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Dough Proportion Optimization of High Albumin "Kerupuk Basah" of Toman Fish, A Traditional Food From Kapuas Hulu West Kalimantan, Indonesia

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Abstract— *The purpose of this study was to determine the effect of the optimization of the proportion of tapioca flour: MOCAF: fish on the physical, chemical, and organoleptic characteristics of "kerupuk basah". The research design in this experiment is Response Surface Model (RSM) using Design Expert 7.0 method of Box-Behnken Design (BBD) using 3 factors (proportion of tapioca flour, MOCAF, and fish) and 2 responses (elasticity and protein content). The optimum projection of "kerupuk basah" was tested for albumin levels. The results of this study indicate that the optimum proportion of belida "kerupuk basah" is tapioca flour: MOCAF: fish that is 55.19: 30.00: 97.09. The optimum proportion of belida "kerupuk basah" produces optimal response predictions, namely 0.13816 kg of hardness and protein content 14.0356%, while the actual optimal response is 0.134 ± 0.02 kg elasticity and protein content 14.210 ± 0.05%. While the optimum proportion of toman fish "kerupuk basah" is tapioca flour: MOCAF: fish that is 54.29: 30.89: 92.55. The optimum proportion of toman fish crackers produces an optimal response prediction that was the hardness of 0.091678 kg and protein content of 17.2758%, while the actual optimal response was the hardness of 0.087 ± 0.04 kg and protein content of 16.560 ± 0.03%. "kerupuk basah" toman fish with the best treatment show higher albumin levels.*

Keywords— *Albumin, Fish, "kerupuk basah", MOCAF, Optimization.*

I. Introduction

Kerupuk basah are snacks made from tapioca flour, freshwater fish, and seasonings (garlic, salt, pepper, and flavoring) so they are similar to pempek and fish meatballs (Supratiwi, 2017). Kerupuk basah are oval-shaped and is sized 10-15 cm length, like pempek lenjer. Freshwater fish that is commonly used in making kerupuk basah is belida fish (*Notopterus chitala*). But the productivity of belida fish is low, so it is starting to be scarce. Therefore the price of belida fish continues to increase every year to reach Rp 170,000/kg in 2018. One of the fish that has the potential to be used as raw material for kerupuk basah to replace belida fish is toman fish. Toman fish prices are cheaper at Rp. 55,000/kg because of high productivity reaching 31,000 tons/year (Timothy, 2017). Toman fish also contains 5.35% albumin (Firlianty et al., 2013) which has the potential to be developed as high albumin kerupuk basah.

The raw material for making kerupuk basah beside fish is tapioca flour. Tapioca flour acts as a filler, adhesive, and forms the texture of kerupuk basah. However, the starch in tapioca flour has the disadvantage of forming a non-uniform gel, solubility is limited to water, and is sticky when cooking (Megaet et al., 2009). One effort to overcome the weaknesses of tapioca starch is to combine tapioca flour with fermented Cassava Flour (MOCAF) (Simanjuntak et al, 2017). MOCAF was made in such way that it is shaped like rice grains made from fermented process of cassava flour. MOCAF has cheaper price (IDR 6,000/kg) than tapioca flour (IDR 10,000/kg) because of its simpler manufacturing method. MOCAF has the advantage of being a good bonding force, forming a strong gel, not easily broken or damaged so that it can produce a chewy and compact kerupuk basah texture (Simanjuntak et al., 2017). In addition, MOCAF contains lactic acid which acts to give a distinctive aroma to kerupuk basah so that it can cover the fishy odor (Astawan and Wresdiyati, 2004; Suarti et al, 2015).

II. Materials and Research Methods

A. Material

The ingredients used were fresh toman fish. tapioca flour, MOCAF, drinking water (boiled water), and seasonings (pepper, salt, and garlic). While the materials for analysis were NaOH, biuret reagents ($CuSO_4.5H_2O$ and $NaKC_4O_6.6H_2O$), aquades, and aquabides. The materials used for the organoleptic test were commercial kerupuk basah, drinking water, and pempek.

B. Preparation of Kerupuk basah

Fish meat that has been cleaned and separated from its bones (according to the proportion treatment), water, salt, garlic, and pepper were mixed and stirred evenly. Then add flour (according to treatment) gradually while stirred. After all the mixture was mixed evenly, the dough was formed oval (elliptical) with a diameter of 2-3 cm and 10-15 cm of length. Next, the dough was put into boiling water and boiled for 30-40 minutes until it floats and then removed and drained (Supratiwi, 2017).

