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THE EFFECT OF ADDING BLUE SWIMMING CRAB SHELL FLOUR ON INCREASING CALCIUM AND THE PREFERENCE LEVEL FOR BISCUIT

Pengaruh Penambahan Tepung Cangkang Rajungan Terhadap Peningkatan Kalsium dan Tingkat Kesukaan Biskuit

Annisa Dewi Nur Azizia*, Evi Liviawaty, Ayi Yustiati, Rusky Intan Pratama

Fisheries Study Program, Faculty of Fisheries and Marine Sciences, Padjadjaran University

Jl. Raya Bandung Sumedang KM.21, Hegarmanah, Jatinangor District, Sumendang Regency, West Java 45363

*Coresponding author: annisa20044@mail.unpad.ac.id

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ABSTRACT

Blue Swimming Crab (*Portunus pelagicus*) has a calcium content of 19.97% which can be fortified in biscuit products. The purpose of this study was to understand the impact of using crab shell flour in biscuits on panelist preferences. The study was conducted from July to August 2024 at the Fisheries Product Processing Laboratory, Faculty of Fisheries and Marine Sciences, Padjadjaran University. The method used in this study was experimental using Friedman data analysis consisting of 4 treatments and 20 replications in the form of semi-trained panelists on organoleptic parameters, namely appearance, aroma, taste, and texture and chemical parameters, namely calcium content, water content, ash content, protein content, fat content, and carbohydrate content. The results of the hedonic test proved that the addition of 5% crab shell flour was the most preferred treatment, with an average appearance value of 7.9; aroma 8.2; taste 8.1; and texture 8.1. Based on chemical analysis of the most preferred treatment, namely the addition of 5% crab shell flour produced a calcium content of 1.98%; water content 2.11%; ash content 3.45%; protein content 12.35%; fat content 9.91%; and carbohydrate content 72.18%.

Keywords: Biscuits, Blue Crab Shell Flour, Calcium, Preference Level

ABSTRAK

Rajungan (*Portunus pelagicus*) memiliki kandungan kalsium pada cangkang sebesar 19,97% yang dapat di fortifikasi pada produk biskuit. Tujuan penelitian adalah memahami dampak penggunaan tepung cangkang rajungan dalam biskuit terhadap preferensi panelis. Penelitian dilakukan dari Juli sampai Agustus 2024 bertempat di Laboratorium Pengolahan Hasil Perikanan Fakultas Perikanan dan Ilmu Kelautan Universitas Padjadjaran. Metode yang digunakan di penelitian ini adalah eksperimental menggunakan analisis data Friedman yang terdiri dari 4 perlakuan dan 20 ulangan berupa panelis semi terlatih terhadap parameter organoleptik yaitu kenampakan, aroma, rasa, dan tekstur serta parameter kimia yaitu kadar

kalsium, kadar air, kadar abu, kadar protein, kadar lemak, dan kadar karbohidrat. Hasil uji hedonik membuktikan bahwa dengan tambahan tepung cangkang rajungan 5% merupakan perlakuan yang paling disukai, memiliki rata-rata nilai kenampakan 7,9; aroma 8,2; rasa 8,1; dan tekstur 8,1. Berdasarkan analisis kimia terhadap perlakuan yang paling disukai, yaitu penambahan tepung cangkang rajungan 5% menghasilkan kadar kalsium 1,98%; kadar air 2,11%; kadar abu 3,45%; kadar protein 12,35%; kadar lemak 9,91%; dan kadar karohidrat 72,18%.

Kata Kunci: Biskuit, Tepung Cangkang Rajungan, Kalsium, Tingkat Kesukaan

INTRODUCTION

Crab (*Portunus pelagicus*) is a marine organism that lives in Indonesian waters. In 2018, Indonesia successfully exported crab commodities worth USD 370.14 million, which is equivalent to 10.50% of the total nominal exports of the national fisheries sector (Central Statistics Agency, 2018). According to Anggraeni et al. (2023) crab production in Indonesia can produce crab waste reaching around 25,187 kg per day, much of which is wasted. Crab waste can cause environmental pollution if disposal does not go through a waste processing or waste utilization process first.

One of the by-products of crab processing is shells. According to Multazam (2002), a crab weighing between 100 g and 350 g has a shell weighing between 51 g and 177 g, or around 57% of its total body weight. Crab shells are one of the wastes from fisheries processing that are rich in minerals, especially calcium reaching 19.97% and phosphorus reaching 1.81% (Multazam, 2002). Calcium is an essential mineral needed by the human body in doses of more than 100 mg per day. According to Ramayulis et al. (2018) stated that in general calcium consumption in Indonesia is low, which is only 254 mg per day, even though the recommended nutritional requirement standard is 500 to 800 mg per day. Lack of calcium intake in the human body can cause metabolic disorders and osteoporosis (Rahmelia et al., 2015).

Biscuits are used as an alternative product fortified with the addition of crab shell flour because they are liked by various age groups, from infants to the elderly, with biscuit formulations designed according to their respective needs (Paramitha, 2022). According to Riskiani et al. (2014) biscuits are popular with all groups because they are practical and easy to obtain. This product is widely found both in the market and in places that sell snacks. This food has a low water content, so it can last a long time when stored (Astuti et al., 2023).

