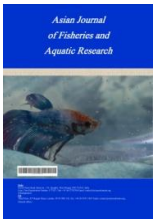

Asian Journal of Fisheries and Aquatic Research

8(1): 1-13, 2020; Article no.AJFAR.58976
ISSN: 2582-3760

Utilization of Waste Lemi Blue Swimming Crabs on Preference Level of Crackers

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Authors' contributions

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

Article Information

DOI: 10.9734/AJFAR/2020/v8i130128
Editor(s):
(1) Dr. Bruno Fiorelini Pereira, Federal University of West of Bahia, Brazil.
Reviewers:
(1) V. J. Ajay Kumar, Rajiv Gandhi Institute of Veterinary Education and Research, India.
(2) P. P. S. Kavya Mathukumalli, University of Houston College of Pharmacy, USA.
Complete Peer review History: http://www.sdiarticle4.com/review-history/58976

Original Research Article

Received 06 May 2020
Accepted 12 July 2020
Published 28 July 2020

ABSTRACT

Lemi is a yellowish product which usually finds under the surface of the cooked blue swim crab carapace. This research aims to determine the number of lemi addition from the utilization of blue swimming crabs waste in crackers that produces the most liked crackers by panelist. This research was undertaken in the Fishery Production Processing Laboratory, Faculty of Fisheries and Marine Sciences Universitas Padjadjaran and Food Technology Laboratory, Faculty of Engineering, Pasundan University in January 2020. The method of research used was an experimental method with the treatment of addition of lemi blue swimming crabs in 15%, 20%, 25%, 30% and 35% based on the amount of tapioca flour with 20 semi trained panelists as a repetition. The observed parameters are physical test (level of florescence), proximate test (moisture content, ash content, protein content and fat content in preferred treatment) and hedonic test (favorite test) based on organoleptic characteristics which include the appearance, smell, textures and flavors. The level of acceptance of crackers are analyzed using a non parametric statistical method Friedman then followed by the Bayes test to discover the best treatment of crackers. The results showed that the addition of a 25% lemi is a more preferential treatment by the panelists.

Keywords: Crackers; lemi; blue swimming crab; preference level; proximate.

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1. INTRODUCTION

Blue Swimming Crabs (*Portunis pelagicus*) is one of the most important fishery resources in Indonesia that has a high economic value. Blue Swimming Crabs contains a lot of protein which makes more demand for a ridge from inside and outside the country. The increase in demand for blue swimming crabs is directly proportional to the increase in the resulting waste, on the one side it can be increasing foreign exchange for a country, but in the other hand it produce more waste. The waste generated from the blue swimming crab canning industry requires handling and processing in order to not negatively impact the environment. Well managed waste will provide benefits to the blue environment swimming crab waste has a fairly high nutritional value especially the content of calcium and phosphorus. Nutritional content of blue swimming crab waste has the potential to be processed as food additives, so far the waste of blue swimming crab are widely utilized as raw materials feed industry and the manufacture of chitin and chitosan. Meat taken from the body of blue swimming crab ranges from 20-25% and produces waste ranging from 75-80% making up to shells, gills, innards and lemi [1].

Lemi is a yellowish product that usually found under the surface of the cooked blue swim crab carapace. This ingredient has a good taste like blue swimming crab meat. In the blue swimming crab meat extraction process, lemi must be discarded in order to not mix with it because of avoiding discoloration and decreased its quality that has been canned.The effort to use crab waste can be a diversification of food products that are raw material for flavor makers and can be applied as natural additives in products [2].

Cracker making is a way of processing that aims to increase the value of a fishery product. Crackers are a well loved Indonesian community and has a large enough domestic marketing potential that is suitable for fishery diversification products. The preparation of crackers must certainly pay attention to some aspects such as flavor, texture, smell and appearance so that it will produce a diversified fishery products that are favored by consumers [3].

According to the Indonesian Industrial Standard (SII) number 0272-90 crackers are dried food products, made from tapioca flour and sago with or without the addition of food ingredients and other permitted food additives, should be prepared in a way frying or baking before serving. In 100 grams of lemi blue swimming crab is found nutritional composition of moisture content 33.75%, ash 4.9%, protein 11.87% and fat 4.46% [4].

