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SUBSTITUTION FOR MACKEREL FISH (Scomberomorus Commerson) BONE MEAL ON FISH CRACKERS

Karakteristik Mutu Dari Substitusi Tepung Tulang Ikan Tenggiri (Scomberomorus Commerson) Pada Kerupuk Ikan

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ABSTRACT

Fish bones are only considered waste by the community, even though they have good nutritional content, so they can be used as fish bone flour as an ingredient for fish crackers. To ensure the quality characteristics of fish crackers that have been substituted between fish bone flour and tapioca flour in fish crackers. Stages of the mackerel fish bone flour manufacturing process: preparation of raw materials for mackerel fish bones, boiling 1, washing, softening, boiling 2, baking, and flouring. Stages of the cracker processing process are: preparation of raw materials, washing fish, filleting, scraping meat, grinding, substitution of mixing fish bones and dough, forming, steaming, cooling, cutting, drying, baking, then frying. The results of the proximate analysis of fish bones showed water content of 5.77%, ash content of 60.20%, protein content of 11.26%, fat content of 2.58%, calcium content of 29.83%, ALT of 3.90x104 colonies/gram. The water content of the crackers produced ranged from 2.57% to 4.17%, the acid insoluble ash content of 0.05% to 0.41%, the protein content of 2.19% to 5.04%, the calcium content of 0.06% to 4.22%. The results of statistical analysis showed that there was an effect of mackerel fish bone flour substitution on water content, ash content, protein content, and calcium content. The Total Plate Count of crackers in all treatments obtained results <2.5x102 colonies/gram. The selected product in the P3 formulation with a calcium content of 4.22% increased the calcium content by 400%. The best sensory test of the formulation at P3 with 30 panelists on the parameters of appearance, odor, taste, and texture was still acceptable to the panelists.

Keywords: Crackers, Fish bone flour, Quality

ABSTRAK

Tulang ikan hanya di anggap limbah oleh masyarakat, padahal memiliki kandungan gizi yang baik, sehingga dapat dimanfaatkan menjadi tepung tulang ikan sebagai bahan kerupuk ikan. Penelitian ini bertujuan untuk memastikan karakteristik mutu kerupuk ikan yang sudah di subtitusi antara tepung tulang ikan dengan tepung tapioca pada kerupuk ikan. Tahap proses

pembuatan tepung tulang ikan tenggiri: persiapan bahan baku tulang ikan tenggiri, perebusan 1, pencucian, pelunakan, perebusan 2, pengovenan, dan penepungan. Tahap proses pengolahan kerupuk yaitu: persiapan bahan baku, pencucian ikan, pemfilletan, pengerokkan daging, penggilingan, subtitusi pencampuran tulang ikan dan adonan, pembentukan, pengukusan, pendinginan, pemotongan, penjemuran, pengovenan, selanjutnya penggorengan. Hasil analisa proksimat tulang ikan kadar air 5.77%, kadar abu 60.20%, kadar protein 11.26%, kadar lemak 2.58%, kadar kalsium 29.83%, ALT $3.90x10^4$ koloni/gram. Kadar air kerupuk yang dihasilkan berkisar 2.57% sampai 4.17%, kadar abu tidak larut asam yang dihasilkan berkisar 0.05% sampai 0.41%, kadar protein yang dihasilkan berkisar 2.19% sampai 5.04%, kadar kalsium yang dihasilkan berkisar 0.06% sampai 4.22%. Hasil analisis statistik menunjukan bahwa ada pengaruh subtitusi tepung tulang ikan tenggiri terhadap kadar air, kadar abu, kadar protein, dan kadar kalsium. Jumlah Angka Lempeng Total kerupuk pada semua perlakuan mendapatkan hasil $<2,5x10^2$ koloni/gram. Produk yang terpilih pada formulasi P3 dengan kadar kalsium 4.22% kadar kalsium meningkat 400%. Uji sensori formulasi yang terbaik pada P3 dengan 30 panelis pada parameter kenampakan, bau, rasa, dan tekstur masih bisa diterima oleh panelis.

