

PROTEIN, FIBER, AND ACCEPTABILITY LEVELS OF MACKEREL (DECAPTERUS MACROSOMA) STICK AND MOCAF WITH TOFU DREGS FLOUR SUBSTITUTION
Kadar Protein, Serat, Dan Daya Terima Snack Stick Mackerel (Decapterus Macrosoma) Dan Tepung Mocaf Dengan Substitusi Tepung Ampas Tahu

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ABSTRACT

*Obesity caused by unbalanced intake between calories and a source of dietary fiber for a long time. High snack consumption is cause low a source of dietary consumption. **Purpose:** the purpose of this study was to determine the protein, fiber, and acceptability of mackerel stick with added tofu dregs flour of 0%, 20%, 35%, and 50%. **Methods:** This study used a completely randomized desigh (CRD). Acceptability levels used hedonic scale test that involved students of the Public Health Faculty of the University of jember as panelists. Laboratory experiments in the study used 12 repetitions to test the protein and fiber. Protein mackerel stick was analyzed using One Way ANOVA and tukey. The fiber of the meckerel stick was analyzed using Kruskall Wallis and Wilcoxon Signed Rank Test. **Results:** the results showed that there were significant differences in the average levels of protein, fiber, and Acceptability of mackerel stick with added tofu dregs flour, because p value of protein is $(0,000) < \alpha (0,05)$, p value of fiber is $(0,017) < \alpha (0,05)$, and p value of acceptability of color is $(0,002) < \alpha (0,05)$, p -value of aroma is $(0,010) < \alpha (0,05)$, p -value of taste is $(0,000) < \alpha (0,05)$, and p -value of texture is $(0,005) < \alpha (0,05)$. **Conclusion:** the X1 treatment of mackerel stick with addition of 20% tofu dregs flour be an alternative snack to prevent obesity.*

Keywords: Protein, Fiber, Acceptability of mackerel stick

ABSTRAK

Obesitas disebabkan oleh tingginya konsumsi kalori yang tidak diimbangi dengan konsumsi serat pangan dalam waktu lama. Konsumsi *snack* yang tinggi merupakan penyebab rendahnya konsumsi serat pangan. **Tujuan:** untuk mengetahui kadar protein, serat, dan daya terima *snack stick* Mackerel dan tepung mocaf dengan penambahan tepung ampas tahu 0%, 20%, 35%, dan 50%. **Metode:** Penelitian ini menggunakan metode penelitian eksperimen dengan desain penelitian rancangan acak lengkap. Panelis yang digunakan yaitu mahasiswa kesehatan masyarakat universitas jember. Eksperimen laboratorium menggunakan 12 unit percobaan untuk uji kadar serat dan protein dengan sumber data berupa data primer yang diperoleh dari uji kadar protein dengan teknik semi micro kjeldahl, serat dengan teknik gravimetri, dan daya terima dengan tes uji daya terima menggunakan form uji daya terima. Analisis data kadar protein menggunakan uji One Way Anova dilanjutkan dengan uji Tukey, kadar serat menggunakan uji Kruskall Wallis dilanjutkan dengan Wilcoxon Signed Rank Test. **Hasil:** Hasil dari penelitian yaitu adanya perbedaan yang signifikan pada kadar protein, serat, dan daya terima *stick* Mackerel dengan penambahan tepung ampas tahu karena nilai p value protein $(0,000) < \alpha (0,05)$, nilai p value serat $(0,017) < \alpha (0,05)$, dan nilai p value daya terima terkait warna $0,002 < \alpha (0,05)$, aroma p value $(0,010) < \alpha (0,05)$, rasa p value $(0,000) < \alpha (0,05)$, dan tekstur p value $(0,005) < \alpha (0,05)$. **Kesimpulan:** *Stick* Mackerel pada perlakuan X1 dengan penambahan tepung ampas tahu sebesar 20% menjadi alternatif *snack* dalam pencegahan obesitas.

Kata kunci: Protein, Serat, Daya terima *stick* Mackerel

INTRODUCTION

The incidence of obesity based on the results of Riskesdas (2018) at age > 18 years is 21.8% and age > 15 years is 31%. Obesity is caused by high calorie consumption that is not matched by the consumption of fiber sources for a long time. Fiber is useful for controlling weight and preventing obesity. Management of obesity by dr.Kunkun K. Wiramihardja said the handling and prevention of obesity must reduce the consumption of fat and carbohydrates but is not recommended to reduce the consumption of protein and fiber.

The consumption of fiber in Indonesian society is still low, as evidenced by the results of Riskesdas (2018), namely 93.5% of Indonesians do not consume 5 servings of fiber and fruit a day. This happens because people's eating patterns are unhealthy with high consumption of snacks by 38.606% in 2017 (Ministry of Agriculture, 2018). Snacks in general have low to non-existent protein and fiber content. Therefore, the importance of new innovations to make snacks that are high in protein and fiber content to help the needs of protein and fiber in the body with raw materials of Mackerel, mocaf flour, and tofu dregs flour in the form of Mackerel sticks.

