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The Improvement of Food Quality and Safety of Fish Skin Crackers in Serangan Bali

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Abstract

Indonesia's government is attempting to improve the leading economic sectors such as the fishing industry, together with its processed products that could strengthen the national economy. Therefore, small industries should be able to improve the quality and security of their products for consumers' assurance. Fish Skin Cracker is one of the products from domestic industry in Serangan, Bali, which made from Tuna and Shark. Those kinds of crackers are processed by adding spices, in which the spices would be different among processors and result in different quality. This research was aimed to investigate the best-quality fish skin cracker among the processors, based on the microbiological, chemical, and organoleptic analyzes. This research used Descriptive Method. Based on the results of analyzes, it was discovered that the best Tuna Skin Crackers were those from processor number 2 with values of quality analyzes; Moisture Content 6.1%, Ash Content 0.04%, Protein Content 59.33%, Fat Content 25.98%, TVB 14.21mg N %, TMA 7.45mg N%, Micro Analysis 4.9 x 10^4 Colony/gr, Organoleptic rates: texture 6, taste 7, aroma 6, and color 6. Processor number 2 used garlic, salt, and flavor enhancer as the seasoning. Meanwhile, the best Shark Skin Crackers were those from Processor number 5 with values of quality analyzes; Moisture Content 9.3%, Ash Content 0.04%, Protein Content 86.94%, Fat Content 3.7%, TVB 20.08mg N%, TMA 10.64mg N%, Micro Analysis 2.1 x 10^4 colony/gr, Organoleptic rates: texture 6, taste 6, smell 6, and color 6. Processor number 5 used garlic, coriander, turmeric, flavor enhancer, and lime juice as the seasoning.

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1. Introduction

Indonesia's Government through Directorate General of Processing and Marketing of Fishery Products (Ditjen P2HP) has started to nurture rural Fish Processing Unit (UPI) by establishing fish-processing center. The measure aimed to develop economic growth centers (Anonymous, 2015).

Most of the fishing industries in Indonesia are still considered to be small industries with traditional execution. Nevertheless, the industries sustain the national economic growth very much. One of the efforts to increase the competitiveness of traditional fish products from coastal areas is by improving the quality and food safety.

Serangan Village is one of the areas with active fishing activities, particularly for fish processing. One of fish processing there is the production of fish skin crackers (Anonymous, 2010). Fish skin which was previously considered as waste now has been processed into crackers to improve its economic value. The fish skin crackers are made by rubbing certain spices along the surfaces of the fish skin, in which each processor has different processing technology with different spices that results in different taste. The fish skin crackers are mostly processed from two kinds of fishes, namely Tuna (*Thunnus* Sp) and Shark (*Carcharhinus* Sp).

On the other hand, Serangan Village is often visited by international tourists, since there are turtle conservation center and various water sports and recreations there. The condition could give opportunities for the traditional fish skin industries to reach the international market. Considering the opportunities, a research on improving quality and food safety for fish skin crackers is needed.

Objective of the Study

To investigate and obtain the best-quality fish skin crackers (Tuna and Shark) in terms of Microbiological, Organoleptic, and Chemical Analyzes. The result of analyzes was compared to Indonesian National Standard (Anonymous, 2009).

2. Materials and Methods

The study used Descriptive Method which described and analyzed all of data or conditions of the object of the study, based on the ongoing facts when the study was conducted (Kartiko Widi, 2009). The sampling process used some techniques, namely Survey, Observation, and Direct Interview with respondents. Further, the data were tabulated and analyzed.

Place and Time of the Study

The study was conducted at four places, namely Serangan Village, Denpasar, Bali; The Laboratory of Faculty of Agriculture in Warmadewa University; The Laboratory of Faculty of Agriculture in Udayana University; and Bali Provincial Laboratory of Quality Control and Testing of Fishery Products (LPPMHP). The study lasted for 4 months (April-July), counted from the preparation to the main research.