Based on the explanation above, it is very important to conduct research on the addition of different crab shell flour to biscuits on the level of panelist preference. The addition of crab shell flour to biscuits can cause changes in organoleptic characteristics in terms of appearance, aroma, taste, and texture as well as chemical parameters in terms of calcium content, water content, ash content, fat content, protein content and carbohydrate content. This study can identify the effect of the addition of optimal crab shell flour to create biscuits with the quality desired by panelists and can meet the community's calcium nutritional adequacy.

METHODS

The research was conducted from July to August 2024 at the Fisheries Product Processing Laboratory, Faculty of Fisheries and Marine Sciences, Padjadjaran University to make crab shell flour, make biscuits with added crab shell flour and hedonic tests on biscuits. Analysis of water content, calcium content, fat content, ash content, and protein content using testing services at the Food Technology Laboratory, Faculty of Engineering, Pasundan University. Carbohydrate content was tested using the by difference method. Some of the tools used for this study include a 100 mesh sieve, blender, knife, gas stove, pan, oven, baking sheet, cutting board, digital scale, analytical scale, mixer, rolling pin, mold, and spatula. The materials

used for this study were crab shells, margarine, egg yolks, granulated sugar, powdered milk, vanilla, baking powder, and wheat flour.

This study used an experimental method with four types of treatments, as many as 20 semi-trained panelists were used as replications to evaluate the level of preference for biscuits. The 4 treatments are:

Treatment A: Addition of 0% crab shell flour
Treatment B: Addition of 2.5% crab shell flour
Treatment C: Addition of 5% crab shell flour
Treatment D: Addition of 7.5% crab shell flour

Stages of making crab shell flour according to Prayoga et al. (2015) which was modified as follows:

1. The crab shells were washed clean with running water and cut using a knife into 1 cm - 2 cm sizes
2. The crab shells were boiled at a temperature of 100^{o}C for 1 hour
3. The crab shells were rinsed thoroughly using running water from the remaining meat on the shells as many as 2 washes
4. The crab shells were dried in an oven at a temperature of 100°C for 2 hours until dry
5. After drying, the crab shells were crushed using a blender
6. The resulting flour was then sieved using a 100 mesh sieve to obtain fine and even crab shell flour.

The process of making these biscuits uses the formulation of Afriani et al. (2016) which has been modified as shown in Table 1. The procedure for making biscuits with crab shell flour is guided by the research of Hapsoro et al. (2017) which is modified, namely:

1. Egg yolks, sugar and margarine are stirred using a mixer for 15 minutes until fluffy
2. Wheat flour, vanilla, baking powder, and milk powder are added to the dough, stirred using a spatula until homogeneous
3. Crab shell flour is mixed into the biscuit dough in accordance with the specified treatment
4. The dough is flattened using a rolling pin and the mold is placed on top of the dough and pressed using hands
5. The dough is baked in an oven at 100^{o}C for 18 minutes
6. The biscuits are served on a serving plate.

Table 1. Crab Shell Flour Biscuit Formulation

Material Name	Crab Shell Flour Biscuit Formulation			
	A (0%)	B (2.5%)	C (5%)	D (7.5%)
Crab Shell Flour (g)	0	4.25	8.5	12.75
Wheat Flour (g)	85	85	85	85
Margarine (g)	45	45	45	45
Sugar (g)	25	25	25	25
Egg Yolk (g)	18	18	18	18
Milk (g)	25	25	25	25
Baking Powder (g)	1	1	1	1
Vanilla (g)	1	1	1	1
Total (g)	200	204.25	208.5	212.75

Source: Afriani et al. (2016) modified

The parameters analyzed in this study include organoleptic parameters of biscuits, such as appearance, aroma, taste, and texture, as well as chemical parameters including calcium, water, ash, protein, fat, and carbohydrate levels. Data obtained from observations of the level of organoleptic preference of biscuits were analyzed using the Friedman Test. If the calculated

X^2c value is < X^2c table, then H_0 is accepted and H_1 is rejected. Meanwhile, if the calculated X^2c value is > X^2c table, then H_1 is accepted and H^0 is rejected. If H_1 is accepted, then the treatment shows a significant difference, and then a multiple comparison test is carried out to determine the difference between treatments. Decision making regarding the treatment of adding crab shell flour to the most preferred biscuits is carried out using the Bayes method.

RESULT

Appearance

Appearance is crucial in the level of consumer acceptance of a product. Appearance includes the color, shape, and size of a product (Tarwendah, 2017). The average results of the appearance of crab shell flour biscuits are in Table 2.

Table 2. Average Hedonic Test of Biscuit Appearance Based on Different Concentrations of Crab Shell Flour

Treatment	Median	Average
0%	7	7.7[a]
2.5%	7	6.9[a]
5%	8	7.9[a]
7.5%	7	6.5[a]

Description: values followed by the same letter horizontally indicate no significant difference in the Multiple Comparison Test.

Aroma

Aroma affects the extent to which a food is considered delicious so that it can be accepted or rejected by the panelists. Aroma plays an important role in food production because it can increase interest in the product (Antara & Wartini, 2014). The average results of the aroma assessment of biscuits using crab shell flour can be seen in Table 3.