2. MATERIALS AND METHODS

2.1 Tools and Research Material

The equipments used in the process of making crackers lemi blue swimming were: pan, basin, digital scales, stoves, knives, coolers, frying pan, thermometer. The tools used in organoleptic, physical and proximate testing were as follows: Tools for organoleptic testing, namely plates as a serving, evaluation sheets and stationery. Tools for physical tests namely, yarn and ruler. Tools for chemical test (moisture content, ash, protein and fat), namely glassware (erlenmeyer, burette, volumetric pipette, pipette drops, pumpkin measure etc.), oven, mortar, volumetric measuring instruments, blender, aluminum cup, desiccator, destructor, condenser, pumpkin *kjeldahl*, analytical balance and *soxhlet.*

This research was conducted in January 2020, making crackers and organoleptic tests in the Fishery Product Processing Laboratory of the Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran, and the proximate tests was conducted in the Food Technology Laboratory, Faculty of Engineering, Pasundan University. For the research material used was fresh lemi blue swimming crabs from Cirebon, if the raw materials used were not good in the freshness will affect the appearance, smell and taste of products produced crackers.

2.2 Research Methods Dan Procedures

The method used in this research was experimental, consisted of 5 treatments with 20 semi trained panelists as a repetition [5]. These panelists are students of the Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran who had known and have experience in organoleptic testing. The following formulations of blue swimming crab crackers are presented in Table 1.

Table 1. Formulation of ingredients of crackers with the addition of lemi blue swimming crab waste

Materials	Treatment				
	A	B	C	D	E
Tapioca Flour (g)	100	100	100	100	100
Lemi (g)	15	20	25	30	35
Salt (g)	4	4	4	4	4
Coriander Powder (g)	1	1	1	1	1
Garlic (g)	3	3	3	3	3
Sugar (g)	2	2	2	2	2
Water (%)	60	60	60	60	60

The usage percentage of lemi crabs in the manufacture of fish crackers based on the weight of tapioca flour with the following treatment:

1. **Treatment A:** Addition of 15% blue swimming crab lemi
2. **Treatment B:** Addition of 20% blue swimming crab lemi
3. **Treatment C:** Addition of 25% blue swimming crab lemi
4. **Treatment D:** Addition of 30% blue swimming crab lemi
5. **Treatment E:** Addition of 35% blue swimming crab lemi

The research procedure consists of several stages, namely the manufacture of crackers with the addition of lemi blue swimming crab waste, organoleptic testing, florescence testing, moisture content testing, ash content, protein content and fat content.

The process of making blue swimming crab crackers: The process of making crackers consist of several stages, namely mixing raw materials, dough making, printing, steaming, cooling, cutting/slicing, drying and frying.

2.3 Observed Parameters

The observation parameters are differentiated into main parameters and additional parameters. The main parameters performed on the hedonic test (the level of preference of crackers with observed parameters are appearance, smell, taste, texture) were carried out with a hedonic test and to additional parameters consisted of physical test that calculated the circumference the crackers and proximate test (moisture content, ash, protein and fat) in the treatment of crackers with the addition of the most preferred lemi.

2.3.1 Hedonic test

This test was conducted to know the preference level based on hedonic test with a value scale ranging from 1-9, which is strongly disagree (1), disagree (3), ordinary/neutral (5), agree (7) and strongly agree (9). The characteristics observed in hedonic testing includde the appearance, smell, taste and texture of the already fried crackers [6].

2.3.2 The florescence test

Testing the florescence of crackers is done by measuring and comparing the circumference of raw crackers with fried crackers. The way of measuring the circumference of crackers is using yarn that surround crackers and then yarn is measured using a ruler [7]. The percentage of florescence was calculated using the formula:

$$\text{Florescence } (\%) = \frac{K_1 - K_0}{K_0} \text{ x } 100\%$$

Description:

K_0 = Round the crackers before frying (cm)
K_1 = The circumference of crackers after frying (cm)

2.3.3 Proximate test

2.3.3.1 Moisture content

The principle of moisture analysis was to know the content or amount of water contained in an ingredient [8]. The percentage of sample moisture content was calculated by the formula:

$$\text{Moisture Content } (\%) = \frac{B1 - B2}{B} \text{ x } 100\%$$

Description:

B = Weight of sample (*g*)
B1= Weight (sample + cup) before drying (*g*)
B2 = Weight (sample + cup) after drying (*g*)