Kata kunci: Kerupuk ikan, Tepung tulang ikan, Mutu

INTRODUCTION

Mackerel is a type of pelagic fish that is used for meat with a distinctive taste. In addition, mackerel contains a fairly high protein of 21.4gr/100gr which is good for growth (Wahyudi & Maharani, 2017). Mackerel meat has a savory, tender meat texture and has a distinctive smell (Wulandari & Amin, 2021). Mackerel has a high protein content and is very good for growth (Ambaryanti et al., 2022).

Fish bones are only considered waste by the community who lack their utilization. This is in contrast to the fact that mackerel bone waste that has been processed into fish bone meal contains about 85% minerals, namely calcium phosphate, 14% calcium carbonate, and 1% magnesium. Fish bones can be used in the food sector through the process of making fish bone meal.

In addition to being used as flour, one of the processed bone alternaphim is crackers (Wicaksono et al., 2023). The use of mackerel bone meal in products has one of the goals to increase public acceptability and fish bone meal is one of the sources of calcium for consumers. Crackers are foods that undergo volume development to form porous products that have low density during the frying process (Kusuma et al., 2022). Fish bone crackers are a diversified product that utilizes fish waste in the form of fish bones as ingredients for making crackers and shows changes in processed fishery products to increase the added value of commodities in fish processing units.

Therefore, the author conducted a study entitled "The Effect of Substitution of Mackerel Bone Meal (Scomberomorus commerson) on Fish Cracker Products as a Source of Calcium**".**

RESEARCH METHODS

Tools and Material

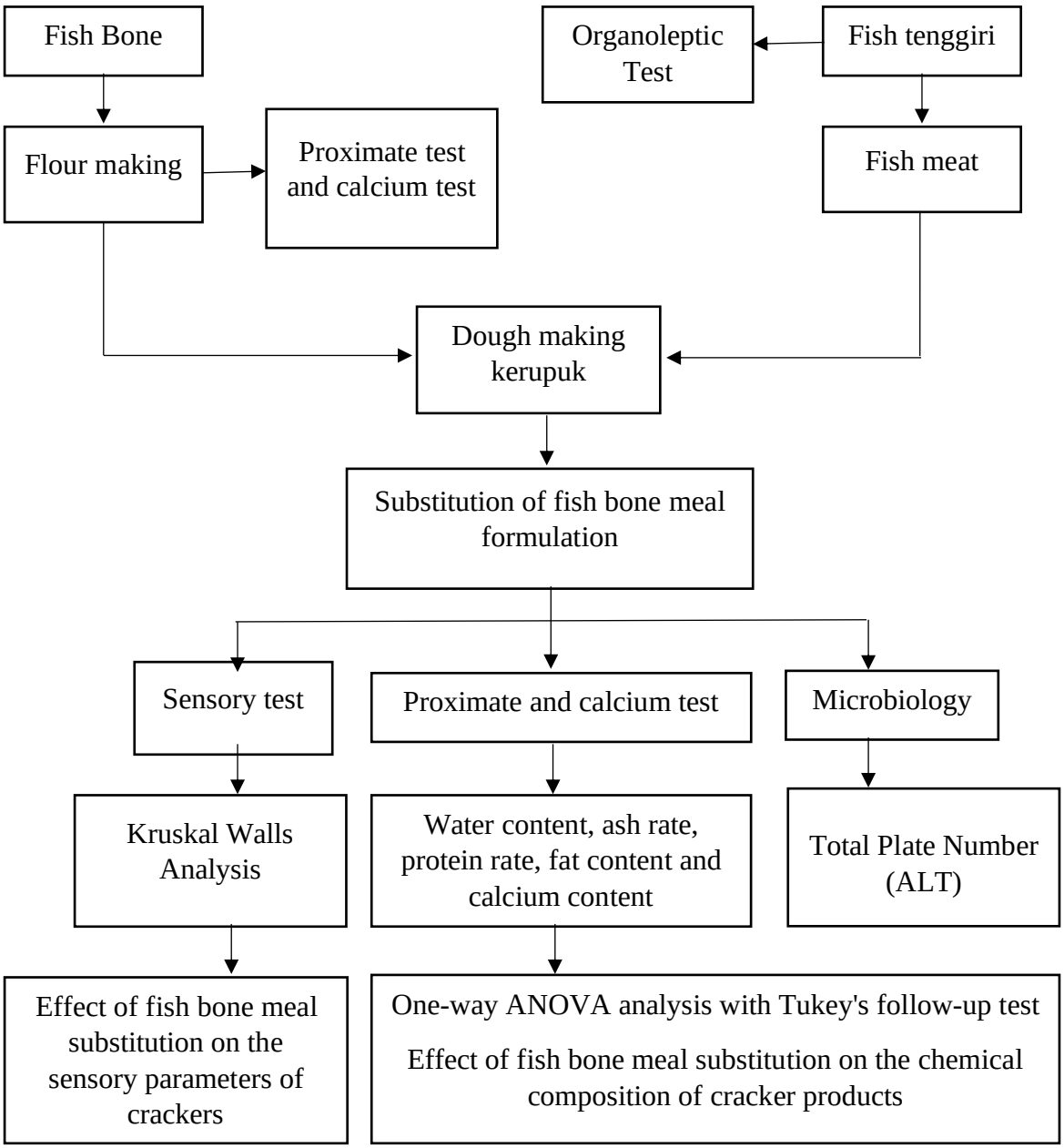
This research was conducted at DWI 888 MSMEs, Kulon Progo-Yogyakarta from February 5 to May 5, 2024. The equipment used during the production and quality testing process is ovens, digital scales, molds, knives, spoons, basins, spatulas, stoves, food processors, panic steamers, pans, blenders, sieves and pancipresto. Quality testing: Porcelain cups, desiccants, analytical scales, grgrps, spatula, burettes, Erlenmeyer, measuring pipettes, graying tuners, measuring flasks, hot plates, autoclaves, incubators, coloni counters, laminari erairflow, micro pipettes, flasks, soxhlets.