Table 3. Average Hedonic Test of Biscuit Aroma Based on Different Concentrations of Crab Shell Flour

Treatment	Median	Average
0%	7	7.4[a]
2.5%	7	7[a]
5%	9	8.2[b]
7.5%	7	6.1[a]

Description: values followed by the same letter horizontally indicate no significant difference in the Multiple Comparison Test.

Taste

Taste is one of the key elements in determining the level of panelists' preference for a product. Although other parameters such as appearance, aroma, and texture of a product are good, if consumers do not like the taste, the product can be rejected (Soekarto, 2012). Taste is related to one of the five senses of taste, namely the tongue. The average results of the taste of crab shell flour biscuits are shown in Table 4.

Table 4. Average Hedonic Test of Biscuit Taste Based on Different Concentrations of Crab Shell Flour

Treatment	Median	Average
0%	7	7.3[b]
2.5%	7	6.3[ab]

Treatment	Median	Average
5%	9	8.1[b]
7.5%	3	5[a]

Description: values followed by the same letter horizontally indicate no significant difference in the Multiple Comparison Test.

Texture

Texture is a characteristic of a product resulting from a combination of various materials, including size, shape, quantity, and elements that form the material (Tarwendah, 2017). Texture assessment comes from touch and feel on the surface of the product, and generally uses the sense of touch (fingertips) and taste (tongue). The average results of the texture of crab shell flour biscuits are in Table 5.

Table 5. Average Hedonic Test of Biscuit Texture Based on Different Concentrations of Crab Shell Flour

Treatment	Median	Average
0%	7	6.5[a]
2.5%	7	7.2[a]
5%	9	8.1[b]
7.5%	7	6.3[a]

Description: values followed by the same letter horizontally indicate no significant difference in the Multiple Comparison Test.

Decision Making with Bayes Method

Determination of the relative weight value and criteria for appearance, aroma, taste, and texture of crab shell flour biscuits was carried out through pairwise comparison. The results of the calculation of the weight of the biscuit product criteria for appearance, aroma, taste, and texture can be seen in Table 6.

Table 6. Biscuit Criteria Weight Values Based on Different Concentrations of Crab Shell Flour

Criteria	Criteria Weight
Appearance	0.13
Aroma	0.10
Taste	0.48
Texture	0.28

Table 7. Decision Matrix for the Assessment of Biscuits with Crab Shell Flour Concentration Using the Bayes Method

Treatment	Criteria				Alternative Values	Priority Values
	Appearance	Aroma	Taste	Texture		
A	7	7	7	7	7.00	20.54
B	7	7	7	7	7.00	20.54
C	8	9	9	9	8.87	26.02
D	7	7	3	7	5.06	14.85
Criteria Weight	0.13	0.10	0.48	0.28	0.34	1.00

Chemical Composition of Crab Shell Flour Biscuits

The chemical composition in this study was obtained from control biscuits and biscuits that were most preferred by panelists, which included analysis of water, ash, fat, protein, carbohydrate, and calcium content in all treatments. The results of chemical analysis of control biscuits and the most preferred biscuits compared to biscuit standards based on SNI 2973-2011 and SNI 2973-1992 are presented in Table 8.

Table 8. Results of Chemical Composition of Crab Shell Flour Biscuits

No	Test Parameters	Unit	Test Results				SNI
			0%	2.5%	5%	7.5%	
1	Calcium Content	%	1.1	1.85	1.98	2.11	
2	Water Content	%	2.20		2.11		Max 5%*
3	Ash Content	%	0.61		3.45		Max 1.5%**
4	Fat Content	%	8.01		9.91		Min 9.5%**
5	Protein Content	%	6.02		12.35		Min 5%*
6	Carbohydrate Content	%	83.16		72.18		Min 70%**

Description:
*SNI 2973-2011
**SNI 2973-1992

DISCUSSION

Appearance

Based on Friedman's analysis, treatment C produced the highest average calculation value of biscuit appearance, namely with the addition of 5% crab shell flour, which was 7.9. While the lowest average calculation value was recorded in treatment D with the addition of 7.5% crab shell flour, which was 6.5. The median value of the appearance of crab shell flour biscuits ranged from 7 to 8, which indicated that the appearance of the biscuits was liked and well received by the panelists. The highest level of preference was obtained by treatment C with the addition of 5% crab shell flour.

The appearance of crab shell flour biscuits in each treatment did not show a significant difference because the biscuits had a similar color, namely brownish yellow. The brownish yellow color occurs due to the Maillard reaction, which is a reaction between reducing sugars, for example glucose and fructose with amino acids that occurs at high temperatures (Granda et al., 2005). Based on Nelwida et al. (2019), color changes in food products are caused by the heating process where there is a color change reaction without involving enzymes such as the caramel formation process and the Maillard reaction. The appearance of biscuits treated with A, B, C, and D can be seen in Figure 1.