2.3.3.2 Ash content

The principle of ash content analysis was to know the inorganic elements or minerals

contained in a food material [9]. The percentage of sample ash content was calculated by formula:

$$\text{Ash Content (\%)} = \frac{\text{A} - \text{B}}{\text{C}} \text{ x } 100\%$$

Description:

A= Weight of the cup + samples after the ash (*g*)
B= Weight of cup (*g*)
C= Weight of sample (*g*)

2.3.3.3 Protein content

The principle of protein level analysis was to determine the total levels of nitrogen or protein due to the release of nitrogen from proteins in substances using sulfuric acid by heating. Determination of total nitrogen and protein levels used Micro-*Kjeldahl* method. The percentage of sample protein content was calculated by formula:

$$\text{Protein Content (\%N)} = \frac{(\text{A} - \text{B}) \text{ x N HCL x } 14}{\text{C}} \text{ x } 100\%$$

Description:

A = HCl for sample titration (ml)
B = HCl for blanko titration (ml)
C = Sample weight (mg)
N = Standard HCl normality used
14 = Nitrogen Atom weight
%N *x* Conversion factor = 6,25

2.3.3.4 Fat content

The principle of fat content analysis is to dissolve (extraction) fat that is contained in the material with fat solvent for some time. This extraction used the *Soxhlet* method. The percentage of sample fat content was calculated by formula:

$$\text{Total Fat Content(\%)} = \frac{C - A}{B} \; x \; 100\%$$

Description:

A = Weight of pumpkin (g)
B = Weight of sample (g)
C = Weight of pumpkin and sample (g)

2.3.4 Data analysis

Data on chemical measurement is the most liked crackers compared with the value of Indonesian National Standard for crackers. Data of organoleptic test results were analyzed using non parametric statistics using a two-way analysis of Friedman test variants with a *chi-square* test [10]. If there were significant differences between treatments followed by multiple comparison tests to find out the differences between treatments. Then to determine the best treatment by considering the four parameters used *Bayes* method. The *Friedman* test formula as follows:

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

Description:

X^2 = *Friedman* test statistics
b = Deuteronomy
k = Treatment
$(Rj)^2$ = The total ranking of each treatment

If there is data from the same research, the correction factor calculation (FK) is calculated using the following formula:

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

$$X^2\text{c} = \frac{X^2}{\text{FK}}$$

Description:

$T = \sum ti^3 - \sum ti$
ti = The number of same observation values for a rank in the I-block

The significant value of X^2c observation prices can be determined by using the Chi-squared critical prices table with db = k-1; α = 0.05.

The decision rule to test the hypothesis is:

H_0 = Treatment does not give a noticeable impact on the favorite level
H_1 = Treatment gives a noticeable effect on the favorite level

If the calculated X^2c value < X^2c table, then H_0 is accepted and H_1 is rejected. Meanwhile, if the calculated X^2c value > X^2c table, then H_1 is accepted and H_0 is rejected. When H1 is accepted, the treatment gives a noticeable difference and is followed by multiple comparison tests to determine the difference between treatment. The multiple test formula is as follows:

$$| Ri - Rj | = Z\frac{\sqrt{bk(k+1)}}{6}$$

Description:

$| Ri - Rj |$ = The average rank difference
Ri = Average rating from the to-I sample
Rj = Average rating from A to-J sample
Z = Value in table Z for Multiple Comparison (α/K (K-1))
α = Eksperimen *wise error*
b = The amount data or repetition
k = The amount of treatment

3. RESULTS AND DISCUSSION

3.1 Hedonic Test

3.1.1 Appearance

The Appearance is the first characteristic to be assessed by consumers because it has a purpose to know the consumer's acceptance of surface appearance, completeness, and color of crackers [3].