Tools and Materials

The materials of the study were Tuna and Sharkskin crackers that obtained from processors, a set of chemicals for TPC (Total Plate Count), Fat Content, Protein Content, TMA, TVB, and Organoleptic Analyzes, namely Nutrient Agar, Peptone, Aquades, Petroleum Ether, H_2SO_4, Cotton, Tissue Paper, Alcohol, Rubbing Alcohol, etc.

The tools of the study were a set of equipment for Microbiological, Chemical, and Organoleptic Analyzes, namely Autoclave, Laminar flow, Petri Dish, Erlenmeyer, Test Tube, Pipette, Soxhlet Extractor for Fat Content Analysis, Sample Dish, Desiccator, Conway Dish, etc.

Research Execution

The study was conducted by obtaining 10 samples from 7 processors. Those 10 samples consisted of 3 samples of Tuna Skin Crackers and 7 samples of Shark Skin Crackers.

1) The researchers brought the 10 samples to the laboratory to be analyzed microbiologically (Total Plate Count (TPC)) and chemically (Analysis of Moisture Content, Fat Content, Protein Content, Ash Content, TMA, and TVB. Further, the researchers conducted Organoleptic Analysis (Taste, Color, Aroma, and Texture). The Analyzes were repeated 3 times for each parameter.
2) Methods used: The Microbiological Analysis (Total Plate Count (TPC)) was using Pour Plate, the Moisture Content Analysis was using Oven-drying Method, the Fat Analysis was using Gravimetric Method, the Protein Analysis was using Gunning Method, the analysis of Ash Content was using Muffle with 600^0C temperature, the analysis of TVB and TMA levels was using Conway Dish Method (Tranggono, 1991), and the Organoleptic Analysis was using Hedonic and Numeric Scales (Soekarto, 1985).

3. Results and Discussions

3.1 Sampling Process

When the researchers carried out a survey for this study in 2015, they found many of people in Serangan made fish skin crackers. Therefore the researchers were interested to do pre-interview related to the making process. Based on the interview, it was known that:

1) More than 15 people in Serangan produced fish skin crackers actively.
2) Fish skin crackers were made from two kinds of fishes, namely Tuna and Shark.
3) Producing fish skin crackers was considered to be a permanent job for those people.
4) There were 2 ways to boil the fish skin as the raw material.
5) Spices that used to process fish skin crackers were different among processors.

In April 2016, another survey was carried out but showed several changes, in which:

1) The processors of fish skin crackers shrank into 9 people, and only 7 of those that considered the activity as their permanent job.
2) Previously, the researchers would like to collect 10 samples from 5 processors who make both of Tuna and Shark Skin Crackers. Therefore, it should be 1 Tuna Skin Cracker and 1 Shark Skin Cracker from each processor. However, since the number of processors has reduced, so the researchers collected 10 samples from 7 processors, in which 3 samples of Tuna Skin Crackers and 7 samples of Shark Skin Crackers.
3) All of the processors applied the similar boiling technique.
4) From those 7 processors, some of them used different spices. The difference of spices could be seen at Table 1.

Table 1
Spices composition used by tuna and shark skin crackers' processors

Processors of Fish Skin Crackers	Samples' Number	Kind of Fish	Kind of Spices						
			1	2	3	4	5	6	7
1. Liong	4	Shark	v		v	v	v		v
2. Saropah	2	Tuna	v			v	v		
	8	Shark	v	v	v		v		v
3. Sulastri	3	Tuna				v			
	7	Shark	v				v	v	v
4. Cuniawati	6	Shark	v	v	v	v	v		
5. Rapik	1	Tuna	v			v			v
	5	Shark	v	v	v		v		v
6. Sodri	9	Shark	v		v		v		
7. Kandri	10	Shark	v				v		v

Description: Garlic (1), Coriander (2), Tumerik (3), Salt (4), Flavor Enhancer (5), Galangal (6), Lime (7)

The processors in Serangan Village obtained fresh fishes from the fish processing center in Benua, and two main traditional markets in Denpasar, namely Badung Market and Kumbasari Market. The quality of fish skin crackers

depended on the cleansing and skinning processes of the fish skins after the boiling process, kinds of spices, and the dryness level.