Raw materials used during the production process of fish bone meal and cracker products include: fresh mackerel, mackerel bones, garlic, water, oil, salt, sugar, tapioca flour, HCl, aquades, NaOH, PCA (plate count agar), 70% alcohol. Sample mackerel bone meal and cracker products.

Working Method

Research design

The research design for making crackers includes the extraction of raw materials. The raw material for mackerel is obtained from Kulon Progo Market, Yogyakarta. Then organoleptic testing, the manufacture of mackerel bone meal, after which a prtoximate test (moisture content, ash content, protein content, fat content) and calcium was carried out, the manufacture of crackers with the substitution of 0%, 5%, 10%, and 15% mackerel bone meal, after which a proximate test (moisture content, acid insoluble ash content, protein content, carbohydrate content), calcium and ALT were carried out on crackers. The processing of crackers with mackerel bone meal suspension was carried out sensory testing, Kruskal wallis analysis and Tukey's follow-up test. Analyzing the effect of mackerel bone meal substitution using the One Way Variant Analysis Method (ANOVA).



The process of processing mackerel bone meal

The process of processing fish bone meal is: washing fish bones using running water to clean the dirt that is still attached, boiling is carried out for 30 minutes to make it easier to clean the bones from the rest of the meat and blood that is still attached, after boiling the bones are washed and reduced in size, the fish bones then go through a pressure process for 2 hours, the next process is peeled 3 times with 30 minutes each boiling, Next, the fish bones are washed with running water, dried in the oven for 1.5 hours at a temperature of 125°C, dried fish bones are mashed using a blender until they are in the form of flour, Then sift the flour with a sieve of 100 mesh. Processing of megacu fish bone meal in Meulisa et al., (2021), with modifications in this study with substitution of the boiling process after the softening process. In addition, this process does not use NaOH 1.5 N as in previous studies which aim to eliminate protein.

Cracker Processing

The processing of cracker products is in accordance with DWI 888 MSMEs with the substitution of mackerel bone meal for each treatment, namely P0 (0% fish bone meal), P1 (5%

fish bone meal, P2 (10% fish bone meal), and P3 (15% fish bone meal). The process of processing crackers with the addition of mackerel bone meal is: preparation of tools and materials for making fish bone meal, weighing ingredients, mixing ingredients, shaping, cooking dough, cooling, cutting, drying, dredging and packaging.