Table 2. The average result of appearance blue swimming crab crackers

Addition of lemi blue swimming crab	Median value	Average
Treatment A (15%)	5,00	4,7 a
Treatment B (20%)	7,00	6,8 ab
Treatment C (25%)	7,00	6,8 b
Treatment D (30%)	7,00	6,3 ab
Treatment E (35%)	7,00	6,7 ab

**Description: The average number of treatments followed by the same letter showed no apparent difference according to the multiplecomparison test at 5% level*

15% **20%** **25%**

30% **35%**

Fig. 1. The appearance of crab crackers each treatment from left to right with concentrations of 15%, 20%, 25%, 30% and 35%

Table 3. The average result of smell blue swimming crab crackers

Additional of lemi blue swimming crab (%)	Median value	Average
Treatment A (15)	5,00	5,2 a
Treatment B (20)	6,00	5,9 ab
Treatment C (25)	7,00	7,1 b
Treatment D (30)	7,00	6,7 ab
Treatment E (35)	7,00	6,5 ab

**Description: The average number of treatments followed by the same letter showed no apparent difference according to the multiplecomparison test at 5% level*

Based on Friedman's statistical analysis, it shows that the addition of lemi blue swimming crabs to the crackers is a real effect on the appearance of crackers. Furthermore, based on multiple comparative test results, the addition of a 20% and 25% increase in lemi treatment resulted in the highest level of preference for appearance. Treatment A was not significantly different from treatment B, D and E, but significantly different from treatment C. While treatment C was not significantly different from treatment B, D and E, but significantly different from treatment A. The addition of 25% lemi is the most liked panelist with the highest average value (6,8) which is preferred, with the color characteristics of a little brownish and slightly rough surfaces while the addition of lemi as much as 15% have the lowest average value (4,7), which is neutral, with the characteristics of the color tend to be white as well as surfaces that tend to be rougher than other treatments. In the treatment of the addition of crab lemi as much as 30% and 35% showed a decrease in the level of cracker preference, it is caused of the crackers produced in the treatment which has a color that tends to be more brown.

Based on the proximate test conducted on 100 grams of lemi has a protein content of 11.87%, surely when the process of warming will occur Maillard reaction. The product color will affect the appearance and reception on consumers of foodstuffs. Here is the appearance of crackers with the addition of Lemi blue swimming crab according to the treatment presented in Fig. 1.

3.1.2 Smell

Smell is the aroma of a food product, it is a response when the volatile compounds of a food enters the nasal cavity and are perceived by the Olfacori system [11]. Based on a hedonic test on smell of crackers that served in Table 3.

Based on Friedman's statistical analysis, it shows that the addition of lemi blue swimming crabs to the crackers is a real effect on the smell of crackers. Furthermore, based on multiple comparative test results, the addition of 25% increase in lemi treatment resulted in the highest level of preference for smell. Treatment A was not significantly different from treatment B, D and E, but significantly different from treatment C. While treatment C was not significantly different from treatment B, D and E, but significantly different from treatment A. The addition of a crab of up to 25% is the most liked panelist with the highest average value (7,1) same as with the characteristic smell of the crab is sufficient so that the panelist is more liked while the addition of lemi of the blue swimming crab attaching as 15% have the lowest average value (5,2) is neutral, which produces crackers with a less than imaged crab flavor. The higher addition of lemi the blue swimming crab in crackers, the smell will be increasingly stronger. In addition treatment of lemi as much as 30% and 35% have a special smell of crabs are strong enough that tends to smell somewhat fishy because of the concentration of lemi the blue swimming crab are added more than other treatments. In the treatment of addition of lemi as much as 30% and 35% showed a decrease in the smell of the scent, this is due to crackers produced in the treatment has a typical smell of crabs are strong enough that tends to smell somewhat fishy because the lemi concentration of crabs is added more than any other treatment.

Smell is the aroma of foodstuffs that many determine the delicacy of the food ingredients [9]. The more fish levels were added in tapioca flour in the manufacture of fish crackers then the smell rate in the crackers will be more increase [12]. The results oshowed a noticeable difference in the addition of shrimp waste in the manufacture of fish crackers [13]. The more concentration of shrimp head waste is added in crackers, the more powerful the smell will be. Also in [12] added a concentration of 25-75% of the meat of the fish in the manufacture of crackers, obtained the results of crackers with the increase of

concentration of 25% there are only a few distinctive smell of fish and for the treatment of 75% have the smell of fish very strong.

3.1.3 Texture

Texture assessment aims to know the level of acceptance a panelists against the texture of blue swimming crab crackers. Texture is one of the characteristics affecting food product acceptance [3]. The most desirable texture of crackers is the crispy texture.