C. Hardness Analysis Procedure

The hardness was measured based on the ability of the material to do elastic deformation (Sari et al., 2014). The hardness analysis procedure used the method of Cheng et al. (2011). The sample to be analyzed was cut into sizes 1.5 x 1.5 x 0.5 cm. The probe was set with the provisions (pretest speed:

1.0 mm/s; test speed: 2.0 mm/s; post-test speed: 10.0 mm / s; force: 20.0 g; distance: 10.00 mm; tare mode: auto). In the graph preferences were set with the provisions (y = force (g); x = distance (mm); time = x). Data analysis was performed used Anchor-Insert Calculation-maxima.

D. Protein Content Test Procedure

Preparation of reagents and standard solutions

Biuret reagents were made by weighing 0.75 grams of $CuSO_4.5H_2O$, 3.0 grams of NaKC4O6.6H2O and dissolved in 250 ml of distilled water in a 500 ml measuring flask. Then added 150 ml of 10% NaOH while stirred. Then add distilled water to a volume of 500 ml.

Manufacture of standard protein solutions

Preparation of a standard solution was done by weighing 90 mg of Bovine Serum Albumin (BSA), then dissolved it in 25 ml distilled water and added 1 drop of 3% NaOH. Then added distilled water to obtain a 3600 ppm protein solution.

Preparation of protein solutions

A total of 2 grams of sample was weighed and then dissolved with 20 mL of distilled water after that centrifuged for 30 minutes. After centrifuge, the centrifuge was put in cold water and cooled for ±20 minutes. The sample filtrate was pipetted 1 mL with 5 ml of distilled water and 6 ml of biuret reagent and allowed to stand for ± 30 minutes, then measured the protein content of the sample.

Protein concentration (%) = a / b x 100%

Note: a = weight of protein

b = sample weight

$$\text{Protein content (\% db)} = \frac{100}{(100 - \text{water content})} \times \text{protein content (wb)}$$

E. Determination and Analysis of The Best Treatment

Factors and responses used in this study can be seen in Table 1.

Table 1. Factors and Responses in RSM Modeling and Optimization

Factor (Treatment)	Desired response
proportion of tapioca flour proportion of MOCAF proportion of fish	lowest hardness highest protein level

The expected response was the lowest hardness and the highest protein, because the higher the protein content, the lower hardness or kerupuk basah are more tender. The minimum value of tapioca flour, MOCAF, and fish respectively 50:30:50 while the maximum value of tapioca flour, MOCAF, and fish respectively 60: 40: 100.

F. Analysis of Albumin Levels

Samples must be liquid. If it is in the form of solids it must be destructed first and added by water. Then filtered and centrifuged. Next, pipette samples as much as 0.1-1ml. Put it in a test tube, then treat it like a standard curve.

G. Microstructure Morphological Analysis

Microstructure morphological observations were carried out using a Scanning Electron Microscope (SEM) (Zhang et al., 2010). Microstructure morphological analysis refers to Julinawati et al. (2015). The sample to be analyzed is smoothed first. Then the sample was placed on the sample container that has been attached with carbon tape. The remaining samples which were not attached were cleaned from carbon tape. Then the sample container was inserted into the SEM sample holder. Then on another monitor, click “New” on the FILE menu. On the SEM monitor, adjust the spot size so that the DT value and CPS increase.

H. Analysis of Amino Acid Profile

According to Kawai et al. (2009), the composition of essential and non-essential amino acids contained in the sample can be known by analyzing the amino acid profile. Amino acid profile analysis refers to Aprina (2012). 0.1 gram of kerupuk basah sample was hydrolyzed using 5 ml of HCl 6 N, then vortex. Then flowed with nitrogen and put in the oven at 110°C for 22 hours. The mixture was cooled to room temperature. The contents of the closed test tube were transferred into a 50 ml volumetric flask, then aquabides were added to the boundary markers. Then 10 µl of the solution was pipetted and 70 µl of AccQ Fluoric borate was added, and vortex. A total of 20 µl fluoride A reagent was added, incubated for 10 minutes at 55°C, then injected with Ultra Performance Liquid Chromatography (UPLC). UPLC conditions were regulated using column C18, 37°C temperature, 60% acetonitrile mobile phase and 40% water, fluorescent detector, 1 ml/min flow rate, and 5 µl injection volume.