For the making process, the processors used clean makeshift equipment. The first step to making fish skin crackers was by boiling the fish skins. This would be followed by skinning process, in which the processors should make sure there is not any meat that still sticks to the skins. Most of the processors even scrubbed their fish skins to prevent such dull and untasty products. Further, the processors dried their crackers on the seashore, yards, or even on the roof.

The processors usually stored the crackers in plastic bag, Styrofoam, large bucket, or cardboard. The processors have not known how long their products could be stored since their products were sold fast. The researchers obtained the samples directly from the processors and analyzed the samples in terms of microbiology, chemical, and organoleptic.

3.2 Objective Analysis

The researchers conducted Objective Tests that consisted of Microbiological and Chemical Analyzes. The result of analyzes was displayed in the Table 2.

Table 2 Result of the objective analysis of fish skin crackers
(Tuna and shark skin crackers)

Samples' Number	Results of Analyzes						
	Moisture (%)	Ash (%)	Protein (%)	Fat (%)	TVB (mg N%)	TMA (mg N%)	TPC (Coloni/gr)
1	7.6	0.10	80.24	9.60	9.21	4.26	$5\ 10^4$
2	6.1	0.04	59.33	25.98	14.27	7.45	$4.9\ 10^4$
3	7.4	0.02	54.61	25.64	12.08	6.06	$3.1\ 10^4$
4	10.1	0.07	72.28	3.80	27.76	14.06	$2.1\ 10^4$
5	9.3	0.04	86.94	3.70	26.08	10.64	$2.1\ 10^4$
6	11.2	0.06	72.04	3.50	26.08	17.90	$3.1\ 10^4$
7	9.6	0.03	83.51	2.70	28.05	14.03	$5\ 10^4$
8	7.8	0.06	77.03	3.40	22.07	20.87	$4\ 10^4$
9	10.2	0.06	80.35	3.40	20.12	10.12	$4.1\ 10^4$
10	10.3	0.06	81.23	3.30	19.25	11.43	$3\ 10^4$

1) Moisture Content

Based on the result of analyzes, the Moisture Contents of both of Tuna and Shark Skin Crackers displayed on Table 2, have met the Indonesian National Standard. The Indonesian National Standard standardized the Moisture Content of fish crackers by 12%. Tuna Skin Crackers that contained the highest Moisture Content were produced by processor number 1 with 7.6% of Moisture Content. Meanwhile, Shark Skin Crackers that contained the highest Moisture Content were produced by processor number 6 with 11.2% of Moisture Content. Based on the percentages, even the crackers which contained the highest Moisture Content have met the standard and considered to be safe to consume. The sample of Tuna Skin Crackers from processor 1 could be seen from Picture 1, meanwhile, the sample of Shark Skin Crackers from processor 6 could be seen from Picture 2.

For fish skin crackers, the spices rub was not contributing much to the drying process, instead, it merely strengthens the flavor of the crackers. Therefore the decrease of Moisture Content tended to be caused by the heat of the sun and wind.

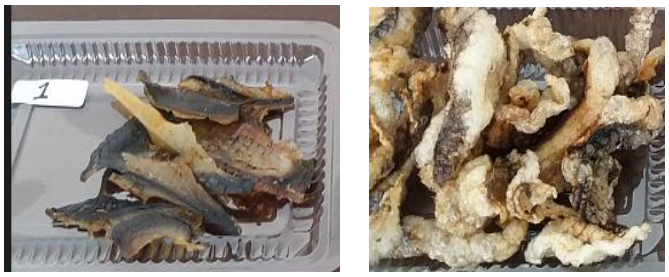

Figure 1. Tuna Skin Crackers (Sample 1: raw crackers (left); fried crackers (right)