Based on Friedman's statistical analysis, it shows that the addition of lemi blue swimming crabs to the crackers is a real effect on the texture of crackers. Furthermore, based on multiple comparative test results, the addition of 25% increase in lemi treatment resulted in the highest level of preference for texture. Treatment A was not significantly different from treatment B, D and E, but significantly different from treatment C. While treatment C was not significantly different from treatment B, D and E, but significantly different from treatment A. The addition of a crab of up to 25% is the most liked panelist with the highest average value (7,4) same as with the characteristic texture crispy, easy to bite and somewhat dense while the addition of lemi of the blue swimming crab attaching as much as 15% have the lowest average value (4,6) is neutral, which results in too dense crackers that are less crispy when bitten. In the treatment of crab lemi addition as much as 30% and 35% have an average value lower than 25% this is due to the texture of crackers which are very crispy so it tends to be more easily broken or crushed so that it is less liked by panelists.

Texture is one of the factors that affects the choice of consumers of a food product [14]. Texture is an important attribute in a crispy food such as crackers [15].

3.1.4 Flavor

Flavor is a criterion that determines the consumer's decision to accept or reject a meal. The taste factor plays an important role in the selection of products by consumers, because although the nutritional content is good but the taste is not acceptable to consumers, the product will not sell [11].

Based on Friedman's statistical analysis, it shows that the addition of lemi blue swimming crabs to the crackers has a real effect on the flavors of crackers. Furthermore, based on multiple comparative test results, the addition of 25% increase in lemi treatment resulted in the highest level of preference for flavors. Treatment A was not significantly different from treatment B, D and E, but significantly different from treatment C. While treatment C was not significantly different from treatment B, D and E, but significantly different from treatment A. The addition of a crab of up to 25% is the most liked

Table 4. The average result of texture blue swimming crab crackers

Addition of lemi blue swimming crab (%)	Median value	Average
Treatment A (15)	5,00	4,6 a
Treatment B (20)	7,00	6,6 ab
Treatment C (25)	7,00	7,4 b
Treatment D (30)	7,00	6,6 ab
Treatment E (35)	7,00	6,2 ab

**Description: The average number of treatments followed by the same letter showed no apparent difference according to the multiplecomparison test at 5% level*

Table 5. The average result of flavor blue swimming crab crackers

Additional of lemi blue swimming crab (%)	Median value	Average
Treatment A (15)	5,00	5,3 a
Treatment B (20)	7,00	6,7 ab
Treatment C (25)	8,00	7,9 b
Treatment D (30)	7,00	6,6 ab
Treatment E (35)	7,00	6,2 ab

**Description: The average number of treatments followed by the same letter showed no apparent difference according to the multiplecomparison test at 5% level*

panelist with the highest average value (7,9), same as with the characteristic flavor of the crab that is quite dominant and the most preferred while the addition of lemi of the blue swimming crab attaching as much as 15% have the lowest average value (5,3) is neutral, which produces crackers with a slight flavor of the crab but not dominant. Crackers with the addition of 20% lemi crabs have a distinctive flavor of crabs but less dominant and crackers with the addition of as much as 30% and 35% lemi crabs have a distinctive flavor of crab that feels very (dominant) compared to the treatment 25%.

The components of food-forming ingredients associated with protein in foodstuffs will affect the flavor and the level of taste, the more protein is contained, the resulting product will feel more savory [12]. The higher the lemi crab added in the making of crackers can produce a distinctive flavor that is increasingly stronger even tend to be more fishy when consumed so that it can interfere with the acceptance of panelist on the crackers that given the highest additions.

3.2 Decision Making by *Bayes* Method

Decision making with the Bayes method is a decision making in accordance with the techniques used to analyze the best decision making in a number of alternatives or treatments by considering the weighting of criteria and median values [16]. After a paired test of the appearance, smell, taste and texture criteria of 20 panelists and matrix manipulation to determine the criterion value the results of calculations on the weight criteria for appearance, smell, taste and texture of the crackers are presented in Table 6.

Based on the calculation of the weight of the criteria, aroma, taste and texture of crackers are put in mind that the weight of the flavor criterion has the greatest value of 0.52 when compared to the weight of the appearance criteria 0.14; smell 0.15; and textures 0.18. This proves that the criteria of flavor is the most influential criteria for the assessment of lemi blue swimming crab because if other assessment are good but the taste of crackers are not liked by panelist then the product will be rejected panelist. The results of the calculation of the criteria weights and the determination of the best treatment of the criteria for appearance, smell, flavor and texture are presented in Table 7.