Formulation of mackerel bone crackers

At the stage of making crackers, the substitution formulation of mackerel bone meal used is P0 (without substitution of fish bone meal) formulations sourced from DWI 888 MSMEs, P1 (5% fish bone meal), P2 (10% fish bone meal) and P3 (15% fish bone meal) which refers to the research of Kusumaningrum & Asikin, (2016) which uses belida fish bone meal.

Table 1. Formula for making fish bone meal substitution crackers

Materials	P0 (g)	P1 (g)	P2 (g)	P3 (g)
Fish Bone Meal	-	50	100	150
Tapioca Flour	1000	950	900	850
Fish Meat	300	300	300	300
Salt	50	50	50	50
Sugar	50	50	50	50
Garlic	100	100	100	100
Water	200	200	200	200
Total	1.700	1.700	1.700	1.700

Analysis procedure

Analysis of the composition of raw materials, quality of fresh mackerel (SNI 2729:2021). Analysis of raw materials for mackerel bone meal includes proximate and calcium in mackerel bone meal (Meulisa et al., 2021), Total Plate Number in mackerel bone meal (SNI 2332.3:2015). Proximate analysis of fish crackers (SNI 2354.2:2015). Sensory UI analysis on cracker products (SNI 8272:2016). The analysis using One Way ANOVA with SPSS 25 software has 95% confidence. The Kruskal Wallis test aims to determine whether there is an effect of fish tualang flour substitution on the appearance, taste, texture of odor and mold in products using a scoresheet with 30 panelists.

RESULT

Quality of fish bone raw materials

Organic testing of fresh fish raw materials uses a scoresheet of 6 (six) parameters, namely including eyes, gills, body surface lenders, meat, odor and texture in accordance with SNI 2729:2021 which is aimed at ensuring that the quality of raw materials is good and can be processed. The results of the organoleptic assessment of raw materials can be seen in Table 2.

Table 2. Organoleptic quality of raw materials

Reps	Interval Value	SNI 2729:2021
1	$7.39 \leq \mu \leq 7.75$	7
2	$7.47 \leq \mu \leq 7.73$	
3	$7.37 \leq \mu \leq 8.08$	
4	$7.27 \leq \mu \leq 8.06$	
5	$7.71 \leq \mu \leq 8.66$	
6	$7.85 \leq \mu \leq 8.44$	

The results of the mackerel bone meal yield can be seen in the Table 3.

Table 3. Yield of mackerel bone meal

Phase	Weight (grams)	Resin (%)
Whole fish bones	2066	100
Boiling	1019	49.32
Softening	871	42.16
Boiling 2	789	38.19
Drying	332	16.07
Containment	305	14.76

Fish bone proximate testing includes the composition of water content, ash content, protein content, fat content, and calcium content. The quality results of solid proximate are seen in Table 4.

Table 4. Quality of proximate mackerel bone meal

Quality Test	Percentage
Moisture content	5.77 ± 0.11
Ash content	60.20 ± 0.08
Protein content	11.26 ± 0.08
Fat content	2.58 ± 0.11
Carbohydrate levels	20.20±0.14

The results of calcium levels in mackerel bone meal can be seen in the Table 5.

Table 5. Calcium content of fish bone meal

Observation	Kalsium (%)
1	25.29
2	25.87
3	25.39
Average	25.51 ± 0.31

The results of the ALT test on fish bone meal can be seen in the Table 6.

Table 6. ALT Results of Mackerel Bone Meal

Code	ALT (colony/gram)	SNI2 2332.3:2015
Mackerel Bone Flour	3.90×10^4	Maks 5×10^5

Final product quality

Cracker quality testing includes proximate chemical tests, namely water content, ash content, protein content, ALT microbiological quality and calcium. The results of the quality testing of proximate and caseium on cracker products with 0%, 5%, 10% and 15% mackerel bone meal substitution can be seen in the Table 7.