Stick is a snack that many people like. Sticks are usually consumed as a snack in spare time. Mackerel sticks with Mackerel ingredients will increase the protein content of the sticks. Mackerel is a pelagic fish that contains 60.1% protein and 6.5% fat but is still low in fiber, therefore it is necessary to add tofu pulp flour to increase the fiber content of the sticks.

Tofu dregs flour is made from tofu dregs left over from making tofu. Tofu dregs flour contains 19.44% fiber and 23.39% protein in every 100 grams. The fiber content of Mackerel sticks will be higher with the addition of tofu dregs flour, but the texture will be more brittle. Therefore, it is necessary to add another ingredient, namely mocaf flour to improve the texture of the mackerel stick. Mocaf flour is a modified flour from cassava which has better quality than cassava flour. Mocaf flour has a high fiber content, which is 6.0 grams higher than wheat flour. The addition of mocaf flour is not only to improve

the texture of the stick but also as a step to diversify local food.

Based on the explanation above, researchers will conduct research related to Mackerel sticks with the addition of tofu dregs flour to increase protein and fiber content as a snack to prevent obesity.

METHOD

This study uses experimental research methods. The research design used was Completely Randomized Design (CRD) with the treatment levels arranged randomly. Research on protein and fiber content was carried out at the Food Analysis Laboratory of the Jember State Polytechnic, for acceptance testing was carried out at the Nutrition Laboratory of the Faculty of Public Health. This research was conducted from January to March 2020.

The research population used two different types of population, namely the population of tofu dregs flour, mocaf flour, and mackerel as ingredients that are added to the manufacture of mackerel sticks and humans as research subjects. The panelists who participated in this study were 25 students of Public Health at the University of Jember. The sample used was the size of the addition of tofu dregs flour with 4 treatment levels of 0%, 20%, 35%, and 50% and there were 3 replications in the test.

Protein content data was obtained by testing the semi micro kjeldahl method and fiber was obtained by the gravimetric method while the acceptability test data was obtained from the hedonic test using the hedonic scale test form. The data analysis used was based on SPSS to determine the effect of adding tofu dregs flour on protein, fiber, and mackerel stick acceptability with presentation in the form of text, graphics, and tables.

RESULT

Protein Level

The results of the analysis of the protein content of Mackerel sticks with the addition of tofu dregs flour in various proportions can be seen in the following graphs and tables.

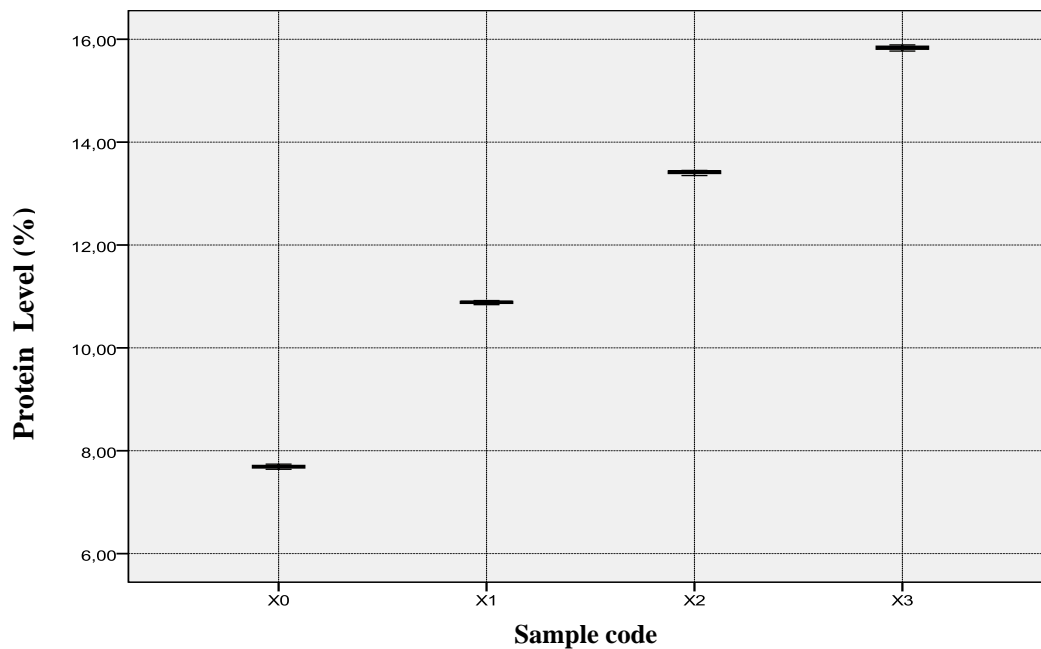


Image 1. Mackerel Stick Protein Content Chart

The graph of protein content shows that the mean value of each treatment group is not the same. The highest median value is in the X3 treatment and the lowest is in the X0 treatment. The data in the X0 and X1 treatments are symmetrical, while the . treatment

X1 and X2 data are not symmetrical with data distribution skewed to the left (negative skewness). The graph above also illustrates the increase in protein levels from the X0 to X3 treatment groups.