Table 6. Weight of criteria for blue swimming crab lemi crackers

Criteria	Weights of criteria
Appaerance	0,14
Smell	0,15
Texture	0,18
Flavor	0,52

Based on the calculation with the method of *Bayes* obtained the result that the cracker with the addition of a lemi blue swimming crab of 25% has an alternative value and the highest priority is 7,52 and 0,23 thus the addition of lemi blue swimming crab as much as 25% is the best treatment the panelist preferred.

3.3 Physical Test Result

Physical testing is done by measuring the crab crackers by seeing the change around of crackers before and after frying, measuring the circumference of crackers using yarn that are stretched to be counted the circumference using a ruler.

3.3.1 Level of florescence

The results of florescence testing on fish crackers with the addition of a different lemi crab treatment in Table 8. The average results of the florescence of crackers in this study is 45,35%-71.21%. It is in accordance with commercial fish cracker power is between 38%-145% [17].

Table 7. The decision matrix of blue swimming crab crackers with *Bayes* method

Treatment	Criteria				Alternative value	Priority value
(%)	Appaerance	Smell	Texture	Flavor		
15	5	5	5	5	5,00	0,15
20	7	6	7	7	6,85	0,20
25	7	7	7	8	**7,52**	**0,23**
30	7	7	7	7	7,00	0,21
35	7	7	7	7	7,00	0,21
Weight	0,14	0,15	0,18	0,52	33,37	1,00

Table 8. The result of florescence test of cracker

Repetition	Treatment (%)				
	15	20	25	30	35
1	43,15	47,95	71,875	57,14	42,7
2	46,66	43,15	74,73	77,41	55
3	46,23	51,57	67,01	58,51	60,19
Total	136,04	142,67	213,62	161,39	157,89
Average	45,35	47,56	71,21	53,80	52,63

Table 9. Moisture content of blue swimming crab lemi cracker

No.	Addition of lemi	Moisture content (%)	
	Blue swimming crab (%)	Raw cracker	Cooked cracker
1	25	3,1341	1,827

Table 10. Ash content of blue swimming crab lemi cracker

No.	Addition of lemi	Ash content (%)	
	Blue swimming crab (%)	Raw cracker	Cooked cracker
1	25	3,387	3,861

Table 11. Protein content of blue swimming crab lemi cracker

No.	Addition of lemi	Protein content (%)	
	Blue swimming crab (%)	Raw cracker	Cooked cracker
1	25	4,630	4,1688

Based on the results of the power florescence test of crackers with the addition of lemi blue swimming crab treatment there is a difference, where the addition of crab lemi of 25% has a greater inflated power than other treatment. Great florescence power demonstrates the nature of maturation on all parts of crackers. The occurrence of florescence power in crackers can be caused by the formation of air cavity in crackers that have been fried due to the effect of temperature, causing water that is bound in the gel to steam. The resulting steam pressure will then force the starch gel to form crackers which expand [18].

The florescence of crackers in the addition treatment is 15% and 20% less than the other treatment, it is suspected that there is no perfect gelatinization in starch resulting in the breakdown of the cells of less large starch during frying so the product becomes less fluffy with a less crisp texture and slightly higher water content.

The florescence of the crackers at the addition treatment of 30% and 35% decreased compared to the treatment with the addition of 25%, it is suspected because the increasing number of non-starch ingredients into the raw cracker mixture. The more non-starch ingredients are added into the raw cracker mixture, the smaller the power of cracker florescence during frying [19].

Starch is a component that is rich in amylopectin and causes crackers to expand better than amylosa based starch. Amylopectin is one component of starch that can affect the florescence power of cooked crackers. This is because Amylopectin has a structure that is less compact and less strong in resisting the florescence of mass volume before frying [20].

3.4 Proximate Test Result

Proximate testing on crackers is based on the results of the assessment of the level of panelists preference towards those tested with SNI (Indonesian National Standard) as a comparison. Based on the results of the preferred test, it was found that the most preferred crackers were crackers with the addition of lemi blue swimming crab as much as 25% so that the proximate test is done in crackers with the addition of lemi as much as 25%.