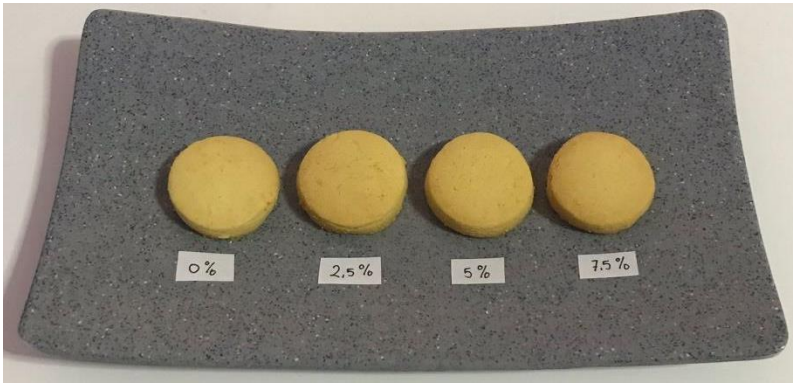

Figure 1. Biscuits with Different Addition of Crab Shell Flour

Aroma

Based on Friedman's analysis, the median value of biscuit aroma is in the range of 6.1 to 8.2. Treatment C with the addition of 5% crab shell flour produces the highest average aroma value of 8.2, while treatment D has the lowest average aroma value of 6.1. The median value of the aroma of crab shell flour biscuits is in the range of 7 to 9, which indicates that the aroma of the biscuits is liked, even very much liked, and well accepted by the panelists. The highest level of aroma preference was recorded in treatment C with the inclusion of a mixture of crab shell flour of 5%.

Treatment C is the treatment most preferred by panelists because it has a distinctive crab aroma that is not too sharp and still has a savory aroma typical of biscuits. According to Beybidanin et al. (2016), in crab shell flour cheese sticks, panelists prefer a crab aroma that is not too strong, because the cheese stick product already emits a savory aroma from other compositions. Meanwhile, the distinctive aroma of fragrant cookies appears due to the influence of ingredients such as sugar, egg yolks, powdered milk and margarine (Prihatiningrum, 2012).

Increasing the concentration of added crab shell flour in biscuits will affect the aroma of the biscuits so that the higher the concentration of added crab shell flour in biscuits, the distinctive aroma of crab in biscuits will increase. The distinctive aroma of crab is caused by crab shell flour and mixing of ingredients that go through a heating process. According to Pramudya et al. (2022), heating can cause chemical changes in volatile compounds and other components in the ingredients, such as evaporation, which produces a distinctive aroma from the ingredients. Ingredients such as powdered milk, egg yolks, vanilla, margarine, and sugar have a very large influence on the aroma of biscuits formed due to the Maillard reaction. Meiyani et al. (2014) stated that the aroma comes from volatile components produced through fat oxidation and Maillard reactions during the processing process which produces a distinctive fragrant aroma.

Taste

The average value of biscuit taste based on Friedman's analysis is between 5-8.1. Treatment C with the addition of 5% crab shell flour produced the highest average taste value of 8.1, while treatment D recorded the lowest average taste value of 5 with the inclusion of 7.5% crab shell flour. The median taste value of crab shell flour biscuits was 3 to 9, meaning that the taste of crab shell flour biscuits was in the category of disliked to very liked. Treatment D was the treatment that was rejected by the panelists because it had a median value of 3 while the highest was obtained by treatment C.

Treatment C was the highest treatment that was favored by the panelists because it had a distinctive crab taste that was not too sharp and still had the typical savory taste of biscuits. Increasing the concentration of crab shell flour addition to biscuits will affect the taste of the biscuits so that the higher the concentration of crab shell flour addition to biscuits, the distinctive crab taste of the biscuits will increase. According to Pujianto et al. (2018), increasing the amount of crab shell flour substitution can increase the distinctive crab taste of the product. Yanuar (2009) stated that amino acids such as taurine, glycine, arginine and proline play a role in creating the distinctive taste of crab.

Texture

The average value of biscuit texture based on Friedman analysis is between 6.3-8.1. Treatment C with the addition of 5% crab shell flour obtained the highest average texture value of 8.1, while treatment D recorded the lowest average texture value of 6.3. The median value of the texture of crab shell flour biscuits is 7 to 9, meaning that the texture of crab shell flour biscuits is included in the category of liked to very liked and can be accepted by the panelists.

The highest level of biscuit texture preference was obtained from treatment C with the addition of 5% crab shell flour.

The top treatment favored by the panelists was treatment C which had a crunchy texture. According to Beybidanin et al. (2016), cheese sticks accompanied by the addition of 5% crab shell flour have the right texture, namely softer and crunchier. Along with the increasing amount of crab shell flour added, the texture of the biscuits tends to be easily broken and harder. Research by Hapsoro et al. (2017) also said that the more the amount of crab shell flour, the harder the texture formed. Pujianto et al. (2018) explained that crab shell flour has a coarse texture so that the higher the substitution, the harder the texture formed. In addition, the lime content in crab shell flour can cause the texture of cookies to become harder and less crispy.

Decision Making with the Bayes Method

Based on the results of the assessment of various aspects, it is known that taste has the highest value of 0.48 so that it is the most important factor in the final assessment of the panelists on crab shell flour biscuit products. The second factor considered important by the panelists is texture with a weight of 0.28. Furthermore, the appearance criteria received a weight of 0.13, while aroma was the factor with the lowest weight, namely 0.10.