Table 1. Mackerel Stick Protein Test Results

Treatment	n	Mean	Std. Deviation	Minimum	Maximum
X0	3	7,6900	,05000	7,64	7,74
X1	3	10,8833	,04041	10,84	10,92
X2	3	13,4100	,05292	13,35	13,45
X3	3	15,8333	,06028	15,77	15,89
Total	12	11,9542	3,15527	7,64	15,89

The table of protein test results shows the average protein content of Mackerel sticks with the addition of tofu dregs flour of 0%, 20%, 35%, and 50%, respectively, 7.69%, 10.88%, 13.41%, and 15.83%. The highest protein content was in the X3 treatment and the lowest was in the X0 treatment.

One Way Anova test on protein test obtained p value (0.000) < (0.05), meaning that there is a difference in the average protein content of Mackerel sticks with the addition of tofu dregs flour in X0, X1, X2, and X3 treatments

Table 2. Tukey's Test Results on Protein Levels of Mackerel Sticks

Treatment	X0	X1	X2	X3
X0		0,000*	0,000*	0,000*
X1			0,000*	0,000*
X2				0,000*
X3				

Description (*)there is a significant difference because the p value 0.05.

The results of the Tukey test showed the p value of the treatment X0, X1, X2, and X3 <

(0.05), meaning that there was a significant difference in the average protein content of

each treatment group with the addition of tofu dregs flour.

Fiber Level

The results of the analysis of the fiber content of Mackerel sticks with the addition of tofu dregs flour in various proportions can be seen in the following graphs and tables.

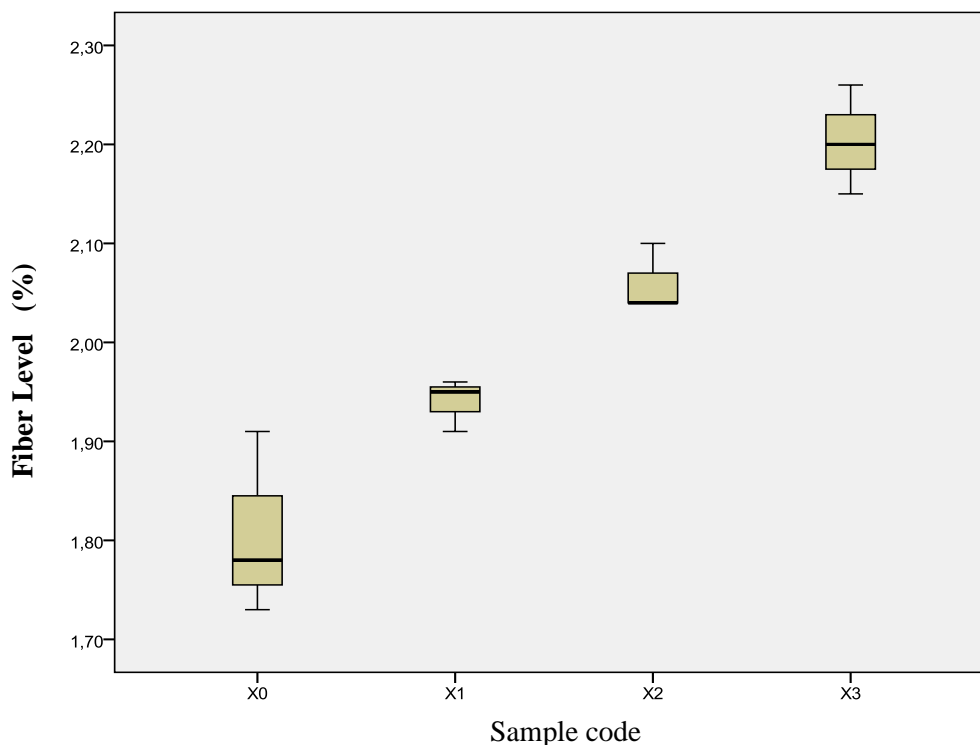


Image 2. Graph of Fiber Content of Mackerel Stick

The graph of protein content shows that the mean value of each treatment group is not the same. The highest median value is in the X3 treatment and the lowest is in the X0 treatment. The data in the X0, X2 and X3 treatments are not symmetrical because the data

skewed to the right, and in the X1 treatment the data is not symmetrical because the data is skewed to the left. The graph above also illustrates the increase in fiber content from the treatment groups X0 to X3.

