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PREFERENCE LEVELS OF SHORTFIN EEL MEATBALLS WITH THE ADDITION OF SEAWEED FLOUR (*EUCHEUMA COTTONII*)

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KeyWords
Shortfin eel meatballs, fiber, preference level, seaweed flour.

ABSTRACT

This research aims to determine the percentage of the addition of seaweed flour as a source of fiber which produces shortfin eel meatballs which are the most preferred by panelists. This research was conducted at the Fisheries Product Processing Laboratory, Faculty of Fisheries and Marine Sciences, Padjadjaran University and the Food Engineering Laboratory, Faculty of Engineering, Pasundan University in January - February 2020. The method used in the research was the experimental method with 4 additional treatments of seaweed flour, which are control, 5%, 10%, and 15 % with 15 semi-trained panelists as replicates. The parameters observed were the level of preference for organo-leptic characteristics and fiber content. The results showed that eel meatball with the addition of 5% seaweed flour was the most preferred by panelists with an average appearance value of 6,8; aroma 7,1; texture 6,6 and taste 6,7; alternative value 7,00 and priority value 0,28; 3,91% fiber content.

INTRODUCTION

Eel fish (*Anguilla* sp.) is one of the Indonesian fisheries commodities traded in the international market. Eel fish has a high value and has been cultivated through intensive or extensive systems, especially in Asia (Altun et al. 2005). According to Liviawaty and Afrianto (1998), Indonesia has a huge potential as the largest producer in the world, because of the abundance of eel in Indonesia. This is evidenced by the production of eel which was exported reaching 2,4 thousand tons in 2018, making Indonesia ranked 5th as an eel exporting country in the world (ITC 2019).

According to the level of utilization, eel in Indonesia is dominated by 2 types, namely *A. bicolor* which is mostly caught on the southern coast of Java, and *A. marmorata* which is the center of its catch in the area of lake Poso (Fahmi et al. 2012). The abundance of *A. bicolor* higher in the southern waters of Java is thought to be due to the influence of the movement of currents carrying eggs and larvae from the spawning sites in the Mentawai waters to the west coast of Sumatra and south of Java which is part of the Indian Ocean (Arai 2014).

Eel fish included in the fish species with high economic value, besides the content of Vitamin A, Eicosa Pentaenoic Acid (EPA) and Docosa Hexaenoic Acid (DHA) contained in eel fish are among the highest when compared with the salmon fish and mackerel fish (Suitha and Suhaeri 2008). Eel resources in Indonesia have not been widely used, this can be seen from the level of eel utilization locally (domestically) is still very low, even though the number of fish both in terms of seed size and consumption size is quite abundant. One reason is this fish has not been widely known so that most of Indonesia's population is not yet familiar to consume eel (Affandi 2017).

Utilization of the eel fish one of them is as a raw material of processed products such as meatballs, ekado, the legs of the dragon, risoles, and dumplings. Meatball is one of a processed meat product that is popular with the public, both children, and adults (Princestasari and Amalia 2015). The nutritional content of fish meatballs is generally high in protein and low in fiber. It has been proven in Hariadi's research (2017) which states that the nutrient content in 100 g meatballs tilapia with the addition of carrots and white oyster mushroom consists of proteins of 11,76 g, fat 2,31 g, carbohydrates 25,56 g, and fiber 0,71 g. The fiber content is still very far from the needs of the Indonesian people for fiber-based on the Nutrition Adequacy Rate (NAR) Department of Health (2013), which states that at the age of teenage to the adult average of 34 g per day, and food additives that can be a source of fiber and meet the needs of one of them is seaweed. As an effort to increase people's fiber consumption, it is necessary to add seaweed as a good source of fiber for the body so that it adds nutritional value to fish meatballs products.

Seaweed type of *Eucheuma cottonii* or now also known as *Kappaphycus alvarezii* can function as a source of fiber that can be used in the food industry. The fiber content found in seaweed is an important value because it is good for meeting the daily nutritional needs of humans. According to Herdiani's research (2003), *Eucheuma cottonii* has a food fiber content of 78.94% so it is very potential to be used as a source of dietary fiber on the food. One alternative is the utilization of seaweed to increase the added value is to make it into flour (Santosa et al. 2016).