Taste parameters play an important role in determining the acceptance of the product by the panelists. Although the aspects of appearance, aroma, and texture are considered good, the product will still be rejected if it tastes bad or is not liked (Abdullah et al., 2021). The taste of biscuits is a crucial aspect because it is the main element in the sensory experience when consuming food. The second factor is texture, where the consistency of the ingredients can affect the resulting taste. According to Beybidanin et al. (2016), panelists prefer the right texture of cookies, softer and crispier. The third factor is appearance, which although it does not absolutely determine the level of panelist preference, still influences product acceptance. Finally, the aroma factor also plays an important role. According to Soekarto & Hubeis (2000), the enjoyment of food is influenced by aroma, which can provide a special attraction in forming the perception of the enjoyment of a food product.

Based on the calculation results using the Bayes method, treatment C is the highest preferred treatment because it has the highest alternative value and priority value, which are 8.87 and 26.02 respectively. Meanwhile, treatment D is in last place with the lowest alternative value and priority value, which are 5.06 and 14.85.

Calcium Content

The results of chemical tests indicate that treatment D has the highest calcium content of 2.11% with the addition of 7.5% crab shell flour, while the lowest calcium content is treatment A, which is 1.1 with 0% additional crab shell flour. The increase in the amount of crab shell flour content is directly proportional to the increase in calcium levels in biscuit products. The high calcium content is due to the calcium content in the crab shell flour itself, which reaches 19.97% (Multazam, 2002). According to Deswita & Fitriyani (2019), the increase in calcium levels is also influenced by other additional ingredients such as milk and butter.

The human body can absorb calcium well in hard tissues such as crab shells, namely with an absorption rate of between 60% - 70% (Muna, 2005). Based on the serving size of biscuits on the market, such as Roma Kelapa products which weigh around 27 g per serving, the calcium content in biscuits with the addition of crab shell flour is 0%; 2.5%; 5%; and 7.5% are 297 mg, 499.5 mg, 534.6 mg, and 569.7 mg. These data indicate that the addition of crab shell flour of 5% and 7.5% in biscuit products can meet the daily calcium needs of humans, which is around 500-1000 mg per day (LIPI Food and Nutrition Workshop 2004).

Water Content

The results of chemical analysis, the water content contained in biscuits treatment A with the addition of 0% crab shell flour is 2.20%, while treatment C with the addition of 5% crab shell flour is 2.11%. Based on the quality requirements of biscuits according to SNI 2973-2011, the maximum water content for biscuit products is 5%. The water content in this study is still within the normal limits permitted for biscuit products.

One of the reasons for the decrease in water content in biscuit products is the addition of increasing concentrations of crab shell flour. The results of this study are in line with research conducted by Hapsoro et al. (2017), which showed that the highest average water content was found in control biscuits, while the lowest water content was recorded in biscuits with the addition of crab shell flour of 7.5%. Thus, it can be indicated that the higher the amount of crab shell flour added, the lower the water content in the biscuit product. This decrease in water content is due to the low amount of gluten content in the mixture, which facilitates the release of water molecules during the baking process. Linder (1992) also stated that increasing the concentration of crab shell flour can reduce the water content in food products. This occurs because the calcium ion particles from the crab shell flour bind hydroxide particles which are components that form water molecules, so that the water content decreases along with the increase in crab shell flour.

Ash Content

Based on the results of chemical tests, the amount of ash content in biscuits in treatment A with the addition of 0% crab shell flour was 0.61%, while in treatment C with the addition of 5% crab shell flour it reached 3.45%. Based on the biscuit quality criteria according to SNI 2973-1992, the highest amount of ash content allowed for biscuits is 1.5%. The ash content in treatment A is still lower than the maximum limit specified, while the ash content in treatment C with the addition of 5% crab shell flour exceeds the specified standard. Passos et al. (2013) said that the amount of ash content in several biscuits is generally in the range of 0.5% to 4.3%.

Increasing the concentration of crab shell flour affects the increase in ash content. This is proven by the findings of Pratama et al. (2014), that in biscuits with the addition of jangilus fish bone flour, the highest ash content was recorded in treatment E (20%) at 3.89%, while the lowest ash content was in treatment A (0%) with a value of 0.62%. Thus, the amount of ash content in biscuits increases along with the increasing amount of jangilus fish bone flour added. Crabs are animals from the Crustacea class whose shells contain abundant minerals, so that the addition of crab shell flour can also increase the amount of ash content in biscuits. According to Sudarmadji et al. (2003), the amount of ash content contained in food ingredients is closely related to the amount of minerals in it. Too much ash content can reduce the durability of the dough in the development process, as explained by Ningrum (1999) and Sulaswatty (2001).

Protein Content

The results of chemical analysis, the protein content contained in biscuits treatment A with the addition of 0% crab shell flour is 6.02%, while treatment C with the addition of 5% crab shell flour is 12.35%. According to the biscuit quality requirements in SNI 2973-2011, biscuit products must contain at least 5% protein. Passos et al. (2013), stated that the amount of protein content in various biscuits is between 3% - 14.6%.