Table 3. Hasil Uji serat *Stick* Ikan Layang Mackerel Fish Stick’s Fiber Test Result

Treatment	n	Mean	Std. Deviation	Minimum	Maximum
X0	3	1.8067	.09292	1.73	1.91
X1	3	1.9400	.02646	1.91	1.96
X2	3	2.0600	.03464	2.04	2.10
X3	3	2.2033	.05508	2.15	2.26
Total	12	8.0100	.70482	7.83	8.23

The table of fiber test results showed the average value of the fiber content of Mackerel fish sticks with the addition of tofu dregs flour at 0%, 20%, 35%, and 50%, respectively, namely 1.80%, 1.94%, 2.06% , and 2.20%. The highest fiber content was found in the X3 treatment and the lowest in the X0 treatment.

The results of the Kruskal Wallis test on the fiber content test obtained p value (0.017) < (0.05), meaning that there was a difference in the average fiber content of Mackerel fish sticks with the addition of tofu dregs flour in X0, X1, X2, and X3 treatments.

Table 4. Results of the Mann Whitney U Test on the Fiber Levels of Mackerel Fish Sticks

Perlakuan	X0	X1	X2	X3
X0		0.077	0.046*	0.050*
X1			0.046*	0.050*
X2				0.046*
X3				

Information (*) there is a significant difference since the p value ≤ 0.05 .

The results of the Mann Whitney U Test showed a significant distinction in the five treatment groups since the p value $< (0.05)$, namely in the treatment group X0 was smaller than X2 and X3, X1 was smaller than X2 and X3, and X2 was smaller. from X3.

Color Acceptance

The results of the Hedonic Scale Test on the color acceptability of scad fish sticks with the addition of tofu dregs flour can be described in the following figure.

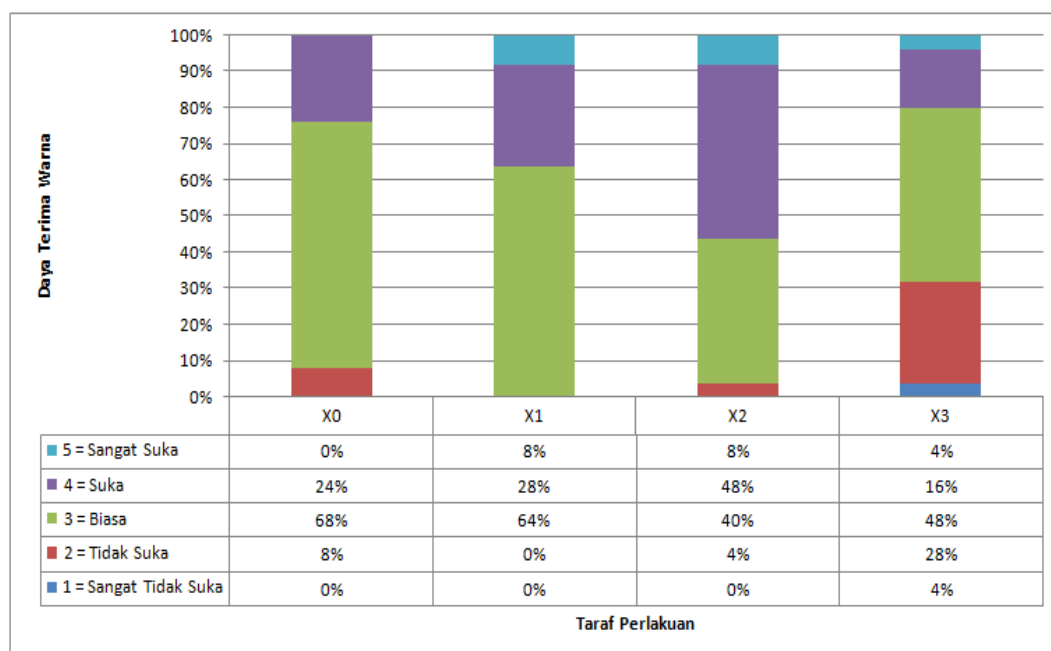


Figure 3. Test Results for Mackerel Fish Stick Color Acceptance

The Mackerel fish sticks which had the highest average acceptability in terms of color are the X2 treatment group with the addition of 35 grams of tofu dregs flour, i.e. 48% of the panelists chose to like it and 8% of the panelists chose to really like it while the one with the lowest scale of preference value was in the X3 treatment. with the addition of

50 grams of tofu dregs flour, 28% of the panelists chose not to like it and 4% of the panelists chose to strongly dislike it. Based on the analysis of the Friedman Test with p value $0.002 < (0.05)$, it means that there is a significant difference in acceptance with the addition of tofu dregs flour in each treatment X0, X1, X2, and X3.