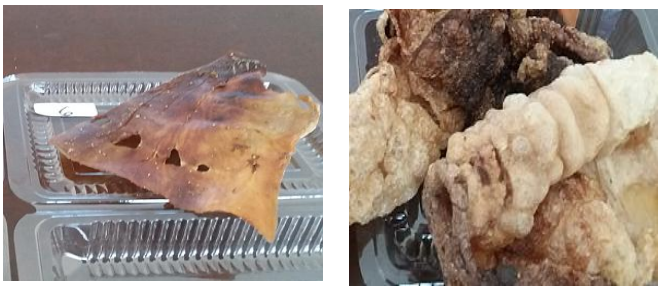

Figure 2. Shark Skin Crackers (Sample 6: raw crackers (left); fried crackers (right)

The Moisture Content is closely related to the shelf life of the product. The higher the Moisture Content, the shorter the shelf life of the product, since water might give chances for microorganism, especially bacteria, to multiply and damage the product. If the Moisture Content is reduced to 15% or more, the bacterial activity could be greatly controlled (Trenggano, 1991).

2) Ash Content

Based on the result of analyzes, Tuna Skin Crackers that contained the highest Ash Content were produced by processor number 1 with 0.1% of Ash Content, meanwhile Shark Skin Crackers that contained the highest Ash Content was produced by processor number 4 with 0.07% of Ash Content. The Ash Contents of both Tuna and Shark Skin Crackers displayed on Table 3.2 have met the Indonesian National Standard, since the Indonesian National Standard standardized the Ash Content of fish crackers maximally 0.2%. The sample of Tuna Skin Crackers from processor 1 could be seen from Picture 1 and the sample of Shark Skin Crackers from processor 4 could be seen from Picture 3.

Ash is known as the inorganic residue of the combustion of an organic substance with high temperatures. The total Ash Content reflects the Mineral Content of material (Muchtadi, 1989). Therefore the cleaner the fish skins, the lower Ash Content would be detected (Tranggano, 1991).

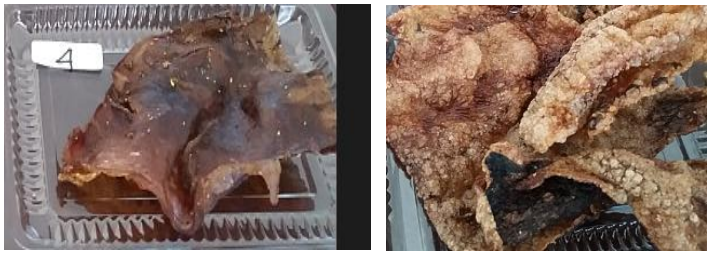

Figure 3. Shark Skin Crackers (Sample 4: raw crackers (left); fried crackers (right)

3) Protein Content

Based on the result of analyzes, the Protein Contents of both Tuna and Shark Skin Crackers displayed on Table 2, was discovered to be beyond the minimum standard of Indonesian National Standard. The Indonesian National Standard standardized the Protein Content of fish crackers minimally 5%. Tuna Skin Crackers that contained the highest Protein Content were produced by processor number 1 with 80.24% of Protein Content. The crackers could contain the highest Protein Content since those were made by skins at the fin section, in which a lot of meat tended to remain at the section, compared to other sections. The sample could be seen from Picture 1. Meanwhile, Shark Skin Crackers that contained the highest Protein Content were produced by processor number 5 with 86.94% of Protein Content. The Crackers could hit the highest Protein Content since the processor let a thin layer of meat still sticking on the skins. The sample could be seen from Picture 4. Generally, both of Tuna and Shark are sea creatures that have thick skins consist of Fat, Protein, and Minerals (Tranggano, 1991).