Increasing the concentration of added crab shell flour causes the protein content to increase. The results of this study are in line with research conducted by Pratama et al. (2014), which found that the amount of protein content in biscuits added with jangilus fish bone flour was highest recorded in treatment E (20%) at 11.85%, while the lowest was in treatment A (0%) at 9.63%. This fact indicates that the amount of protein content in biscuits increases along with the increasing amount of jangilus fish bone flour added. Iqbal et al. (2016) stated that

changes in the amount of recorded protein content are likely influenced by the volume of water lost from the material. The more water lost, the higher the recorded protein value.

Fat Content

The results of chemical tests indicate that the amount of fat content in biscuits from treatment A with the addition of 0% crab shell flour is 8.01%, while in treatment C with the addition of 5% crab shell flour it is 9.91%. Based on the biscuit quality criteria according to SNI 2973-1992, the fat content in biscuits must be at least 9.5%. The amount of fat content in treatment A does not comply with the specified criteria, while treatment C with the addition of 5% crab shell flour has exceeded the minimum permitted limit. Passos et al. (2013) stated that the amount of fat content in various biscuits is in the range of 11.1% to 29%.

Increasing the concentration of added crab shell flour causes the fat content to increase. This statement is supported by research conducted by Muzdalifah (2019) that the amount of fat content in cat's tongue cookies with the addition of crab shell flour is highest in treatment B4, namely 25.53%, while the lowest is in treatment B1, namely 24.42%. This shows that the amount of fat content in cat's tongue cookies increases along with the increase in the amount of added crab shell flour. The high amount of fat content in this product is due to the contribution of the added material. According to Komala (2008), the high fat concentration in biscuits is caused by the use of other ingredients that contain high fat such as milk, margarine and eggs in the processing process.

Carbohydrate Content

The results of chemical tests indicate that the amount of carbohydrate content in biscuits treatment A with the addition of 0% crab shell flour is 83.16%, while in treatment C with the addition of 5% crab shell flour, it is 72.18%. Based on the biscuit quality standards according to SNI 2973-1992, the amount of carbohydrate content in biscuit products is a minimum of 70%. Both treatments, namely A and C, have carbohydrate levels that exceed the minimum limit set. Passos et al. (2013) noted that the amount of carbohydrate content in various biscuits is in the range of 56.8% to 74.6%.

Increasing the concentration of added crab shell flour causes the carbohydrate content to decrease. This statement is supported by research by Muzdalifah (2019), which indicates that the highest carbohydrate content in cat's tongue cookies with the addition of crab shell flour was 66.22% found in treatment B1, while the lowest was 61.30% in treatment B4. This indicates that the amount of carbohydrate content in cat's tongue cookies tends to decrease along with the increasing amount of crab shell flour content. The carbohydrate content contained in biscuits is a contribution from the ingredients that contain carbohydrates. According to Trisyani and Syahlan (2022), wheat flour and sugar as ingredients used to make biscuits affect the carbohydrate value because both also contain carbohydrates. Proximate tests such as protein, water content, fat and ash affect the decrease in the amount of carbohydrate content by difference in biscuits, which means that the lower the nutritional content of these components, the higher the carbohydrate content in the biscuits. Fatkurahman et al. (2012) stated that the amount of carbohydrate content by difference will decrease if other nutritional components, such as protein, water content, fat and ash in the ingredients are high.

CONCLUSION

Based on the research results, it can be concluded that the addition of 5% crab shell flour is the treatment most preferred by the panelists. This is reflected in the average value of the level of preference for appearance (7.9), aroma (8.2), taste (8.1), and texture (8.1). These results produce a brownish yellow appearance, a distinctive crab aroma that is not too pungent, a crab taste that is not too strong, and a softer and crispier texture. The addition of 5% crab shell flour

also shows the highest alternative and priority values in decision making using the Bayes method, namely 8.87 and 26.02.

Based on the results of chemical analysis, the treatment of adding 5% crab shell flour that is most preferred by the panelists shows a calcium content of 1.98%, a water content of 2.11%, ash content of 3.45%, protein content of 12.35%, fat content of 9.91%, and carbohydrate content of 72.18%. The calcium content is still within the normal limits according to the daily calcium nutritional needs of humans. The water content and protein content are also still within the normal limits according to SNI 2973-2011, while the ash content, fat content, and carbohydrate content are within the normal limits according to SNI 2973-1992.

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REFERENCES

Abdullah, Fatima, S. & Suriani. (2021). Uji Organoleptik Minyak Kelapa Dalam Dengan Pemberian Ekstrak Serai (*Cymbopogo citratus* L.) Pada Konsentrasi Berbeda. *Jurnal Pengolahan Pangan*, 6 (1), 15-19. https://doi.org/10.31970/pangan.v6i1.53

Anggraeni, E., Rahayuningsih, M., Nugraha, B. A., Amalia, K. P., Fadhlurrakhman, A. R., Alan, J, A., & Faidzin, M. N. (2023). Desain Tempat Pengelolaan Limbah Cangkang Terpadu (TPLCT) Sebagai Upaya Peningkatan Nilai Tambah Limbah Padat Rajungan. *Jurnal Teknologi Industri Pertanian*, 33 (3), 290-304. https://doi.org/10.24961/j.tek.ind.pert.2023.33.3.290

Antara, N, & Wartini, M. (2014). *Aroma and Flavor Compounds*. Bali: Udayana University.