I. Organoleptic Analysis

The organoleptic test used a sample of 100 untrained panelists using a questionnaire instrument with a scoring method. The organoleptic test was divided into sensory and hedonic tests. Sensory tests refer to Rahayu's (2001) research, while hedonic tests refer to Putri's (2014) research. In hedonic test, each panelist was asked to indicated the level of preference by using a scale of 1 (very dislike) to 5 (very like).

J. Data Analysis

Data were analyzed using Minitab 16. Qualitative data were tested using the Kolmogorov-Smirnov test for normality analysis and continued with the non-parametric Kruskal-Wallis test (significance level $p < 0.05$). Organoleptic test results data were analyzed using Hedonic Scale Scoring test. While the best treatment analysis used Multiple Attribute method based on physical and organoleptic parameters.

III. RESULTS AND DISCUSSION

A. Analysis of Raw Materials

In raw material, the hardness of toman fish was analyzed as well as the protein content. Results Analysis of hardness and protein content of raw materials can be seen in Table 2.

Table 2. Results of analysis of hardness and protein content of raw materials

Raw Material	Hardness (kg)	Protein Levels (%)
Tapioca flour	-	0,22±0,03
MOCAF	-	1,40±0,02
Toman fish	0,14± 0,03	31,23±0,03

Description: Value is the average ± standard deviation of 3 repetitions

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Protein content of toman fish was higher than tapioca flour and MOCAF. It is because fish are a source of protein, whereas tapioca flour was a source of carbohydrates which means the protein content was much lower than the level of the starch. The high protein content of toman fish was due to the fish belonging to the cork fish group (Channidae) whose protein content is higher than other types of fresh fish (Mustafa et al., 2012). Toman fish protein levels in this study were higher than natural cork fish containing protein 20.14% (Nugroho, 2013).

B. Optimization of Kerupuk Basah Proportion

Optimization of the proportion of kerupuk basah of toman fish aimed to obtain the optimum proportion which has the lowest hardness value and the highest protein content. The results of the optimization of proportions using BBD obtained 17 experimental designs which can be seen in Table 3.

Table 3. Optimization of the proportion of kerupuk basah

Run	Factors			Responses	
	Tapioca flour	MOCAF	Fish	Hardness (kg)	Protein (%)
1	50,00	30,00	75,00	0,11±0,03	15,29±0,04
2	60,00	30,00	75,00	0,11±0,02	14,58±0,05
3	50,00	40,00	75,00	0,11±0,04	11,72±0,03
4	60,00	40,00	75,00	0,12±0,05	11,00±0,02
5	50,00	35,00	50,00	0,12±0,04	9,75±0,03
6	60,00	35,00	50,00	0,12±0,03	11,19±0,05
7	50,00	35,00	100,00	0,11±0,05	15,33±0,04
8	60,00	35,00	100,00	0,13±0,04	14,89±0,03
9	55,00	30,00	50,00	0,12±0,04	9,94±0,05
10	55,00	40,00	50,00	0,12±0,05	9,90±0,02
11	55,00	30,00	100,00	0,10±0,04	15,84±0,05
12	55,00	40,00	100,00	0,13±0,03	10,79±0,04
13	55,00	35,00	75,00	0,09±0,02	16,66±0,01
14	55,00	35,00	75,00	0,09±0,01	16,89±0,02
15	55,00	35,00	75,00	0,08±0,02	17,24±0,01
16	55,00	35,00	75,00	0,08±0,03	17,44±0,02
17	55,00	35,00	75,00	0,08±0,05	16,39±0,01

Description:

- Value is the mean ± standard deviation of 3 replications
- The proportion of fish 50 means the ratio of flour: fish is 2: 1, the proportion of fish 75 means the ratio of flour: fish is 2: 1.5, while the proportion of fish 100 means the ratio of flour: fish is 1: 1

C. Modeling and Response Analysis of Elasticity

The results of the analysis of the program against elasticity responses indicate that the quadratic model is a suggested model. Based on the sum of squares sequential model testing, the quadratic model has the lowest p-value and less than 0.05 which is <0.0001. This indicates that the quadratic model has a significant effect on the responsiveness of toman fish crackers. The choice of model can also be seen from the maximum values of adjusted R^2 and predicted R^2 (Myers and Montgomery, 2002). In the summary statistical model, the quadratic model has the highest adjusted R^2 and predicted R^2 values compared to the linear and 2FI models, respectively 0.9190 and 0.8747. Quadratic model is known to have a low PRESS (Prediction Error Sum of Squares) value of 6,222E-004. This illustrates a small error prediction. ANOVA for elasticity response is shown in Table 4.