Table 7. Final Product Quality

Formulation	Proximate (%)			
	Power Water	Acid insoluble ash content	Protein Content	Fat content
P0	4.17 ± 0.02^c	0.05 ± 0.00^a	2.19 ± 0.03^a	23.06 ± 0.76^b

P1	2.83 ± 0.02[b]	0.23 ±0.005[b]	3.45 ± 0.11[b]	10.76 ± 0.06[a]
P2	2.59 ± 0.26[a]	0.34 ± 0.02[c]	4.14 ± 0.10[c]	10.86 ± 1.07[a]
P3	2.57 ± 0.06[a]	0.41 ± 0.10[d]	5.04 ± 0.00[d]	8.28 ± 0.93[a]

Information:
a b c d Showing results that obtained significantly different results in the ANOVA analysis of Tukey's further test

The cracker products in this study were tested for calcium levels which aimed to determine the quality of calcium levels in each different formulation. The results of calcium dappate levels are seen in Table 8.

Table 8. Calcium level test results

Treatment	Calcium Levels
P0	0.06 ± 0.01[a]
P1	1.35 ± 0.02[b]
P2	2.58 ± 0.04[c]
P3	4.22 ± 0.03[d]

The results of the Total Plate Number test can be seen in the Table 9.

Table 9. Total Plate Number (ALT)

Code	ALT (colony/gram)	SNI 8272:2016
0%	< 2.5 x 10^2	5 x 10^5
5%	< 2.5 x 10^2	
10%	< 2.5 x 10^2	
15%	< 2.5 x 10^2	

Sensory testing refers to SNI 8272:2016 on fish, shrimp and mollusk crackers. The results of sensory values based on the parameters of appearance, odor, taste, texture, and mold showed different results from each treatment with the formulations P0, P1, P2 and P3. The sensory test was carried out with a scoresheet using 30 test panelists conducted using human senses. The average value of the sensory test on the response of all parameters can be seen in Table 10.

Table 10. Sensory results

Treatment	Specifications				
	Show	Smell	Taste	Texture	Mushroom
P0	8.33±0.84[b]	8.67±0.66[b]	8.30±0.92[b]	8.53±0.78[b]	9.00±0.00[a]
P1	8.30±0.79[b]	8.57±0.77[b]	8.47±0.78[b]	8.50±0.68[b]	9.00±0.00[a]
P2	8.37±0.67[b]	8.33±0.76[b]	8.40±0.72[b]	8.30±0.88[b]	9.00±0.00[a]
P3	7.67±0.99[a]	7.53±0.90[a]	7.83±0.91[a]	7.63±1.03[a]	9.00±0.00[a]

[a b c d] Showing results that obtained significantly different results in the ANOVA analysis of Tukey's further test

DISCUSSION

Quality of Fish Meal Raw Materials

The yield is influenced by several factors from the process of boiling, softening, re-boiling and flocculation. The yield obtained in the first boiling process was 49.32%, softening obtained a percentage of 42.16%, the second boiling was 38.19%, drying was 16.07% and in the frying process obtained a yield of 14.76%. According to Meulisa et al., (2021) showed the best yield at 90°C with a yield of 22.92%, while according to Suad, (2019) the processing of

mackerel bone meal obtained a yield of 15.73%. In this study, the yield was lower at the drying temperature of 120°C with a yield of 14.76%.

The results of the yield calculation in this study were obtained from the percentage of the dry weight of mackerel bone meal to the wet weight of mackerel bone raw materials. The length of the boiling process also affects the yield value because in the boiling process there is a loss of meat residue and fat content. The next stage that affects the moisture content is the drying stage (Husna, 2020).

Fish bone meal is one of the sources of calcium that has been processed. Calcium has advantages for the formation of bones and teeth, regulating muscle contraction and heart rate (Afrinis et al., 2018). The results of the research by Meulisa et al., (2021) showed that the calcium content of yellow fin bone meal was 20.75%, while the results of Kondolele et al., (2022) showed that the calcium content of mackerel bone meal was 11.55%. The chemical composition of fish is affected by habitat and size. The results of calcium analysis in mackerel bone meal in this study produced 25.51%, the higher the temperature used, the higher the calcium content obtained from fish bone meal (Untailawam, 2021). The result of the Total Plate Number in mackerel bone meal is 3.90x104 colonies/gram. With a maximum limit value of 5 x 105 colonies/gram (SNI 2332.3:2015), it can be concluded that mackerel bone meal gets results below the maximum limit so that it is safe to consume.