3.4.1 Moisture content

Water is a major component in the food ingredients. A certain moisture content in crackers is required to produce maximum stem

pressure when the crackers are fried. Maximum stem pressure can develop starch gel in crackers so that the raw crackers can expand [21].

Quality requirement of fish crackers based on SNI 8272-2016 (National Standardization of Indonesian, 2016) states that the maximum moisture content is 12%. Moisture content of raw and cooked crackers with the addition of lemi blue swimming crabs as much as 25% is 3,1341% and 1.827% so it is rated to meet SNI standards.

The value of moisture content in low crackers due to the influence of long time making, the length of the mixture will affect the resulting water content, this is caused during the heating process, the mixture releases a number of water resulting in a decrease in moisture content on the product, in addition to the process of the processing of drying or wrapping also leads to decreased moisture content [22]. Moisture content in food processing is depreciable after cooking because in general the cooking process uses a high temperature until the boiling point of water (100ºC) [23].

The occurrence of decrease in moisture content in cooked cracker is suspected due to frying. At the time of the frying, some of the oil used will go into the crust (outer surface) and the outer layer so that it fills the empty space originally filled with water.

3.4.2 Ash content

Ash content indicates inorganic substances which are not combustible in a material during the combustion process. Ash content testing is carried out to determine the content of organic ingredients present in cracker products. Usually the component consists of calcium, potassium, sodium, iron, manganese, magnesium, and Iodium. The mineral elements in the body serve as builders and regulator substances [11].

Quality requirement of fish crackers based on SNI 8272-2016 (National Standardization of Indonesian, 2016) states that maximum ash content is 0.2%. The level of raw and cooked cracker ash content with the addition of 25% lemi blue swimming crab is 3,387% and 3.861%. The value of ash content on this research is still classified into commercial fish crackers than the average yield of commercial fish crackers which range from 5.75% to 6.52%. However, the value of lemi blue swimming crab ash content with the addition of as much as 25% in the research is not in accordance with SNI 8272-2016 stating that the maximum ash content value is 0.2%. It is suspected because of the addition of lemi crabs that allow to contain minerals that cause high ash content.

The high value of ash content in crackers can be caused by the steaming process, with increasing the temperature of the steaming and drying resulting in decreased water content so that many residue left in the material [24]. The moisture content of dried foodstuffs will experience a higher decline and cause the compression of the ingredients left behind one of the minerals. The components of ash are decomposition or even evaporated at high temperatures so the evaporated temperature for each ingredient can vary depending on the component contained in the foodstuffs.

3.4.3 Protein content

The nutritional content of crab waste is rich in proteins (32.95%) [25]. Consuming protein in fish is very beneficial for the body as a cell tissue builders substance, regulating the metabolic system and the fuel in the body [26]. The addition of fish meat affects protein levels [27], the more fish meat and fish crackers protein levels will increase, this increase is caused by the addition of fish meat, resulting in a change in the protein concentrations in the mixture.

Quality requirement of fish crackers based on SNI 8272-2016 (National Standardization of Indonesian, 2016) states that the content of the minimum protein level of fish crackers Grade I is 8%-12%. Protein content of raw and cooked crackers with the addition of the blue swimming crab lemi as much as 25% is 4,630% and 4,160 so it is rated to meet SNI standards. Based on the data it can be noted that the addition of lemi can increase protein levels in crackers. The addition of fish meat affects protein levels, the more fish meat and fish crackers protein levels will increase. This increase is caused by the difference in the addition of fish meat, resulting in a change in protein concentrations in the mixture.

Raw protein cracker content have a slightly higher value than fried crackers, this is caused by protein denaturation when frying the crackers. Decreased content of protein crackers are caused by the process of protein denaturation due to repeated heating of steam, drying and frying [22].

