity of a product. Elasticity is the force needed to return to its original shape. The results of observations on the test of folding of pomfret meatballs can be seen in Table 6.

Table 6. Average Value of Folding Test for Pomfret Meatballs

Treatment	Mean	Value	Rangking	Elasticity
Control	3.8	4	A	Springy
Carrageenan	4.3	4	A	Springy
Seaweed flour	4.3	4	A	Springy

Based on the observations of the average value of elasticity of pomfret meatballs added with seaweed flour and carrageenan one can see the average value in the range of 3.8 to 4.3. Addition with carrageenan and seaweed flour has the highest average value of 4.3, while the lowest average value is 3.8 by the control treatment.

The addition of seaweed flour, carrageenan flour, and control treatment are considered in the elasticity criteria with a value of 4 and categorized as rank A. This was due to the addition of seaweed flour and carrageenan flour, as well as the use of tapioca flour on fish meatball dough which could lead to gelatinization. Tapioca flour has amylose content which has a function in absorbing water and the perfection of the product gelatinization process. Fish surimi which is also used is very influential in optimizing the gel formation. One of the characteristics of surimi is to form a gel that is elastic and strong during the heating process.

4. CONCLUSIONS

Based on the results of the research on the addition of carrageenan flour and seaweed flour to the level of preference of freshwater pomfret meatballs, all the treatments were still favored by panelists. The treatment with the addition of seaweed flour was preferred by panelists with an average value of 5.7; texture which is 8.2; taste that is equal to 7.1; and aroma which is equal to 7.1. The weight of the taste criteria is 0.48 and the alternative value is 7.49 and the folding test result was equal to 4.3 which indicates that pomfret meatballs are considered as elastic.

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