Astuti, N. B., Raya, M. K. & Rahayu, E. S. (2023). Pengaruh Suhu dan Tempat Penyimpanan Terhadap Kadar Air dan Mutu Organoleptik Biskuit Subtitusi Tepung Belut (*Monopterus albus zuieuw*). *Action: Aceh Nutrition Journal*, 8 (1), 81. http://dx.doi.org/10.30867/action.v8i1.811

[BPS] Badan Pusat Statistik. (2018). *Data ekspor – impor 2012-2017*. Jakarta: Badan Pusat Statistik.

[BSN] Badan Standarisasi Nasional. (1992). SNI 01-2973-1992. *Syarat Mutu dan Cara Uji Biskuit*. Jakarta: Badan Standarisasi Nasional.

[BSN] Badan Standarisasi Nasional. (2011). SNI 2973-2011: *Syarat Mutu Biskuit*. Jakarta: Badan Standarisasi Nasional.

Beybidanin, A. R., Surti, T. & Rianingsih, L. (2016). Pengaruh Penambahan Tepung Cangkang Rajungan (*Portunus pelagicus*) Terhadap Kadar Kalsium Stik Keju. *J. Peng. & Biotek. Hasil Pi.*, 5 (2), 16–20. https://ejournal3.undip.ac.id/index.php/jpbhp/article/view/16005

Deswita, N. C. & Fitriyani, E. (2019). Kadar Kalsium dan Mutu Hedonik Donat Yang Ditambahkan Tepung Kalsium Tulang Ikan Tongkol (*Euthynnus affinis*). *Jurnal Ilmu Perikanan Octopus*, 8(1), 13-19. https://doi.org/10.26618/octopus.v8i1.2487

Fatkurahman, R., Atmaka, W. & Basito. (2012). Karakteristik Sensoris dan Sifat Fisikokimia *Cookies* Dengan Substitusi Bekatul Beras Hitam (*Oryza sativa* L.) dan Tepung Jagung (*Zea mays* L.). *Jurnal Teknosains Pangan*, 1 (1), 49-57.

Granda, C., Rosana, G. M., & Elena, C. P. (2005). Effect of Raw Potato Composition on Acrylamide Formation in Potato Chips. *J Food Science*, 70, 519-525. https://doi.org/10.1111/j.1365-2621.2005.tb08313.x

Hapsoro, M. T., Dewi, E. N. & Amalia, U. (2017). Pengaruh Penambahan Tepung Cangkang Rajungan (*Portunus pelagicus*) Dalam Pembuatan *Cookies* Kaya Kalsium. *J. Peng. & Biotek. Hasil Pi.*, 6 (3), 20–27.