Table 5. Wilcoxon Signed Rank Test Results Against Acceptance of Mackerel Fish Stick Colors

Treatment	X0	X1	X2	X3
X0		0.083	0.012*	0.251
X1			0.397	0.022*
X2				0.005*
X3				

Information (*) there is a significant difference since the p value ≤ 0.05 .

Based on the table, it can be seen that there were color differences, where the X2 treatment was preferred in terms of color compared to X0 and X3.

Scent Receptivity

The results of the Hedonic Scale Test on the acceptability of scent on the sticks of Mackerel fish with the addition of tofu dregs flour can be illustrated by the following picture.

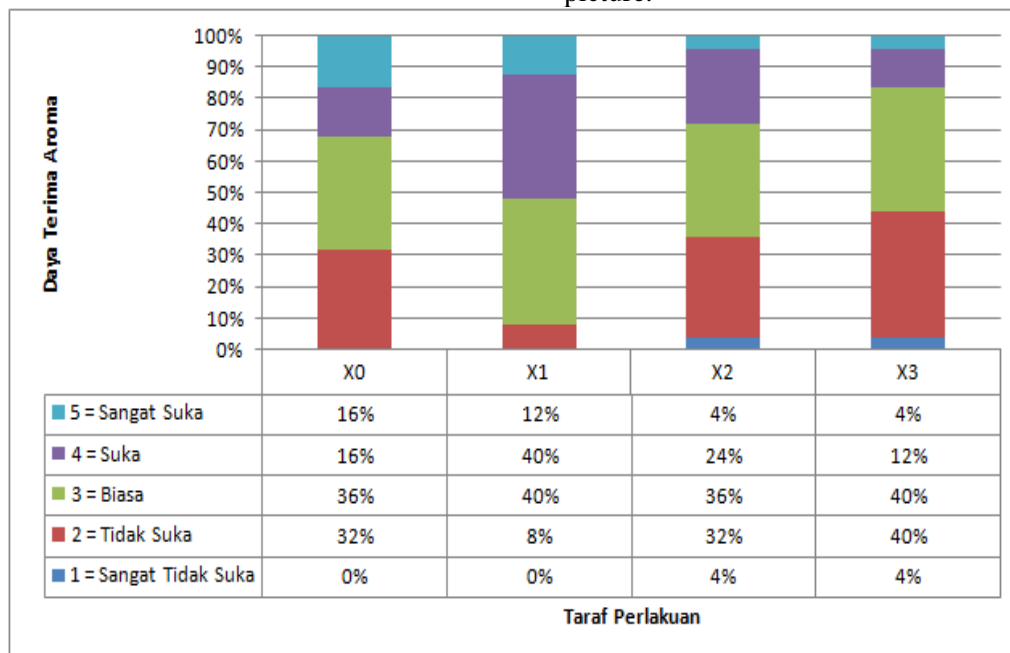


Figure 4. The Result of Acceptance Test of Mackerel Fish Stick Scent

The Mackerel fish sticks which have the highest average acceptance in terms of aroma are the X1 treatment group with the addition of tofu dregs flour of 20 grams, that is, 40% of the panelists chose to like it and 12% of the panelists chose to really like it. with the addition of 50 grams of tofu dregs

flour, 40% of the panelists chose not to like it and 4% of the panelists chose to strongly dislike it. Based on the analysis of the Friedman Test with a p value of $0.010 < (0.05)$, it means that there is a significant difference in aroma acceptance with the addition of tofu dregs flour in each treatment X0, X1, X2, and X3.

Table 6. Results of the Wilcoxon Signed Rank Test on Acceptance of the Color of Mackerel Fish Stick

Perlakuan	X0	X1	X2	X3
X0		0,211	0,432	0,179
X1			0,005*	0,004*
X2				0,505
X3				

Information (*) there is a significant difference since the p value ≤ 0.05 .

Taste Acceptance

Based on the table, it can be seen that there are differences in scent, where the X1 treatment was preferred in terms of scent compared to X2 and X3.

The results of the Hedonic Scale Test on the acceptability of flavors on the sticks of Mackerel fish with the addition of tofu dregs flour can be described in the following figure.