Flour is one of the raw materials in the food industry and almost all types of food industry using flour. The flour in the food industry is usually used as the main raw material, additional raw material, or as supporting materials (Ristanti 2003). The addition of seaweed flour in the manufacture of fish meatballs has the potential to increase the fiber content so that it can meet the daily fiber needs of the community. Manufacture of fish meatballs with the addition of seaweed flour will have an impact on organoleptic characteristics such as appearance, aroma, texture, and taste. Therefore, it is necessary to research how much influence the addition of *E. cottonii* seaweed flour to the fiber content and preference level of shortfin eel meatballs.

MATERIALS AND METHODS

Materials

The research was conducted in January-February 2020. Organoleptic tests were carried out at the Fisheries Product Processing Laboratory, Faculty of Fisheries and Marine Science, Padjadjaran University, and fiber test were carried out at the Food Technology Laboratory, Faculty of Engineering, Pasundan University.

Tools used in the process of making shortfin eel meatballs were food processors, meat grinders, knives, cutting board, pan, tray, digital scales, and gas stove. The ingredients used were shortfin eel fillets, tapioca flour, *E. cottonii* flour, salt, garlic, onion, and fine pepper.

Methods

The method used in this research was experimental, consisted of 4 treatments with 15 semi-trained panelists as a repetition. These

panelists are students of the Faculty of Fisheries and Marine Science, Padjadjaran University who had known and have experience in organoleptic testing. The following formulations of shortfin eel meatballs are presented in Table 1.

Table 1. Formulation of ingredients shortfin eel meatballs with the addition of *E. cottonii* flour

Materials	Treatments			
	0	**5**	**10**	**15**
Eel fillet (g)	300	300	300	300
Tapioca flour (g)	45	45	45	45
***E. cottonii* flour (g)**	**0**	**15**	**30**	**45**
Garlic (g)	3	3	3	3
Onion (g)	6	6	6	6
Fine pepper (g)	1,5	1,5	1,5	1,5
Salt (g)	7,5	7,5	7,5	7,5
Ice (ml)	15	15	15	15

Source: BBP2HP (2014) with modification

The usage percentage of *E. cottonii* flour in the manufacture of shortfin eel meatballs based on the weight of eel fillets with the following treatment:

1. Treatment A: Without the addition of *E. cottonii* flour
2. Treatment B: Addition of 5% *E. cottonii* flour
3. Treatment C: Addition of 10% *E. cottonii* flour
4. Treatment D: Addition of 15% *E. cottonii* flour

The research procedure consists of several stages, namely manufacture of shortfin eel meatballs with the addition of *E. cottonii* flour, organoleptic, and fiber content testing.

Data analysis

Organoleptic test data were analyzed using non-parametric statistics using a two-way analysis of Friedman test variants with a *chi-square* test. 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 several alternatives or treatments by considering criteria.

The statistical formula used in the Friedman test is as follows (Siegel 1991):

$$X^2 = [\frac{12}{bk\ (k+1)} \sum_{i\ =1}^{t} (RJ)^2] - 3b\ (k+1)$$

Description:

X^2 = Friedman test statistics
b = Repeat
k = Treatment
Rj = Total ranking of each treatment

If any of the same numbers were performed, calculation of correction factor ware needed using the following as formula:

$$FK = 1 - \frac{\sum Ti}{bk\ (k^2-1)}$$

$$x_c^2 = \frac{x^2}{FK}$$

The significant value of the x_c^2 can be known by using the chi-squared critical po table with: db = k-1; α = 0,05
H_0 = treatment does not give a real difference at the level of α = 0,05
H_1 = treatment gives a significant difference at the level of α = 0,05