Fish Cracker Product Quality

Results of Proximate Analysis

The moisture content in crackers with mackerel bone meal substitution was highest at the concentration of P0 (without fish bone meal substitution) with a value of 4.17%, while the moisture content of crackers was lowest with P3 formulation (15% fish bone meal). The moisture content in cracker products has met the SNI 8272:2016 standard regarding fish, shrimp and mollusk crackers max 12%.

The results of this study stated that the higher the concentration of fish bone meal substitution, the lower the moisture content, so that the results of the moisture content in this study were lower, from the results of this study stated that the results of Kusumaningrum & Asikin, (2016) obtained higher moisture content results with a result of 14.15%-14.52%. The low moisture content is influenced by the drying factors carried out. The moisture content in cracker products can be low due to the time of drying. In addition, the duration of steaming the dough also affects the moisture content, this is due to the length of the heating process, the dough releases the water content so that there is a decrease in the moisture content of the product (Cahyono et al., 2019). The moisture content in the product is one of the important things to pay attention to because it can be known how to maintain the quality and durability of the product.

Based on the One Way Anova analysis test at a 95% confidence level, the result of P=0.949 (P > 0.05) in Appendix 3, which states that there is an effect of fish bone meal substitution on the moisture content results in the concentration of P2 (10% fish bone meal) and P3 (15% fish bone meal) is stated to be no real difference but P0 (without fish bone meal) is significantly different in the P1 treatment (5% fish bone meal), So that the more bone meal, the higher it will produce a lower moisture content.

Acid Insoluble Ash Content

The ash content of fish bone meal crackers was the highest variable P3 (15% fish bone meal) with a value of 0.41%, while the lowest value was with a concentration of P0 (without bone meal substitution) with a value of 0.05%. The results of the ash content analysis in this study are lower than the results of the research of Kusumaningrum & Asikin, (2016) with a result of 2.82%-10.76%. This shows that the ash content produced from the final product of

crackers has met SNI 8272:2016 concerning fish, shrimp and mollusk crackers with a maximum of 0.2%. The low ash content is due to tapioca flour being more than fish bone meal, which causes ash levels not to increase or are still at normal levels (Alkhamdan & Husain, 2022).

Ash content is one of the components in food contained from minerals such as calcium, phosphorus, magnesium, and potassium. Acid-insoluble ash levels can have an impact on the health of kidney organ performance if consumed in large quantities (Cahyono et al., 2019).

Based on a one-way analysis test at a 95% confidence level, the result was obtained P=0.00 (P<0.05) in Appendix 3, which stated that the substitution of mackerel bone meal had a significant effect on the ash content of crackers, with each treatment producing a significant difference in P0 (no fish bone meal), P1 (5% fish bone meal), P2 (10% fish bone meal) and P3 (15% fish bone meal).

Protein Content

The results of protein content testing in cracker final products with the highest fish bone meal substitution with a concentration of P3 (15% fish bone meal) had a value of 5.04%. This shows that the naming of mackerel bone meal ingredients has an effect on the higher protein levels in each different treatment. The results of protein content analysis in the Kusumaningrum & Asikin study, (2016) with higher results with a value of 7.75%. The protein content of crackers has met the SNI 8272:2016 standard for fish, shrimp and mollusk crackers min 8%.

Based on the One Way Anova analysis test at a 95% confidence level, the result was obtained P=0.00 (P < 0.05) in Appendix 3, which states that the presence of fish bone meal substitution will have an effect on the protein content value, which states that mackerel bone meal substitution has a real effect on the protein content of crackers, with each treatment getting a significantly different result at P0 (without fish bone meal), P1 (5% fish bone meal), P2 (10% fish bone meal) and P3 (15% fish bone meal). The higher the substitution of fish bone meal, the higher the protein content obtained.

Fat content

The fat content in the product can affect the taste and durability of crackers, crackers that contain more oil will go rancid faster.