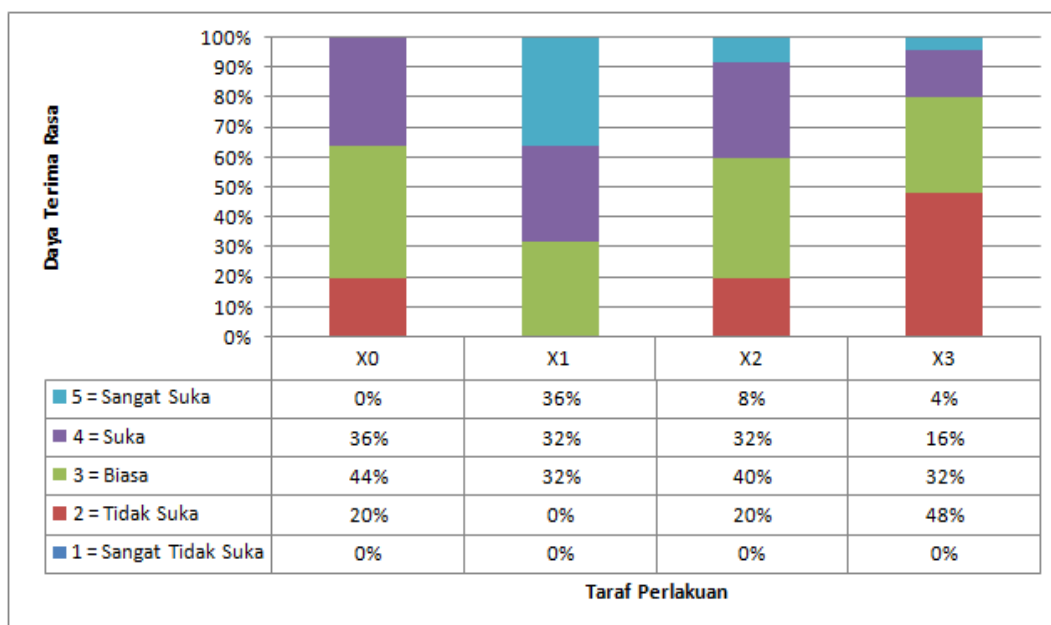


Figure 5. The Result of Acceptance Test of Mackerel Fish Stick

The Mackerel fish stick, which had the highest average acceptance in terms of taste was the X1 treatment group with the addition of tofu dregs flour of 20 grams, namely 32% of the panelists chose to like it and 36% of the panelists chose to like it very much while the one with the lowest scale of preference value

was in the X3 treatment. with the addition of 50 grams of tofu dregs flour, 48% of the panelists chose not to like it. Based on the analysis of the Friedman Test with p value $0.000 < (0.05)$, it means that there was a significant difference in taste acceptance with the addition of tofu dregs flour in each treatment X0, X1, X2, and X3.

Table 7. Results of the Wilcoxon Signed Rank Test on Acceptability of the Taste of Mackerel Fish Stick

Perlakuan	X0	X1	X2	X3
X0		0,003*	0,575	0,167
X1			0,016*	0,000*
X2				0,101
X3				

Information (*) there is a significant difference since the p value ≤ 0.05 .

Based on the table, it can be seen that there were differences in taste, where the X1 treatment was preferred in terms of scent compared to X0, X2, and X3.

Texture Acceptance

The results of the Hedonic Scale Test on the acceptability of the texture on the sticks of Mackerel fish with the addition of tofu dregs flour can be described in the following figure.