If the value of Hc < H table then accept H_0 and reject H_1 and if Hc > H table, then reject H_0 and H_1 accepted. If the results of the analysis of variance two-way Friedman's significance then to know the difference of each treatment test further the comparison of multiple (multiple comparison). The formula test is more multiple as the following:

$$|R_i - R_j| \geq Z \frac{\propto}{k(k-1)} \sqrt{\frac{bk(k+1)}{6}}$$

$R_i - R_j$	= Difference in the number of each treatment
R_i	= Average rating from the i sample
R_j	= Average rating from the j sample
α	= Experiment wise error rate (0,05)
b	= Number of tests
k	= Number of treatments
Z	= Value on Z factor for multiple comparisons

The method used to figure out the selected product was the Bayes method. Bayes method is a technique used for the analysis of best decision making by various alternatives that aimed to get a result that considers various criteria.

RESULT AND DISCUSSION

Appearance

The appearance has an important role in the acceptance of a product because it is the first thing seen from a product. Appearance is the first characteristic that is considered a consumer in consuming a product. Although appearance does not determine the absolute level of consumer preference, it does affect consumer acceptance (Soekarto 1985).

Table 2. The average result of appearance shortfin eel meatballs

Treatments seaweed flour (%)	Average of appearance
0	6,7 a
5	6,9 a
10	7,1 a
15	6,7 a

Description: The average value of treatment followed by the same letter shows no significant difference in the Multiple Comparison test at the 5% level

The results of the Friedman test showed that all treatments were not significantly different at the level of 5% so that the calculation was not followed by multiple comparison tests, it means that the panelist had almost the same level of preference for the appearance of each treatment. Based on the assessment of panelists to the appearance of shortfin eel meatballs obtained average values ranged from 6,7 to 7,1, which is the panelist's preferred category. Panelists liked the appearance of the shortfin eel meatballs with the addition of seaweed flour up to 15% because the surface was still quite smooth and the color was not dull.

The appearance of the shortfin eel meatballs produced has a round shape but is not perfectly round and the surface is quite smooth, the color of the shortfin eel meatballs with the addition of seaweed flour and without the addition of seaweed flour is almost the same overall, namely less bright gray color. The color of the final result is influenced by its dominant meat eel and the color of the seaweed flour as a creamy binder. This is following the results of the research Ristanti (2003), who explains that seaweed flour has a diverse color, the color difference on the seaweed flour is the result of soaking in a different solution, one of the colors is cream. According to Oktaviani (2012), forming fish meatballs to produce around and uniform size should be done by an employee who is already an expert and has experience working in making fish balls.

Figure 1. The appearance of shortfin eel meatballs with various treatments (Description: A: 0%, B: 5%, C: 10%, D:15%)

Aroma

The aroma is one of the important factors for consumers in choosing food that is preferred. Testing the aroma is considered important in the food industry because it can provide the results of the assessment of the related products are received whether or not a product (DeMan 1989).

Table 3. The average result of aroma shortfin eel meatballs

Treatments seaweed flour (%)	Average of aroma
0	6,2 a
5	7,1 a
10	6,6 a
15	5,9 a

Description: The average value of treatment followed by the same letter shows no significant difference in the Multiple Comparison test at the 5% level

The results of the Friedman test showed that all treatments were not significantly different in the aroma of the shortfin eel meatballs, so the calculation was not followed by multiple comparison tests, meaning that the panelists had almost the same preference for the aroma of each treatment. Based on the panelists' assessment of the eel meatball aroma, the average value ranged from 5,9 to 7,1, which is categorized as neutral and favored by the panelists. Panelists liked the aroma of shortfin eel meatballs with the addition of seaweed flour up to 10% because it still had a specific product aroma.

The aroma of the shortfin eel meatballs with the addition of seaweed flour and without the addition of seaweed flour as a whole did not show any significant difference. This is following the research of Larasanti (2019) which made pomfret meatballs with the addition of seaweed flour, that the aroma produced in the control treatment and the addition of seaweed flour did not give a real difference. According to Agusman et al. (2014), seaweed flour type *E. cottonii* has a neutral aroma, and if the used amount a little it is does not cause a change in the aroma. This underlies the absence of significant differences to the aroma in the control treatment and the addition of seaweed flour treatment. The Aroma of the typical products of shortfin eel meatballs comes from the volatile compounds found under the skin in the lipid layer. Fat-derived volatile compounds such as aldehydes and ketones are often produced by enzymatic reactions and autooxidation of lipids (Pratama et al. 2018). The high proportion of eel skins greatly affects the distinctive aroma of the product, based on research by Nafsiyah et al. (2018) stated that the proportion of skin on the body of eels reaches 21%.