Table 12. Fat content of blue swimming crab lemi cracker

No.	Addition of lemi	Fat content (%)	
	Blue swimming crab (%)	Raw cracker	Cooked cracker
1	25	0,6267	38,1576

Table 13. Recapitulation of blue swimming crab lemi crackers observation result

Observation	Average addition of blue swimming crab Lemi treatment (%)				
	15	20	25	30	35
Organoleptic (Hedonic)					
Appearance	4,7 a	6,8 ab	6,8 b	6,3 ab	6,7 ab
Smell	5,2 a	5,9 ab	7,1 b	6,7 ab	6,5 ab
Texture	4,6 a	6,6 ab	7,4 b	6,6 ab	6,2 ab
Flavor	5,3 a	6,7 ab	7,9 b	6,6 ab	6,2 ab
***Bayes* methods**					
Alternative Value	5	6,85	7,52	7	7
Physical					
Florescence Test	45,35	47,56	71,21	53,80	52,63
Proximate (Raw/Cooked)					
Moisture Content (%)	-	-	3,1341/1,827	-	-
Ash Content (%)	-	-	3,387/3,861	-	-
Protein Content (%)	-	-	4,630/4,6188	-	-
Fat Content (%)	-	-	0,6267/38,1576	-	-

3.4.4 Fat content

Fats and oils are food substances that are essential for maintaining immunity and the health of the human body. In addition, fats and oils are a more effective source of energy compared to carbohydrates and proteins. One gram of oil or fat can produce 9 kcal, while carbohydrates and protein produce 4 kcal/gram [11].

The fat content of raw and cooked crackers with the addition of a blue swimming crab lemi as much as 25% is 0,6267% and 38,1576%, there is no minimum or maximum limit of the provision of fat content in fish crackers based on SNI 8272-2016. High levels of fat can be caused by some things between them during frying process. Frying is a process for cooking food using fats or food oils. At the time of the frying, some of the oil used will go into the crust (outer surface) and the outer layer so that it fills the empty space originally filled with water.

3.5 Recapitulation of Observation Results

The results of research that has been done to the addition of lemi crabs, hedonic test of 20 semi trained panelist as a repetition, test moisture content, ash content, protein content, fat content and test the florescence of the crackers with the addition of lemi crabs that served the in Table 13.

Based on the results of organoleptic test, the addition of lemi, giving effect on each treatment of the appearance, smell, flavor and texture of crackers. The characteristics of the appearance, smell, flavor and texture of the crackers with the addition of lemi crab 25% have the highest value. Characteristics of the appearance, smell, texture, and flavor of the crab crackers at the treatment of 25% have the highest average value that is an appearance with a value of 6.8 (liked), smell with a value of 7.1 (liked), a texture with a value of 7.4 (liked) and a flavor with value of 7.9 (liked). The *Bayes* test results showed that the treatment of lemi blue swimming crab 25% has the highest alternative value of 7.52 so that it can be concluded crackers with the addition of lemi blue swimming crab 25% is the most preferred by panelists.

Based on the results of the physical test that is done, namely the florescence test, the addition of a blue swimming crab lemi by 25% has a greater value than the other treatment is 71.21%.

Based on moisture and protein test, crackers with the addition of lemi blue swimming crab of 25% already qualified SNI 8272-2016 about fish crackers with a value of moisture content on raw cracker 3,1341% and cooked cracker 1.827% along protein content on raw cracker 4,630% and cooked cracker 4,6188%. Based on the test of

ash, crackers with the addition of lemi blue swimming crab by 25% did not accordance with the condition of SNI 8272-2016 about fish crackers that is with a value of ash content on raw cracker 3,387% and cooked cracker 3.861%. Meanwhile, based on fat cracker content test with the addition of blue swimming crab lemi has a value of fat content on raw cracker 0,6267% and cooked cracker 38,1576% where the minimum or maximum limit of qualified fats contained in fish crackers do not contain in terms of SNI 8272-2016.

Based on the purpose of the research want to be achieve, the level of preference is the main thing that is taken into consideration. The addition of lemi blue swimming crabs up to 35% can still be accepted panelists, but 25% treatment is the most preferred treatment by panelists. Nutritional value is a supporting power in attracting consumers to consume fish crackers. This indicates that the addition of fish meat as much as 25% is better treatment than other treatments, because it produces the more well liked organoleptic characteristics and the presence of proteins contained there in.

4. CONCLUTION

Based on the results of research can be concluded that the crackers with the addition of blue swimming crab lemi as much as 25% is the most preferred treatment by the panelists.

ACKNOWLEDGEMENT

Acknowledgments are conveyed to the cv dua puteri in Cirebon Regency who have agreed to be help and are open to all information needed. To the Supervising Lecturers and the entire academic community at the Faculty of Fisheries and Marine Sciences. As well as all the friends that I cannot mention one by one.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/58976