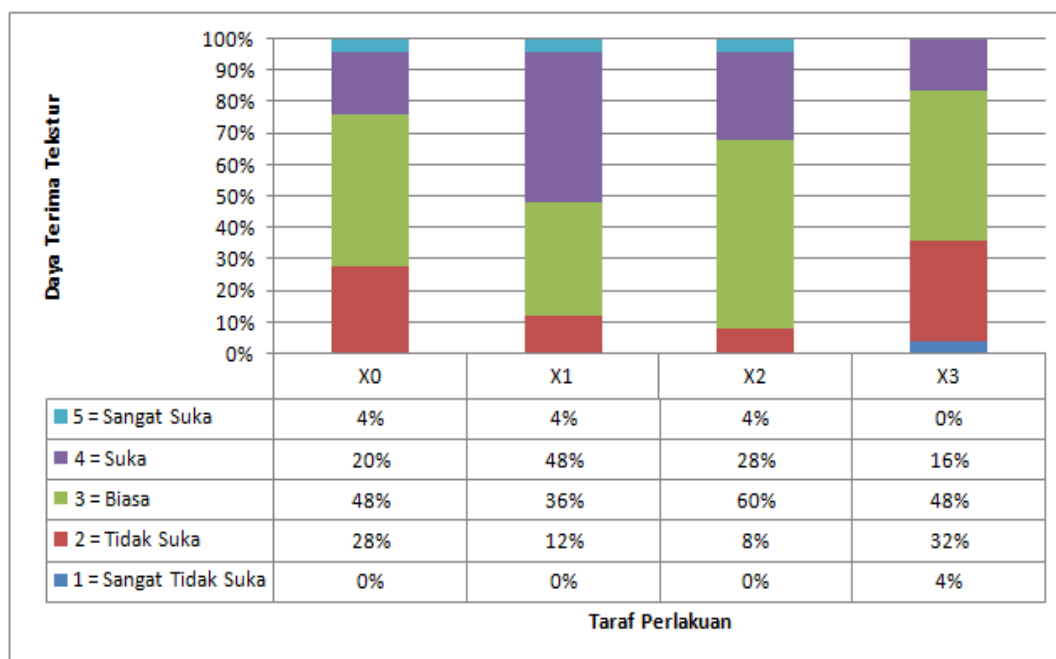


Figure 6. Acceptance Test Results of Mackerel Fish Stick Texture

The Mackerel fish stick which had the highest average acceptance in terms of texture is the X1 treatment group with the addition of tofu dregs flour of 20 grams, namely 48% of the panelists chose to like it and 4% of the panelists chose to really like it while the one with the lowest scale of preference value was in the X3 treatment. with the addition of 50

grams of tofu dregs flour, 32% of the panelists chose not to like it and 4% of the panelists chose to strongly dislike it. Based on the analysis of the Friedman Test with p value $0.002 < (0.05)$, it means that there was a significant difference in texture acceptance with the addition of tofu dregs flour in each treatment X0, X1, X2, and X3.

Table 8. Results of the Wilcoxon Signed Rank Test on Acceptability of the Mackerel Fish Stick Texture

Treatment	X0	X1	X2	X3
X0		0.024*	0.108	0.268
X1			0.415	0.006*
X2				0.021*
X3				

Information (*) there is a significant difference since the p value ≤ 0.05 .

Based on the table, it can be seen that there were differences in texture where the X2 treatment was preferred in terms of color compared to X0 and X3.

DISCUSSION

Protein Level

The protein content of the mackerel sticks increased along with the increase in the proportion of tofu dregs flour and a decrease in the proportion of mocaf flour added to each treatment. This happens because according to Kaahoao, et al (2017: 5), the water content in tofu dregs flour is low at around 8.33%, thus it

contains high protein. The high protein content in the mackerel sticks is also influenced by the high protein content in the tofu dregs flour, which is about 23.39 grams in every 100 grams of tofu dregs flour. The results of this study are in accordance with research conducted by Rahmadian (2018: 7) regarding food bars made from mocaf flour and mung bean flour. The highest protein content is in the treatment with the lowest addition of mocaf flour.

Another study, namely fatty biscuits by Fasikah and Kristiastuti (2013:26) stated that the highest protein content in the treatment after the addition of tofu dregs flour was 9.88% protein and before the addition of tofu

dregs flour with a protein content of 6.11%. The protein content of mackerel sticks with variations in the addition of tofu dregs flour is relatively high.

Fiber Content

The fiber content of the mackerel sticks increases with the increase in the proportion of tofu dregs flour and decreases in the proportion of mocaf flour added. These results are in accordance with research conducted by Fasikah and Kristiastuti (2013:26) which stated that the highest fiber yield in fatty biscuits was the addition of 45% tofu dregs flour with a fiber content of 5.28% and the lowest was in the addition of 15% tofu dregs flour with fiber content of 2.18%, research by Sabir (2020:46) related to crackers obtained similar results with the addition of tofu dregs flour of 25%, 50%, and 75%, respectively, obtaining fiber content of 3.65%, 4, 39%, and 5.28%. Research with similar results was also obtained in the sponge cake study by Aprilia, et al (2019:176) regarding the addition of the proportion of mocaf flour which obtained results that each addition of mocaf flour would reduce the fiber content in sponge cake. This is in line with research on mackerel sticks. which obtained the lowest fiber content in the addition of the highest mocaf flour. The fiber content in mackerel sticks is relatively high after looking at comparisons from other studies that also use the addition of tofu dregs flour.

Color Acceptance

Research conducted by Fransiska and Deglas (2013:21) on fatty biscuits obtained the highest acceptability related to color, namely the addition of 45% tofu dregs flour at 3.35 with a slightly brownish yellow color. Another study related to crackers by Sabir (2020:48) obtained the highest acceptability value at the addition of 25% tofu dregs flour with a golden yellow color and the lowest acceptability at the addition of 75% tofu dregs flour with brown color. Research with similar results by Suryani, et al (2018:13-14) examined the highest acceptability of P0 (0%) of 3.28 was a yellow color and the lowest in treatment P3 (45%) of 2.56 was a dark brown color .