The appearance of the aroma of food is caused by the formation of volatile compounds. The aroma of a product can be detected when the aroma evaporates and enters through the nose. The evaporation of the product is influenced by temperature and the natural components contained in it (Meilgaard et al. 1999 in Rahmawati 2013). The aroma released by each food is different, besides that different cooking methods will cause different aromas (Moehyi 1992). The process of arising aromas according to Purba (2014) in several types of foodstuffs is grouped into four parts, namely: (1) Aroma naturally contained in foodstuffs; (2) Aroma which is formed enzymatically after the food is harvested; (3) Aroma formed through processing or storage; and (4) Aroma added to food, either natural, natural or artificial. Many aroma components appear during the food processing process, especially heating applications such as boiling, roasting, frying, canning, extrusion, and pasteurization, some of which can even be formed through fermentation. Aliani and Farmer (2005) stated that chemical reactions during boiling produced many volatile chemical substances that gave them aroma.

Texture

Food texture can be evaluated by mechanical tests or by sensory analysis. The texture is an important factor in the meatball (Hsu & Chung 1998).

Table 4. The average result of texture shortfin eel meatballs

Treatments seaweed flour (%)	Average of texture
0	7,4 b
5	6,6 ab
10	5,9 a
15	4,2 a

Description: The average value of treatment followed by the same letter shows no significant difference in the Multiple Comparison test at the 5% level

The results of the Friedman test showed that the texture of the shortfin eel meatballs in the control treatment had no significant difference with the 5% treatment but had a significant difference with the 10% and 15% treatment, so the calculation was continued with multiple comparison tests and the best treatment was obtained for shortfin eel meatballs texture is a control treatment. The texture of the eel meatball in the control treatment and the addition of 5% seaweed flour was preferred by the panelists because it had a dense, compact, and slightly chewy texture, while the addition of 15% seaweed flour was not liked by the panelists because the texture was not compact and not chewy. This is following the statement of Supriadi (2004), which states that the addition of seaweed flour has a significant effect on the resulting texture, namely the more seaweed flour is added, the harder the product is produced. According to Agustini (1996), the texture of the mature form is affected by the formula, mixing, and cooking conditions, which is also the time and method of storage. Seaweed flour in this research acts as a binder, Anjarsari (2010) in Sahlan et al. (2018) states that the binder is a material used to bind the water contained in the dough, its function is to improve the stability of the emulsion, the lower the shrinkage during the process of processing and forming a dense texture.

Based on the panelists' assessment of the texture of the shortfin eel meatballs, the average value ranged from 4,2 to 7,4, which was categorized as disliked, neutral, and preferred by panelists. The highest average texture value was found in the control treatment, while the lowest average value was found in the addition of 15% seaweed flour. The texture of the shortfin eel meatballs with the addition of seaweed flour and without the addition of flour of seaweed showed significant changes. Based on the preference level, the texture that is produced on the addition of seaweed flour 15% is not preferred by the panelists because the texture is not compact and not chewy, so it was unacceptable to see the average value which was below the rejection limit, which was less than five. According to Fernando (2007), the reception is a group of panelists that gave the impression of a very like (9), like (7), and neutral (5), while rejection is a group of panelists that gave the impression of not like (3) and strongly dislike (1).

Taste

Taste is a parameter that determines the acceptance of food, the level of preference based on taste is influenced by the personal tastes of each person (Maina 2018).