Table 4. ANOVA in quadratic models with elasticity responses

Response	R^2	Model		Lack of fit	
		P-value	Desc	*P-value*	Desc
Elasticity	0,9646	0,0003	Significant	0,8839	Not significant

The parameters used are known to produce significant quadratic models at the 95% level to predict hardness responses (p = 0.0003). Quadratic model produces insignificant lack of fit (p = 0.8839) to the pure error. A surface response image for the hardness of the toman kerupuk basah was shown in Figure 1.

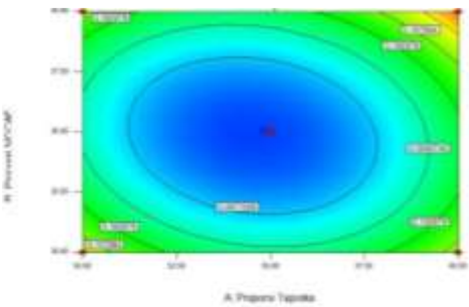

Figure 1. Contour plot (2D) response of kerupuk basah of toman fish elasticity response

Figure 1 shows that the result of hardness response model has an R^2 value of 0.9646 which was close to 1. The value of R^2, which was close to 1, shows that the independent variable was closely related to the hardness response (Saniah and Hasimah, 2008).

D. Modeling and Response Analysis of Protein Content

The protein content results analysis on the response of kerupuk basah toman fish showed that the quadratic model was the suggested model. Based on the sum of squares sequential model testing, the quadratic model has the lowest p-value 0.05<0.0001. This indicates that the quadratic model has a significant effect on the response of protein levels. The choice of model can also be seen from the maximum values of adjusted R^2 and predicted R^2 (Myers and Montgomery, 2002). In the summary statistical model, the quadratic model has the highest adjusted R^2 and predicted R^2 values compared to the linear and 2FI models, respectively 0.9530 and 0.7481. Quadratic model is known to have a low PRESS (Prediction Error Sum of Squares) value of 33.93. This illustrates a small error prediction. ANOVAs for protein response are shown in Table 5.

Table 5. ANOVA in quadratic models with protein content responses

Response	R^2	Model		Lack of fit	
		P-value	Desc	*P-value*	Desc
Protein level	0,9646	<0,0001	Significant	0,1143	Not significant

The parameters used are known to produce a significant quadratic model at the 95% level to predict the response of protein content (p <0.0001). The quadratic model produces insignificant lack of fit (p <0.1143) to the pure error. A large and insignificant lack of fit P-value implies a model that is used reasonably well so that it is as expected (Myers and

Montgomery, 2002). The surface response image for kerupuk basah of toman fish protein content is shown in Figure 2.

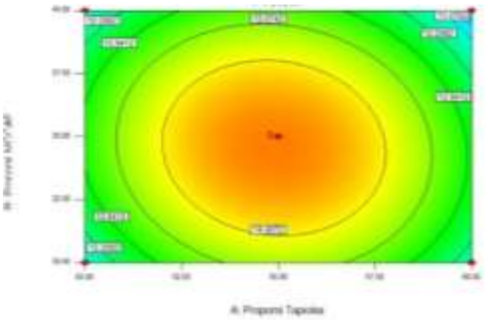

Figure 2. Contour plot (2D) response of kerupuk basah of toman fish protein content

Figure 2 shows the model produced by the response of kerupuk basah of toman fish protein content is a quadratic model. This model has an R^2 value of 0.9646 which is close to 1. The value of R^2 is close to 1, indicating that the independent variable is closely related to the response of protein content (Saniah and Hasimah, 2008).

E. Verification of Kerupuk basah

Optimum responses were obtained through statistical analysis and based on desirability values. The recommended optimum proportion (prediction on RSM) was confirmed and compared with actual testing, can be seen in Table 6.

Table 6. Verification of the optimum proportion

X_1 (%)	X_2 (%)	X_3 (%)	Response	Prediction	Actual	% Error
54,29	30,89	92,55	Hardness	0,091678	0,087±0,04	4,667
			Protein	17,2758	16,560±0,03	4,143

Description: Value is the average ± standard deviation of 3 replications

The recommended proportion was the proportion of tapioca 54.29%, MOCAF 30.89%, and fish 92.55%. This proportion produces an optimal response prediction with a hardness value of 0.091678 kg and protein content 17.2758% with a fairly good desirability value close to 1 which is 0.861 which can be seen in Figure 3.