The fat content obtained in this study obtained the highest value in P0 with a result of 12.06%, while the lowest fat content value in the P3 treatment with a result of 8.28%. The results in this study obtained lower results compared to the fat content of the research Neiva et al., (2012) which used mackerel raw materials with a result of 26.11%. In the research of Nurnidar & Kiflah, (2023), the fat content was obtained at 15.79%. The high fat content in crackers is caused by the frying process that is not done by the spiner, but by manual draining. According to the length of the drying process, it can also affect the fat content of the product to increase while the cavity air level decreases.

Based on a one-way analysis test at a 95% confidence level, the result of P=0.072 (P < 0.05) was obtained in Appendix 3, which states that the substitution of fish bone meal will have an influence on the results of the fat content value. The results of the analysis obtained by P1, P2 and P3 did not differ significantly in fat content, only P0 was significantly different in the treatment of P1, P2 and P3.

Calcium Levels

Results of Table 8 The results of testing calcium levels in cracker final products with the highest fish bone meal substitution with the highest concentration of P3 (15% fish bone meal) had a value of 4.22% while the lowest calcium content with a concentration of P0 (without fish bone meal substitution) had a value of 0.06%. In the research of Kusumaningrum & Asikin,

(2016) with a score of 3.53%-5.64%. The high calcium content in crackers is due to the more substitutions of mackerel bone meal, the higher the calcium content in crackers.

Based on the One Way Anova analysis test at a 95% confidence level, the result was obtained P=0.00 (P < 0.05) in Appendix 3, which states that the substitution of fish bone meal will have an effect on the results of calcium level values. The results of this study prove that mackerel bone meal is one of the potentials as a food additive to increase the nutritional value of cracker products such as calcium and protein content.

ALT Analysis Results

Based on the results of the ALT of the final product crackers with mackerel bone meal substitution in Table 9 got <2.5 x 102. From the results obtained, it can be concluded that all cracker products with 0%, 5%, 10% and 15% formulations are suitable for consumption because they are still below the maximum standard of the colony, which is 5 x 105. Processed cracker products with mackerel bone meal substitution are safe for consumption because the processing process is carried out using clean equipment and goes through heating stages such as steaming and frying.

Sensory Test Results

Cracker products are carried out sensory tests with one of the specifications, namely the appearance of cracker products with various values ranging from 9 with the specification of intact, neat, clean, flat thickness, and bright color crackers. The 7 grade has the specification of whole, neat, clean, uneven thickness, bright color.

Based on the results in Table 12, it shows that the sensory test on cracker products with the highest fish bone meal substitution with a concentration of P2 (10% fish bone meal) with a value of 8.37% and the lowest value in the sensory test on the appearance parameter at the concentration of P3 (15% fish bone meal) 7.67%.

The results of the Kruskal wallis analysis test at a 95% confidence level obtained the result P=0.012 (P > 0.05) found in Table 12, which states that the results of the analysis produce a significant difference so that there is an influence of fish bone meal substitution on the appearance results. The results of the follow-up test with the results of the analysis of the P0 formulation were significantly different from the P3 formulation but not significantly different from the P1 and P2 formulations.

Smell or aroma can determine the taste or delicacy of a product that relies on the five senses of smell. The odor specification in the sensory test on crackers has the characteristics of each value from a value of 9 odors more than the product specification, a value of 7 specifications for less product odor and a value of 5 for the lowest specification, namely the smell of musty or rancid crackers. In the manufacture of crackers, Tapioca flour is more dominant than fish bone meal, it's just that it already has a difference in smell, each fish bone meal substitution starts from 0% without fish bone meal substitution, 5%, 10% and 15%. Based on the smell, it can be concluded that the more fish bone meal substitutions in cracker products, the lower the value of the odor specification.

The smell test based on testimony on 30 panelists argued that the more fish bone meal substitutions, the more fishy smell would be. Based on the results in Table 8, it shows that the sensory test on cracker products with the highest fish bone meal substitution with a concentration of P0 (without fish bone meal) with a value of 8.67%, while the lowest value in the sensory test on the appearance parameter at the concentration of P3 (15% fish bone meal) with a result of 7.53%.