Table 5. The average result of taste shortfin eel meatballs

Treatments seaweed flour (%)	Average of taste
0	6,4 ab
5	6,7 b
10	5,9 a
15	4,6 a

Description: The average value of treatment followed by the same letter shows no significant difference in the Multiple Comparison test at the 5% level

The results of the Friedman test showed that the taste of the treatment 5% shortfin eel meatballs had no significant difference with the control treatment, but was significantly different from the 10% and 15% treatment, so the calculation was continued with multiple comparison tests and obtained the best treatment to the texture of the shortfin eel meatballs which with the addition of 5% seaweed flour. Based on the panelists' assessment of the taste of the shortfin eel meatballs, the average value ranged from 4,6 to 6,7, which was categorized as disliked, neutral, and preferred by panelists. The taste of the shortfin eel meatballs on the control treatment and the addition of 5% seaweed flour was preferred by the panelists because it had a specific product taste, although a bit less. The high and low concentration of the added seaweed flour will affect the specific taste of the shortfin eel meatballs. The addition of seaweed flour increases the panelists' preference to a certain point, furthermore, this addition will reduce the panelists' ac-

ceptance of taste (Purwanto 2006). According to Yamaguchi & Watanabe (1990) in Pratama et al. (2013), free amino acids play a role in providing the flavor of fishery products. Based on research by Nafsiyah et al. (2018) the amino acid content in eel consists of 8 types of essential amino acids (histidine, threonine, methionine, valine, phenylalanine, i-leucine, leucine, lysine) and 7 types of non-essential amino acids (aspartic acid, glutamate, glycine, serine, arginine, alanine, tyrosine).

The taste of the shortfin eel meatballs with the addition of seaweed flour and without the addition of seaweed flour showed a significant difference. Based on the level of preference, the taste produced by the addition of 15% seaweed flour was not liked by the panelists because the dominant taste of the fish species was lost. This can be explained by the SNI 7266-2014 that fish balls must have a specific product taste, and Wibowo (2000), which states that the fish meatball taste criteria are the dominant fish taste according to the type of fish used and the taste of the spices is quite prominent but not excessive.

Decision making by Bayes Method

The decision making on the alternative weight value and the appearance, aroma, texture, and taste criteria of the shortfin eel meatballs was done by using pairwise comparison. The results on the weight of criteria against appearance, aroma, texture, and taste for 15 panelists are presented in Table 6.

Tabel 6. Weight of criteria for shortfin eel meatballs

Criteria	Priority
Appearance	0,12
Aroma	0,13
Texture	0,16
Taste	**0,59**

Based on the calculation of the weight of criteria on the appearance, aroma, texture, and taste of shortfin eel meatballs, it was found that the taste had the highest criterion weight of 0,59, then the texture was 0,16, the aroma was 0,13 and the appearance with the lowest criterion weight was 0,12. This shows that taste is the most influential criterion in the assessment of shortfin eel meatballs. Lebert (2003), explains that in choosing the food products the taste is the most important parameter. According to Purwanto (2006), taste is the most important factor in the final decision of the consumer to accept or reject food.

After knowing the most important taste parameters, then proceed with calculations to determine the weights of criteria for each treatment. The calculation results are presented in Table 7.

Tabel 7. The Results Of Calculation Of Criteria Weight Of Each Treatment

Treatments	Criteria				Alternative Value	Priority Value
	Appearance	Aroma	Texture	Taste		
0%	7	5	7	7	6,76	0,27
5%	7	7	7	7	**7,00**	**0,28**
10%	7	7	5	5	5,50	0,22
15%	7	7	5	5	5,50	0,22
Criteria Value	0,12	0,13	0,16	**0,59**	24,74	1,00

Based on the calculation of the weight of the appearance, aroma, texture, and taste of the shortfin eel meatballs, it was found that the addition of 5% seaweed flour had the alternative value and the highest priority value, namely 7,00 and 0,28 which was followed by control treatment with an alternative value of 6,76 and the priority value is 0,27, after that the treatment of 10% and 15% have the same alternative value and priority value, namely 5,50 and 0,22. According to Marimin (2004), the Bayes method is one of the analytical techniques in making the best decisions from several alternatives, which aims to obtain optimal results by considering several criteria. The Bayes method in this study was used to determine the concentration of the best addition of seaweed flour, which is based on all values of preference levels in the sensory characteristics of the organoleptic results. The calculation results show that the eel meatball with the addition of 5% seaweed flour is the best treatment with the highest alternative value and priority value and is the most preferred by the panelists.