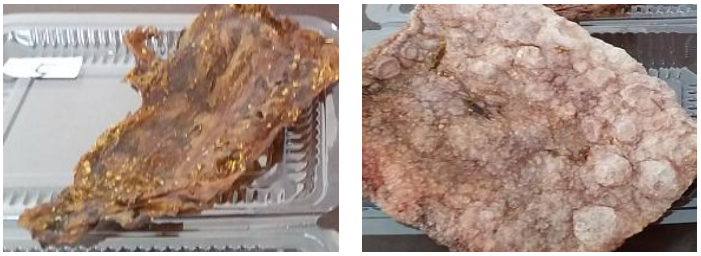

Figure 4. Shark Skin Crackers (Sample 5: raw crackers (left); fried crackers (right)

4) Fat Content

Based on the result of analyzes, the Fat Contents of both Tuna and Shark Skin Crackers were discovered as displayed in Table 2. Tuna Skin Crackers that contained the highest Fat Content were produced by processor number 3 with 25.64% of Fat Content. The sample of Tuna Skin Crackers from processors 3 could be seen from Picture 5. Meanwhile, Shark Skin Crackers that contained the highest Fat Content were produced by processor number 4 with 3.8% of Fat Content. The sample could be seen from Picture 3.

The Fat Content for fish cracker has not been standardized by the Indonesian National Standard. However, since the fat of sea creatures which is full of Vitamins A, D, E, and unsaturated fatty acid considered to be good for human health (Tranggano, 1991), so fish with high-fat content would be very beneficial for human health through the storing process should be managed well.

Figure 5. Tuna Skin Crackers (Sample 3: raw crackers (left); fried crackers right)

5) Total Volatile Bases (TVB)

Based on the result of analyzes, the TVB levels of both Tuna and Shark Skin Crackers displayed on Table 2, showed that fish skin crackers which were produced by processors in Serangan Village were safe for consumption. Generally, products which contain TVB<30 mg N% are considered to be safe to consume. Tuna Skin Crackers that contained the highest TVB level were produced by processor number 2 by 14.27mg N%. The sample could be seen from Picture 6. Meanwhile, Shark Skin Crackers that contained the highest TVB level were produced by processor number 7 by 28.05mg N%. The sample could be seen from Picture 7.

The increase of TVB was mostly caused by an autolysis of uncontrolled enzymes. The phenomenon should be anticipated to prevent low-quality products since it mostly occurs if the raw materials are not handled properly.

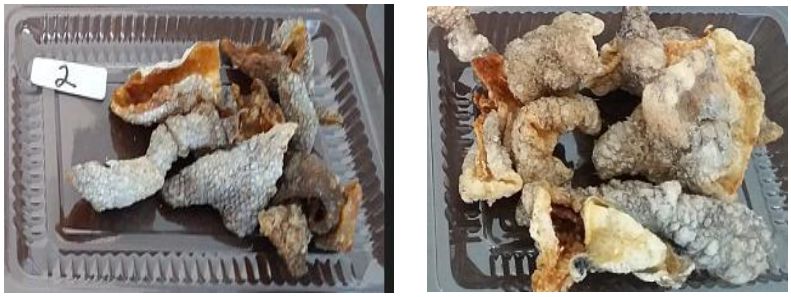

Figure 6. Tuna Skin Crackers (Sample 2: raw crackers (left); fried crackers (right)

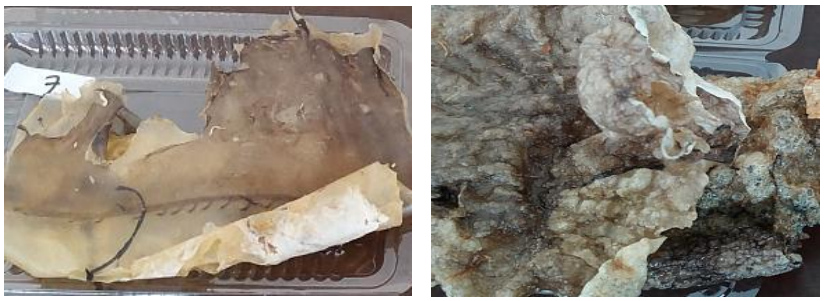

Figure 7. Shark Skin Crackers (Sample 7: raw crackers (left); fried crackers (right)