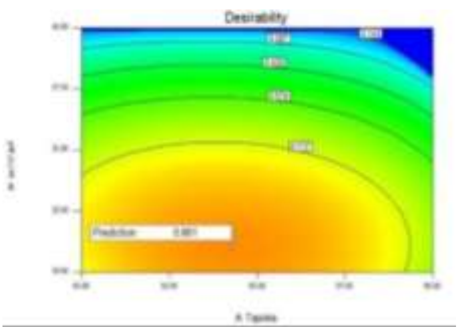

Figure 3. Contour plot (2D) desirability optimization of the proportion of kerupuk basah of toman fish

Verification carried out against the recommended proportion of RSM produces % error of less than 5% of the test value. According to da Silviera et al. (2014)% error is a comparison of the predicted predictive value compared to the real test value. If the value of % error less than 5% can be ignored and the recommended optimal proportion can be considered the best proportion.

F. Results of Albumin Analysis

Albumin was a simple protein and has a globular structure that was generally round or elliptical and was composed of a single polypeptide bond with a multiple amino acid compositions. Albumin can dissolve in neutral water that does not contain salt (Legowo et al., 2003). The results of albumin analysis can be seen in Table 7.

Table 7. Analysis results of albumin levels

Sample	Albumin Level (%)
Kerupuk Basah of Toman Fish	4,65±0,47

Description: Value is the average ± standard deviation of 3 repetitions

The albumin level of kerupuk basah was higher than Sulistiyati (2012) which showed that the cork fish albumin content was 3.119%. However, the level of albumin kerupuk basah of toman fish was still lower than the research of Setiawan et al. (2013) which showed that cork fish contain albumin of 62.24 g/kg (6.22%). Albumin levels were influenced by the content of myogin, where the higher level of myogin, the higher the albumin level was. The content of myogin in young fish was higher than in adult fish. This was because the more mature the fish, the more fat will accumulate in the body (Yulindra et al, 2013).

G. SEM Analysis Results

Morphological analysis of microstructure using SEM was useful to determine the microstructure (including porosity and crack shape) of solid objects (Agustin, 2012). The morphology kerupuk basah of the toman fish microstructure can be seen in Figure 4.

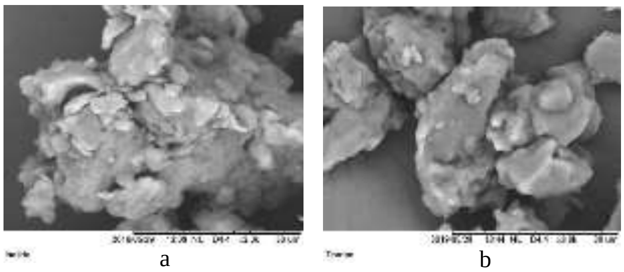

Figure 4. Micro structure morphology of kerupuk basah toman fish with (a) 2000x and (b) 3000x magnification

The morphology of the kerupuk basah microstructure was influenced by the starch content in the product. Tapioca starch and MOCAF were high in amylopectin. This was consistent with Albab and Susanto (2016) that starch used in making kerupuk basah should have high levels of starch, especially amylopectin (70-75% of the total starch) and high water absorption, so that the kerupuk basah were chewy and soft. When tapioca starch and MOCAF were heated at 68-92oC, it will experience gelatinization (Nurainy et al., 2015; Putri and

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Kurnia, 2017). A condition when starch swells and ruptures due to an irreversible development process (Nurainy et al, 2015; Rofiq, 2017). This gelatinization process caused amylopectin to form a gel that is clay, then there will be a softening of the starch cell wall and a rubbery product was produced (Misni et al, 2017).

The morphology of kerupuk basah can also be seen through pores in the resulting kerupuk basah (Figure 5). Kerupuk basah pores affect panelist acceptance and preference.

Figure 5. Transverse incision of kerupuk basah of toman fish

The pore of kerupuk basah were small and tight. This was due to the high protein content of kerupuk basah toman fish. Protein acts to bind water. Low protein and high water in the dough caused the pores formed in the kerupuk basah product to be bigger. This was consistent with Park's (2005) research that one of the causes of large pores was due to lack of protein. This was also supported by research by Pietrasik and Jarmolouk (2003) that large pores were also caused by excessive water use.