One of the differences in the color of the mackerel sticks is influenced by the added ingredients. The effect in this study is the proportion of adding tofu dregs flour and reducing the addition of mocaf flour. The addition of tofu dregs flour and the reduction

of mocaf flour caused the color to get darker because the original color of the tofu dregs flour was slightly darker, but on the reduction of the addition of tofu dregs flour and the addition of mocaf flour the resulting color was not too dark. This happens because the added mocaf flour is pure white. Research that supports this is the research on biscuits by Arsyad (2016: 58) with the addition of mocaf flour will increase the acceptability value related to the color of the biscuits because the color of the mocaf flour added in the study is white thus it has an impact on the color of the biscuits. This is in accordance with research related to the mackerel sticks with the highest acceptability in the addition of 35% tofu waste flour and 25% mocaf flour which is still balanced and produces a brownish yellow flyfish stick color. The difference in the color of the mackerel sticks is another cause of the frying process, thus the frying time greatly affects the color of the kite sticks. The brown color is produced due to the reaction of reducing sugars with primary amine groups or commonly called the Maillard reaction (Sulaiman and Syahrumsyah, 2014: 62).

Therefore, it is necessary to equalize the frying time to get results that are in accordance with other studies.

Aroma Receptivity

Research related to carckers conducted by Sabir (2020: 51) by increasing the proportion of adding tofu dregs flour further reduces the acceptability value related to the aroma of crackers. The addition of proportions starting from 25%, 50%, and 75% resulted in the acceptance of aromas of 3.21, 2.95, and 2.64. Another research is related to sweet bread conducted by Ayunir, et al (2017: 548) with the highest aroma acceptance at A0 that is without the addition of tofu dregs flour of 3.85 and the lowest is the addition of 15% tofu dregs flour of 2.62 due to too real scent of tofu dregs. This is in accordance with research related to mackerel sticks with the addition of 20% tofu dregs flour to get the highest acceptance with a distinctive unpleasant aroma of tofu dregs that is not too visible to be obscured by the aroma of mackerel meal and the lowest is at the addition of 50% tofu dregs flour with a distinctive aroma of tofu dregs, namely stronger than the previous treatment.

This happens because according to Sulaiman and Syahrumsyah (2014:62) the

original aroma of tofu dregs flour is unpleasant, so the more addition of tofu dregs flour and the reduced addition of mocaf flour will increase the unpleasant aroma on the mackerel sticks and the acceptability will decrease. In the X0 treatment without the addition of tofu pulp flour, the acceptability was not the highest because the aroma of scad in the treatment was very strong.

Taste Acceptance

Research related to egg roll by Triatmaja (2016:8) with the addition of the proportion of tofu dregs flour, the taste of egg roll will be more bitter. In the cookie study by Kaahoao, et al (2017:7) along with the addition of tofu dregs flour, the acceptance of the taste of the cookies decreases, this happens because the addition of 75% tofu dregs flour causes a bitter taste thus it gets an acceptance of 2.13. The bitter taste comes from tofu dregs flour which is produced from soybean husk which contains saponin A. This study is in accordance with research on mackerel sticks, namely the addition of the most tofu dregs flour by 50% produces a slightly bitter taste hence it gets the lowest acceptability value and with the addition of 20% tofu dregs flour, the taste of mackerel is not too strong and the bitter taste of tofu dregs flour is still faint. It gets the highest acceptability. However, the addition of tofu dregs flour at 0% did not get the highest acceptability because the taste of mackerel was very strong so it was less desirable but still got a good acceptability value.

Texture Acceptance

Research conducted by Sabir (2020:48) related to crackers resulted in the highest acceptability, namely the addition of 25% tofu dregs flour at 3.23 with a less crunchy texture and the addition of 75% tofu dregs flour with the lowest acceptability and not crunchy or hard texture. In a study related to biscuits by Suryani, et al (2018:14), it produced the lowest acceptability at an additional 45% of 2.60 with hard biscuits. This research is in accordance with the results of the mackerel stick research, namely the addition of 50% tofu dregs flour produces mackerel sticks that are not crispy and slightly hard and the addition of 20% tofu dregs flour produces the highest acceptability with a crunchy texture and a little volume.

This happens because according to Triatmaja (2016: 8) high crude fiber will increase the absorption of liquid so that it hinders the genitalization process of starch which causes the final product not to expand. In the mackerel sticks with the addition of 0% tofu pulp flour, it produces mackerel sticks that are volume but hard thus the acceptability value is not the highest.

CONCLUSION

The protein content and fiber content in the mackerel sticks increased along with the addition of tofu dregs flour with the highest average protein and fiber values in the X3 treatment. The addition of tofu dregs flour in proportions of 0%, 20%, 35%, and 50% had an effect on the acceptability of the mackerel sticks. Acceptability related to color, aroma, taste, and texture has a significant difference.

Based on the results of the hedonic scale test, the most preferred mackerel stick is the mackerel stick with the addition of 20 grams (X1). The X1 treatment with the addition of 20 grams of tofu dregs flour is an alternative snack for obesity prevention.

SUGGESTION

For other researchers, it is recommended to conduct further research to test carbohydrate and fat levels to support mackerel sticks as an alternative snack in preventing obesity.

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