6) Tri Methyl Amine (TMA)

Based on the result of analyzes, the TMA levels of both Tuna and Shark Skin Crackers were tabulated in Table 2. Tuna Skin Crackers that contained the highest TMA level were produced by processor number 2 by 7.45 mg N%. The sample could be seen from Picture 6. Meanwhile, Shark Skin Crackers that contained the highest TMA level were produced by processor number 8 by 20.87 mg N%. The sample could be seen from Picture 8. Both of Tuna and Shark crackers produced by producers in Serangan were considered to be safe for consumption since the TVB level met the standard. TMA level is the part of TVB level in which as long as the TVB level met the standard, the TMA level would automatically meet it.

Basically, TVB or Total Volatile Bases are volatile bases that formed due to autolysis by enzymes. Those volatile bases are *Ammonia, Monomethylamine, Dimethylamine, and Trimethylamine* (TMA). TMA is a substance that is formed as the result of TMAO degradation by microbial activity (*Pseudomonas, Archromobacter*, and *Lactobacillus*), therefore the higher the TMA level, the stronger the rancidity of fish (Tranggono, 1991).

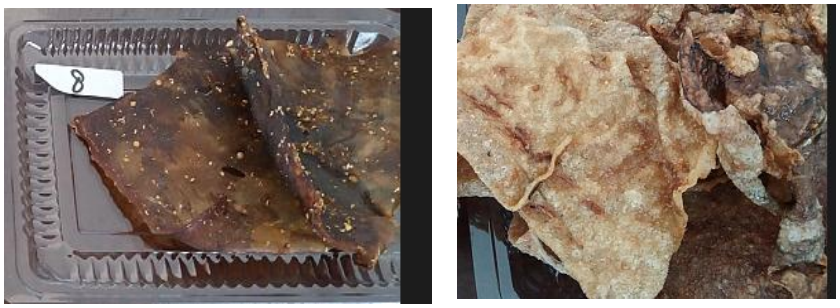

Figure 8. Shark Skin Crackers (Sample 8: raw crackers (left); fried crackers (right)

7) Total Plate Count (TPC)

Based on the result of analyzes, the TPC levels of both Tuna and Shark Skin Crackers were tabulated in Table 2. Generally, the fish skin crackers produced by processors in Serangan Village have met the Indonesian National Standard; since it standardized the TPC level by $5x10^5$ colony/gr. Tuna Skin Crackers that contained the highest TPC level were produced by processor number 1 by $5x10^4$ colony/gr. This level was considered to be safe for consumption, and the sample could be seen from Picture 1. Meanwhile, Shark Skin Crackers that contained the highest TPC level were produced by processor number 7 by $5x10^4$ colony/gr. The sample could be seen from Picture 7.

3.3 Subjective Analysis

The researchers have conducted subjective analysis and displayed the result in Table 3.

Table 3
Result of the subjective analysis of fish skin crackers (tuna and shark skin crackers)

Samples' Number	Results of Subjective Analysis			
	Texture	Taste	Aroma	Color
1	5	6	6	5
2	5	6	5	5
3	4	3	3	4
4	6	5	6	5
5	6	6	6	6
6	5	6	6	6
7	5	6	6	5
8	6	6	6	6
9	5	5	5	5
10	5	6	6	5

1) Texture

Based on the result of Organoleptic Analysis (1-7 scales), the rate of texture for both Tuna and Shark Skin Crackers were tabulated in Table 3. The highest rate of texture for Tuna Skin Cracker hit 5 scales (Like a little) which was gained by crackers from processors 1 and 2. The samples could be seen from Pictures 1 and 6. Though gaining the highest rate, the crackers could not hit the maximum rate since the texture of the raw or fried crackers seemed rigid and curling. According to the processors, it was hard to create good texture for Tuna Skin Crackers, since the skins tended to be curling when undercooked, while soon becoming mush when slightly overcooked. Therefore, the processors tended to boil the skins fast to prevent the mush texture but often gained such curling texture. Meanwhile, the highest rate of texture for Shark Skin Cracker hit 6 scales (Like) which was gained by crackers from processors 4, 5, and 8. The samples could be seen from Pictures 3, 4 and 8. Though the crackers were liked by panelists, those also had rigid texture. According to the processors, the skins remained rigid despite having been boiled for a long period, since the Shark's skin was naturally thick. In case the processors got thinner Sharkskin, the crackers would be much better.