Another cause was the addition of MOCAF. MOCAF has the ability to form a good gel and can fill three-dimensional matrix cavities in kerupuk basah. This was in accordance with Wu and Fang (2003) that MOCAF can produce dough with a smooth, compact, springy, and soft texture. While starch in tapioca flour was more fragile and easily broken during cooking (Suprapti and Lies, 2005), and can only expand by 25% (Wu and Fang, 2003).

H. Results of Amino Acid Profile Analysis

The Amino acid profile determine the quality of a protein, protein was one of the most important macro nutrients for humans obtained from food (Kawai et al., 2009). The amino acid profile of kerupuk basah of toman fish can be seen in Table 8.

Table 8. Profile of amino acid kerupuk basah of toman fish

No	Amino Acid Profile	Content (mg/kg)
1	L-Serine	7804.29
2	L-Asam glutamate	37405.96
3	L-Fenilalanine	11165.04
4	L-Isoleusine	8170.58
5	L-Valine	8963.52
6	L-Alanine	10092.69
7	L-Arginine	12362.71
8	Glisine	9976.81
9	L-Lisine	12635.80
10	L-Asam Aspartate	16390.75
11	L-Leusine	14225.72
12	L-Tirosine	6056.59
13	L-Proline	6226.61
14	L-Threonine	8882.84
15	L-Histidine	5216.20

Source: Output 18-5-17 / MU / SMM-SIG, UPLC

The highest amino acid is L-glutamic acid, while the lowest was the amino acid L-histidine. Heating causes chemical changes in amino acid residues. The heating process will reduce the water content and thus the significantly higher amino acid content will be measured (Lopes et al., 2015). Proteolytic reactions that occur during the heating process can cause increased formation of free amino acids (Liu et al., 2009). Free amino acids were one of the water-soluble extractive components which are the main elements of flavor from fishery-based foods (Pratama, 2011). Amino acids directly contribute to flavor and taste and can be precursors for aromatic components (Ozden, 2005).

The height of the amino acids was directly proportional to the aroma. This was in accordance with Stefany et al (2013) that the protein content of fish that breaks down into glutamic amino acids can strengthen the distinctive aroma of fish. When this decomposed glutamic acid was contaminated with bacteria it will cause a fishy odor. This was supported by Ozden's (2005) research that amino acids such as glutamate along with glucose, lipids, trimetalamin oxide, and urea can be converted by bacteria into products that can be used as indicators of decay such as hydrogen sulfide (H_2S), carbonyl, histamine, and ammonia.

I. Organoleptic Analysis Results

Sensory Test

The sensory test aimed to determine the level of savory taste, fishy odor, hardness, and the white color of of kerupuk basah of toman fish when compared with commercial products. Spider chart from the comparison of sensory analysis of kerupuk basah and commercial products can be seen in Figure 6.

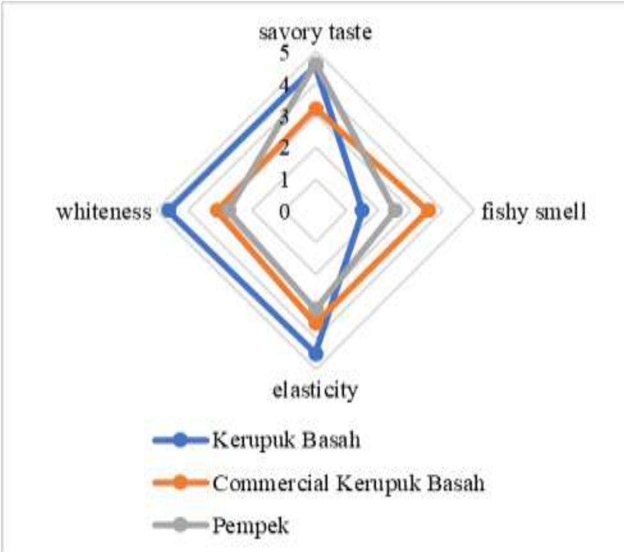

Figure 6. Comparison of spider charts of the results of sensory analysis of kerupuk basah of toman fish with commercial kerupuk basah and pempek

Kerupuk basah of toman fish have a strong savory taste, very white color, hard texture, and the lowest fishy odor. The average results of comparison of sensory analysis of kerupuk basah of toman fish with commercial kerupuk basah and pempek can be seen in Table 9.