https://ejournal3.undip.ac.id/index.php/jpbhp/article/view/20293
Iqbal, A., Rochima, E. & Rostunti, L. (2016). Penambahan Telur Ikan Nilem Terhadap Tingkat Kesukaan Produk Olahan Stik. *Jurnal Perikanan dan Ilmu Kelautan*,7, 2.
Komala, I. (2008). *Kandungan Gizi Produk Peternakan*. Malaysia: UPM.
Linder, M. C. (1992). *Biokimia Nutrisi dan Metabolisme*. Aminuddin Prakasai, penerjemah. Jakarta : UI-Press. Terjemahan dari : Nutritional Biochemistry and Metabolism.
Meiyani, T. A., Riyadi, H. P. & Anggo, D. A. (2014). Pemanfaatan Air Rebusan Kepala Udang Putih (*Penaeus merguiensis*) Sebagai Flavor Dalam Bentuk Bubuk Dengan Penambahan Maltodekstrin. *Jurnal Pengolahan dan Bioteknologi Hasil Perikanan*, 3(2), 67-74. http://www.ejournal-s1.undip.ac.id/index.php/jpbhp
Multazam. (2002). *Prospek Pemanfaatan Cangkang Rajungan (Portunus* sp*) sebagai Suplemen Pakan Ikan*. Skripsi. Fakultas Perikanan dan Ilmu Kelautan. Institut Pertanian Bogor: Bogor.
Muzdalifah, H. N. (2019). *Karakteristik Fisika Kimia dan Organoleptik Kue Lidah Kucing dengan Substitusi Tepung Cangkang Rajungan (Portunus pelagicus) sebagai Sumber Kalsium*. Skripsi. Universitas Brawijaya: Malang.
Nelwida, Berliana, & Nurhayati. (2019). Kandungan Nutrisi Black Garlic Hasil Pemanasan Dengan Waktu Berbeda. *Jurnal Ilmiah Ilmu-Ilmu Peternakan*, 22 (1), 44- 55. https://doi.org/10.22437/jiiip.v22i1.6471
Paramitha, D. A. P. (2022). Quality and Nutritional Analysis of Jackfruit Seed Biscuit Products as An Alternative Complementary Food for Breastfeeding in Toddlers. *Jurnal Multidisiplin Madani (MUDIMA)*, 2 (1), 525–542. https://journal.formosapublisher.org/index.php/mudima/article/view/148
Passos, M. E. A., Moreira, C. F. F., Pacheco, M. T. B., Takase, I., Lopes, M. L. M. & Valente Mesquita, V. L. (2013). Proximate and Mineral Composition of Industrialized Biscuits. *Food Science and Technology, Campinas*, 33(2), 323-331. https://doi.org/10.1590/S0101-20612013005000046
Pramudya, Y., Sigit, S., Pamungkas, T., Studi, P. & Tanaman, B. (2022). Studi Respon Cekaman Garam Terhadap Kondisi Tanaman Tebu (*Saccharum officinarum*). *Open Science and Technology*, 2 (1): 109–116. https://doi.org/10.33292/ost.vol2no1.2022.57
Pratama, R. I., Rostini, I. & Liviawaty, E. (2014). Karakteristik Biskuit Dengan Penambahan Tepung Tulang Ikan Jangilus (*Istiophorus* sp.). *Jurnal Akuatika*, 5 (1), 30-39.
Prayoga, R., Suardi, L. & Sumarto. (2015). Studi Peneriman Konsumen Terhadap Cone Es Krim Dengan Penambahan Tepung Cangkang Rajungan (*Portunus pelagicus*). *JOM*, 3 (4), 29-39.
Prihatiningrum. (2012). Pengaruh Komposit Tepung Kimpul dan Tepung Terigu Terhadap Kualitas *Cookies* Semprit. *Jurnal Food Science and Culinary Education*, 1 (1): 6-12. https://doi.org/10.15294/fsce.v1i1.295
Pujianto, N. R. (2018). *Substitusi Tepung Cangkang Rajungan (Portunus pelagicus) Dengan Tepung Terigu Terhadap Sifat Kimia, Sifat Fisik, dan Organoleptik Cookies Rajungan*. Skripsi. Semarang: Universitas Semarang.
Rahmelia, D., Diah, W. A. M. & Said, I. (2015). Analisis Kadar Kalium (K) dan Kalsium (Ca) Dalam Kulit dan Daging Buah Terung Kopek Ungu (*Solanum melongena*) Asal Desa Nupa Bomba Kecamatan Tanantovea Kabupaten Donggala. *Jurnal Akademi Kimia*, 4 (3), 143–148.
Ramayulis, R., Pramantara, I. D. & Pangastuti, R. (2011). Asupan Vitamin, Mineral, Rasio Asupan Kalsium dan Fosfor Dan Hubungannya Dengan Kepadatan Mineral Tulang Kalkaneus Wanita. *Jurnal Gizi Klinik Indonesia*, 7 (3), 115-122. https://doi.org/10.22146/ijcn.17752
Riskiani, D., Ishartani, D. & Rachmawanti, D. (2014). Pemanfaatan Tepung Umbi Ganyong

(*Canna edulis* ker.) Sebagai Pengganti Tepung Terigu Dalam Pembuatan Biskuit Tinggi Energi Protein Dengan Penambahan Tepung Kacang Merah (*Phaseolus vulgaris* L.). *Jurnal Teknosains Pangan*, 3 (1), 96–105.

Soekarto, S. T. & Hubeis, M. (2000). *Metodologi Penelitian Organoleptik*. Bogor: Institut Pertanian Bogor.

Soekarto, S. T. (2012). *Uji Organoleptik Formulasi Cookies Kaya Gizi*. Depok: Universitas Indonesia

Sudarmaji. (2003). *Produser Analisa Bahan Makanan dan Hasil Pertanian*. Yogyakarta: Liberty.

Sulaswatty, A., Idiyanti, T. & Susilowati, A. (2001). *Pemanfaatan Tepung Non Terigu sebagai Substitusi Tepung Terigu dalam Pembuatan Cookies dan BMC*. Skripsi. Fakultas Teknologi Pertanian. Bogor: IPB.

Tarwendah, I. P. (2017). Jurnal Review: Studi Komparasi Atribut Sensoris dan Kesadaran Merek Produk Pangan. *Jurnal Pangan Dan Agroindustri*, 5 (2), 1383–1390. https://jpa.ub.ac.id/index.php/jpa/article/view/531

Trisyani, N. & Syahlan, Q. (2022). Karakteristik Organoleptik, Sifat Kimia dan Fisik *Cookies* Yang di Substitusi Dengan Tepung Daging Kerang Bambu (*Solen* sp.). *Jurnal Agribisnis Perikanan*, 15(1), 188-196. http://www.jurnal.ummu.ac.id/index.php/agrikan

[WNPG] Widyakarya Nasional Pangan dan Gizi. (2004). *Ketahanan Pangan dan Gizi di Era Otonomi Daerah dan Globalisasi*. Jakarta.

Yanuar, V., Santoso, J. & Salamah, E. (2009). Pemanfaatan Cangkang Rajungan (*Portunus pelagicus*) Sebagai Sumber Kalsium dan Fosfor Dalam Pembuatan Produk Crackers. *Jurnal Pengolahan Hasil Perikanan*, 12 (1), 59–72. http://repository.ipb.ac.id/handle/123456789/11147