2) Taste

Based on the result of Organoleptic Analysis (1-7 scales), the rate of taste for both Tuna and Shark Skin Crackers were tabulated in Table 3. The highest rate of taste for Tuna Skin Cracker hit 6 scales (Like) which was gained by crackers from processors 1 and 2. The samples could be seen from Pictures 1 and 6. The taste of crackers is influenced very much by the spices. Since the processors 1 and 2 added garlic for the rub spices, their crackers brought more delicious taste. Meanwhile, most of the samples of Shark Skin Crackers hit 6 scales (Like), except the samples from processors number 4 and 9. Since the two processors did not add coriander to the mixture of spices, it made the crackers become less savory and only got 5 scales (Like a little) compared to the rests.

3) Aroma

Based on the result of Organoleptic Analysis (1-7 scales), the rate of aroma for both Tuna and Shark Skin Crackers were tabulated in Table 3. The highest rate of aroma for Tuna Skin Cracker hit 6 scales (Like) which was gained by crackers from processors 1. The samples could be seen from Picture 1. The aroma of fish skin crackers is influenced very much by the mixture of the rub. Since the processor 1 spread lime on the skins' surfaces, it was effective to decrease or even eliminate the fishy smell. Meanwhile, most of the samples of Shark Skin Crackers hit 6 scales (Like), except the samples from processor 9. The processor 9 did not rub lime juice on the skins' surfaces, so the fishy smell was discovered to be stronger. Generally, Shark is known for its strong fishy smell, though the smell could be decreased by rubbing lime juice.

4) Color

Based on the results of Organoleptic Analysis (1-7 scales), the rate of color for both Tuna and Shark Skin Crackers were tabulated in Table 3. The highest rate of color for Tuna Skin Cracker hit 5 scales (Like a little) which was gained by crackers from processors 1 and 2. The samples could be seen from Pictures 1 and 6. The color of those Tuna Skin Crackers remained similar to the natural color of Tuna's skin since the processors did not add any certain spices that may change the color. Meanwhile, the highest rate of color for Shark Skin Cracker hit 6 scales (Like) which was gained by crackers from processors 5, 6, and 8. The samples could be seen from Pictures 2, 4, and 8. The bright color of those Shark Skin Crackers resulted from the mixture of coriander and turmeric.

4. Conclusion

Based on the result of analyzes objectively and subjectively, it could be concluded that the best Tuna Skin Crackers were those from Processor number 2, with values of quality analysis; Moisture Content 6.1%, Ash Content 0.04%, Protein Content 59.33%, Fat Content 25.98%, TVB 14.21mg N%, TMA 7.45mg N%, Micro Analysis $4.9x10^4$colony/gr, Organoleptic rates: texture 6, taste 7, aroma 6, and color 6. The processor used garlic, flavor enhancer, and salt as the seasoning.

Meanwhile, the best Shark Skin Crackers were those from Processor number 5, with values of quality analysis; Moisture Content 9.3%, Ash Content 0.04%, Protein Content 86.94%, Fat Content 3.7%, TVB 20.08mg N%, TMA 10.64mg N%, Microanalysis $2.1x10^4$colony/gr, Organoleptic rates: texture 6, taste 6, aroma 6, and color 6. The processor used garlic, coriander, turmeric, flavor enhancer, and lime juice as the seasoning.

Conflict of interest statement and funding sources

The author(s) declared that (s)he/they have no competing interest. The study was financed by the main author.

Statement of authorship

The author(s) have a responsibility for the conception and design of the study. The author(s) have approved the final article.

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