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Table 9. Average results of the comparison of sensory analysis of kerupuk basah of toman fish with commercial kerupuk basah and pempek

Sample	Savory Taste	Fishy Odor	Hardness	White Color
Toman Fish	4,56±0,50	1,48±0,50	4,49±0,50	4,62±4,54
Commercial	3,20±0,68	3,56±0,50	3,54±0,50	3,10±0,70
Pempek	4,62±0,49	2,50±0,50	3,09±0,62	2,73±0,44

Information:
• Value is the mean ± standard deviation of 3 replications
• The higher the value of the sensory test results on the parameters of savory taste, hardness, and white color, the better it was.

The highest savory taste was found in pempek samples with an average of 4.62 ± 0.49 while the lowest savory taste was found in commercial kerupuk basah samples with an average of 3.2 ± 0.68. This was because pempek used mackerel which tastes more savory because it contains higher amino acid glutamate (11.4%) than belida fish. This was consistent with Parmanto's research (2012) that the savory taste of the glutamic amino acid can increase the sensory acceptance of pempek. This was also supported by research Nugroho et al (2014) that fish that were rich in glutamic amino acid can improve the taste of cuisine.

Whereas for fishy odor was found in commercial kerupuk basah samples with an average of 3.56 ± 0.49 while the lowest fishy odor was found in kerupuk basah toman fish samples with an average of 1.48 ± 0.50. kerupuk basah toman fish were added with MOCAF which can cover the fishy smell of fish. This was consistent with Suarti et al (2015) that MOCAF contains lactic acid which acts to cover the fishy aroma. Whereas the commercial kerupuk basah were not given an additional MOCAF so that the fishy smell was more obvious. This was also supported by the research of Subagio et al. (2008) that fermentation can neutralize the taste of MOCAF, so that MOCAF can cover 70% of fishy aromas that consumers dislike.

Highest viscosity value was found in kerupuk basah toman fish samples with an average of 4.49 ± 0.50 while the lowest viscosity was found in pempek samples with an average of 3.09 ± 0.62. This was because kerupuk basah toman fish contain MOCAF. MOCAF is proven to increase water binding capacity and gel strength. This causes the toman fish kerupuk basah produced to be more tender, compact, soft, and smooth during processing. In addition, tapioca flour and MOCAF mixture in the dough can undergo gelatinization during cooking.

For the whiteness level, the highest value was found in kerupuk basah toman fish with an average of 4.62 ± 0.49 while the lowest was found in pempek samples with an average of 2.73 ± 0.44. This was due to the addition of MOCAF to the kerupuk basah toman fish dough. According to Suarti et al (2015) MOCAF has a white color that can cover the murky white color due to tapioca flour and fish meat.

In pempek, the absence of additional MOCAF in the dough causes pempek to easily retrogradation and the texture becomes harder (not chewy) after it has cooled. This was consistent with the research of Nurhuda et al (2016) that starch gelatinization during cooking can increase hardness. Besides, the addition of MOCAF causes the kerupuk basah produced to not experience retrogradation and the texture was more stable after being cooled (Ramirez et al., 2002).

While for grayish-white color value due to the absence of the addition of MOCAF. Besides the mackerel fish's color turns darker during processing compared to toman fish causing the pempek produced to be darker in color. This was in accordance with research Stefany et al (2013) that mackerel fish meat turns grayish white due to heat processing.

Hedonic Test

The hedonic test aimed to analyzed the panelists' preference for the product or sample presented. The parameters tested were taste, aroma, texture, and color. Spider chart comparison of the results of the hedonic analysis of kerupuk basah toman fish with pempek and kerupuk basah commercial can be seen in Figure 7.

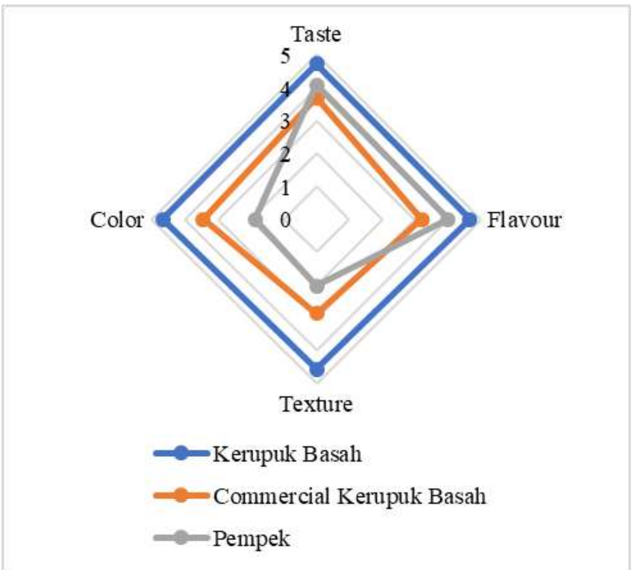

Figure 7. Comparative spider chart of the hedonic analysis of toman kerupuk basah with commercial kerupuk basah and pempek