Based on the Kruskal wallis analysis test at a 95% confidence level, the result of P=0.00 (P < 0.05) is found in Table 10, which states that the results of the analysis produce a real difference so that there is an influence of fish bone meal substitution on the odor parameter.

The results of the follow-up test with the results of the analysis of the P0 formulation were significantly different from the P3 formulation but not significantly different from the P1 and P2 formulations.

Taste

The taste of a product is one of the specifications in a very important sensory test. One of the sensory test parameters is taste that relies on the sense of taste on the tongue.

Based on the results in Table 8, it shows that the sensory test on cracker products with the highest fish bone meal substitution with a concentration of P1 (5% fish bone meal) with a value of 8.47% and the lowest value in the sensory test on the appearance parameter at the concentration of P3 (15% fish bone meal) 7.83%.

The results of the Kruskal wallis analysis test at the 95% confidence level obtained the result P=0.028 (P> 0.05) is found in Table 10, which states that the results of the analysis produce a real difference so that there is an influence of fish bone meal substitution on the taste parameters. The results of the follow-up test with the results of the analysis of the P0 formulation were significantly different from the P3 formulation but not significantly different from the P1 and P2 formulations. Based on the taste, it can be concluded that the more fish bone meal substitutions in the product have no significant effect on the taste of the product.

Texture

Sensory tests with texture parameters are one of the most important quality parameters of a dry and crispy food product. The assessment of the 30 panelists produced an average score that showed. The texture of crispy crackers is not only influenced by tapioca flour, but there are other factors, namely the amount of water contained in it will affect the hardness or softness of a product (Rosiani et al., 2015)

Based on the results in Table 12, the sensory test on cracker products with the highest fish bone meal substitution with a concentration of P0 (without fish bone meal) with a value of 8.53, the lowest result on the texture parameter at P3 (15% fish bone meal) with a result of 7.63.

Based on the Kruskal wallis analysis test at a 95% confidence level, the result of P=0.001 (P < 0.05) is found in Table 10, which states that the results of the analysis produce a significant difference so that there is an influence of fish bone meal substitution on the odor parameter. The results of the follow-up test with the results of the analysis of the P0 formulation were significantly different from the P3 formulation but not significantly different from the P1 and P2 formulations.

Based on the texture, it can be concluded that the more fish bone meal substitutions in cracker products, the lower the texture value, because the higher the concentration of fish bone meal in the cracker products, the harder the texture.

Mushroom

Based on the results in Table 12, it shows that the sensory test on the fish flour substitution cracker product does not contain mold so that it gets a value of 9. Based on the Kruskal wallis analysis test at a 95% confidence level, the result was obtained P=1,000 (P >0.05) which stated that there was no effect of fish bone meal substitution on sensory results with fungal parameters. The results of the Kruskal wallis analysis can be seen in Appendix 4.

The absence of mushrooms is due to fresh raw materials and new products (Zulfahmi et al., 2014). Fungi found on the surface of food products are easy to recognize because they often form fibrous colonies such as cotton. Fungi that grow in the form of threads that can contain pigments with various colors such as white, red, purple, yellow, orange, green (Cahyono et al., 2019). Based on the taste, it can be concluded that the more fish bone meal substitutions in the product do not have a significant effect on the appearance of mold in the product.

CONCLUSION

The organoleptic quality of mackerel still meets SNI 2729:2021 regarding fresh fish, with a minimum score of 7. The yield obtained in mackerel bone meal was 14.76%. The quality of mackerel bone meal: moisture content 5.77%, ash content 60.20%, protein content 11.26%, and fat content 2.58%, calcium content 25.51 and ALT test 3.90 x 104 colonies/gram, still meet the SNI 2332.3:2015 standard regarding the determination of Total Plate Number. The variation in the addition of mackerel bone meal has an effect so that it produces a noticeable difference in the composition of the proximate. The product was selected in the P3 formulation with a calcium content of 4.22%. The sensory test of the best formulation at P3 with 30 panelists on the parameters of appearance, smell, taste, and texture was still acceptable to the panelists.

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