Fiber test

The crude fiber content test was carried out on the control treatment (without adding seaweed flour) and the most preferred treat-

ment, namely the addition of 5% seaweed flour. The results of the fiber content test are presented in Table 8.

Tabel 8. Test Results the Content of Crude Fiber

Treatments seaweed flour (%)	Fiber content (%)
0	0,95
5	3,91

Based on the results of the crude fiber content test, the fiber content of the shortfin eel meatballs with the use of 5% seaweed flour was higher than the shortfin eel meatballs without the addition of seaweed flour. The fiber in seaweed compared to other foodstuffs has a feature that lies in the content of alginic acid, which has a high affinity for heavy metals and radioactive elements. The content of alginate cannot be digested by the body, therefore consumption of alginate can help rid the body of heavy metal pollution and radioactive elements (Ristanti 2003).

According to the Department of Nutrition, Ministry of Health, and Institute of Health Singapore (1999), a product can be claimed as a source or contains fiber if there is more than or equal to 3g of fiber per 100g of product (in solid form) or 100ml (in liquid form). Based on this, the eel meatball with the addition of 5% seaweed flour can be claimed as a fiber source product and high in fiber content. Based on the nutritional adequacy rate recommended by the Ministry of Health of the Republic of Indonesia in 2019, the daily fiber needs of the community are 27-37 g / day. Consumption of fiber is useful for avoiding excess saturated fat, cholesterol, sugar, and helps control body weight (Ristanti 2003).

Recapitulation

Based on the research results, it was found that the hypothesis was rejected because the results of calculations and overall observations indicated that the Eel Meatball with the addition of 5% seaweed flour was the best treatment. This happens because of the factors that influence, according to Wulandari (2010) the selection of basic materials, the interaction between basic materials and additives, and the processing process are factors that affect the final product. The final result of this observation is following the research conducted by Manurung (2009) which states that the treatment of 5% seaweed flour in the manufacture of fish balls is the best treatment that panelists prefer. The overall results of the Eel Meatball observations are presented in Table 9.

Tabel 9. Recapitulation of shortfin eel meatballs observation result

Observation	Treatment			
	0%	5%	10%	15%
Hedonic				
Appearance	6,7 a	6,8 a	**7,1 a**	6,7 a
Aroma	6,2 a	**7,1 a**	6,6 a	5,9 a
Texture	**7,4 b**	6,6 ab	5,9 a	4,2 a
Taste	6,4 ab	**6,7 b**	5,9 a	4,6 a
Bayes Method				
Alternative Value	6,7	**7**	5,5	5,5
Crude Fiber Content Test	0,95%	**3,91%**	-	-

The hedonic test results showed that the addition of seaweed flour did not give a significant difference to the appearance and aroma characteristics, but did provide a significant difference to the texture and taste characteristics. From the organoleptic characteristics of appearance, aroma, texture, and taste the highest criterion weight was the taste, and the addition of 5% seaweed flour was preferred by panelists with the highest alternative value compared to other treatments. The results of the crude fiber content test conducted showed that the addition of 0% and 5% seaweed flour had crude fiber content of 0,95% and 3,91%.

The test results showed that the appearance and aroma characteristics of all treatments were still accepted by the panelists, but the texture and taste characteristics of the treatment, addition of 15% seaweed flour were not accepted by the panelists because it had an average of 4,2 and 4,6. Based on all the parameters observed, the addition of 5% seaweed flour was the best treatment favored by the panelists.

CONCLUSION

Based on the results of research on the level of preference for shortfin eel meatballs with the addition of *E. cottonii* seaweed flour, it was found that the most favored by panelists was the addition of 5% seaweed flour. The average appearance, aroma,

texture, and taste scores were 6,8; 7,1; 6,6 and 6,7; alternative value 7,00 and priority value 0,28. The test result of crude fiber content is 3,91%.

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