Kerupuk basah toman fish show the preferred taste, aroma, texture, and color that panelists like best. The average comparison results of the kerupuk basah hedonic analysis with commercial products can be seen in Table 10.

Table 10. Average comparison results of the hedonic analysis of kerupuk basah of toman fish with commercial kerupuk basah and pempek

Sample	Savory Taste	Fishy Odor	Hardness	White Color
Toman Fish	4,73±0,44	4,66±0,47	4,57±0,50	4,66±0,47
Commercial	3,69±0,73	3,21±0,75	2,87±0,77	3,45±0,65
Pempek	4,09±0,75	4,00±0,65	2,04±0,75	1,87±0,69

Information:
• Value is the mean ± standard deviation of 3 replications
• The higher value of hedonic test results, is better

The highest taste preference was found in the kerupuk basah toman fish with an average valur of 4.73 ± 0.45 while the lowest flavor preference was found in the commercial kerupuk basah sample with an average of 3.69 ± 0.73. It was because the protein content of toman fish is higher than the protein content of belida fish used as raw material for commercial kerupuk basah. This is consistent with the study of Parmanto (2012) that taste preferences were influenced by peptides and amino acids in muscle/meat tissue. This also supported by Stefany et al (2013) that protein in fish especially from the types of glutamate, arginine, methionine, and valine plays a role in flavor formation.

The flavor preference with the highest value was found in the kerupuk basah toman fish with an average of 4.66 ± 0.47 while the lowest flavor preference was found in the commercial kerupuk basah sample with an average of 3.21 ± 0.77. This is due to differences in the types of fish used. This was consistent with Anova and Kamsina (2012) research that the protein and amino acid content in fish varies. The higher the content of glutamic amino acids, the higher the acceptance aroma of kerupuk basah. The aroma was also influenced by a mixture of fatty acids and essential amino acids. According to Parmanto (2012) and Nugroho et al (2014) that the volatile fatty acids contained in fish meat provide a distinctive aroma that was preferred by panelists.

The texture preference was found in kerupuk basah toman fish with an average value 4.57 ± 0.49 while the lowest was found in pempek samples with average value of 2.04 ± 0.75. This was because kerupuk basah toman fish use tapioca flour and MOCAF. According to Remadani and Susanto (2016), starch granules on tapioca flour and MOCAF were gelatinized during cooking. This gelatinization process increases water absorption into starch granules and increases the hardness of the kerupuk basah produced to the level favored by the panelists. Besides toman fish contains high protein and dissolved protein so that the texture was not too hard when bitten. This was in accordance with research Nugroho et al (2014) that the more dissolved protein particles (actin, myosin, and actomyosin), the particles will bind to each other between these particles to form a dough that was not easily brittle and springy.

The average value of the panelists preference level for color from kerupuk basah toman fish was 4.66 ± 0.47 while the lowest color preference was found in pempek samples with average value 1.87 ± 0.69. kerupuk basah toman fish showed a bright white color compared to other samples because the toman fish meat used was white. This was consistent with the statement of Nugroho (2013) and Nurhuda et al (2016) that the flesh of the toman fish is bright white. In addition, the color of kerupuk basah of toman fish has a brighter color because it is substituted by MOCAF, whose color was brighter than tapioca flour.

IV. CONCLUSION

The optimum proportion of kerupuk basah of toman fish was tapioca flour: MOCAF: fish with 54.29: 30.89: 92.55. This proportion indicates that the hardness value was 0.087 ± 0.04 kg and contains 16.560 ± 0.03% protein content. The albumin content of kerupuk basah toman fish was higher than belidak, with consecutive value was 4.65% and 2.49%. The best treatment of fish kerupuk basah toman fish showed higher sensory acceptance and organoleptic preference compared to kerupuk basah and pempek commercial.

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