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THE EFFECT OF NILE TILAPIA FISH FLOUR ADDITION ON THE PREFERENCE LEVEL AND NUTRITIONAL CONTENT OF CHURROS

Pengaruh Penambahan Tepung Ikan Nila Terhadap Tingkat Kesukaan *Churros*

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ABSTRACT

Fish is a high-quality source of animal protein that is easily digested and contains complete essential amino acids. The relatively low fish consumption in Indonesia encourages the need for diversification of fish-based products to increase public interest in nutritious food. Tilapia (*Oreochromis niloticus*) flour contains high protein and can be easily applied to various food products, making it a potential fortification ingredient for snack foods such as churros. This study aimed to analyze the effect of adding tilapia flour on the acceptability and nutritional content of churros. The research used an experimental method with four concentration treatments of tilapia flour (0%, 5%, 10%, and 15% of wheat flour weight) and involved 25 semi-trained panelists in a hedonic test assessing appearance, aroma, texture, and taste. Proximate analysis was conducted on the control and the most preferred treatment. The hedonic data were analyzed using the Friedman and Bayes tests, while the proximate results were analyzed descriptively. The results showed that churros with 10% tilapia flour were the most preferred, with taste being the most influential attribute. The churros contained 17.38% moisture, 11.88% protein, 42.63% fat, 1.47% ash, and 43.60% carbohydrates. This study concludes that the addition of tilapia flour can enhance the nutritional content of churros without reducing consumer acceptance, making it a promising alternative for flour-based food innovation.

Keywords: Churros, Nile Tilapia Fish Flour, Organoleptic, Preference level, Proximate

ABSTRAK

Ikan merupakan sumber protein hewani berkualitas tinggi yang mudah dicerna dan mengandung asam amino esensial lengkap. Konsumsi ikan di Indonesia yang masih rendah mendorong perlunya diversifikasi produk olahan untuk meningkatkan minat masyarakat terhadap pangan berbasis ikan. Tepung ikan nila (*Oreochromis niloticus*) memiliki kandungan protein tinggi dan mudah diaplikasikan pada berbagai produk pangan, sehingga berpotensi digunakan sebagai bahan fortifikasi pada makanan ringan seperti *churros*. Penelitian ini bertujuan untuk menganalisis pengaruh penambahan tepung ikan nila terhadap tingkat kesukaan dan kandungan gizi *churros*. Penelitian menggunakan metode eksperimen dengan empat perlakuan konsentrasi tepung ikan nila (0%, 5%, 10%, dan 15% dari berat tepung terigu) dan melibatkan 25 panelis semi-terlatih melalui uji hedonik yang meliputi kenampakan, aroma, tekstur, dan rasa. Analisis proksimat dilakukan pada perlakuan kontrol dan perlakuan yang paling disukai. Data uji hedonik dianalisis menggunakan uji Friedman dan Bayes, sedangkan hasil proksimat dianalisis secara deskriptif. Hasil penelitian menunjukkan bahwa penambahan tepung ikan nila 10% menghasilkan *churros* paling disukai dengan atribut rasa menjadi faktor paling berpengaruh. *Churros* tersebut mengandung 17,38% air, 11,88% protein, 42,63% lemak, 1,47% abu, dan 43,60% karbohidrat. Penelitian ini menyimpulkan bahwa penambahan tepung ikan nila berpotensi meningkatkan kandungan gizi *churros* tanpa mengurangi penerimaan konsumen, sehingga dapat menjadi alternatif inovasi pangan berbasis tepung.

Kata Kunci: Churros, Organoleptik, Proksimat, Tepung Ikan Nila, Tingkat Kesukaan

INTRODUCTION

Churros are a popular snack characterized by a crispy exterior and a soft interior; however, their protein content is relatively low, rendering them suboptimal for fulfilling the population's nutritional requirements (Husen, 2023). Enhancement of churros' protein content can be achieved through the fortification of high-protein raw materials such as Tilapia Fish flour. Tilapia Fish is a commodity that is easily cultivated, affordable, and nutritionally rich, thus it has the potential to be processed into flour with better shelf life compared to fresh fish (Asyarai *et al*., 2016).

Previous studies indicate that fish-based fortification can improve the nutritional quality of food products without reducing consumer acceptance when applied at optimal concentrations. Putri (2020) demonstrated that fortification of Tilapia Fish flour in crackers increased protein content, while Safitri *et al*., (2023) reported similar outcomes in fish flakes products. However, excessive addition tends to reduce consumer liking due to the emergence of fishy odor and a denser texture (Winarno, 2004).

This study was designed to address two research questions: (1) what is the optimal concentration of *O. niloticus* flour that produces the most preferred churros, and (2) how does fortification affect the proximate composition of churros.

This research contributes to the diversification of Tilapia Fish utilization while academically reinforcing evidence that fish fortification can serve as an innovative approach in developing nutrient-rich flour-based food products.

METHODS

Place and Time

This research was conducted from May to June 2025. The production of churros, fish meal, and hedonic tests were conducted at the Fisheries Product Processing Laboratory, Faculty of Fisheries and Marine Sciences, Padjadjaran University. Proximate analysis was conducted at the Ruminant Animal Nutrition and Animal Feed Chemistry Laboratory, Faculty of Animal Husbandry, Padjadjaran University.

Tools and Materials

This study used fresh tilapia (*Oreochromis niloticus*) as the main ingredient which was processed into tilapia fish meal, as well as additional ingredients for making churros such as wheat flour, margarine, eggs, granulated sugar, salt, vanilla, and cooking oil. The tools used included analytical scales for weighing ingredients, drying ovens, blenders or grinders for grinding fish, 80 mesh sieves, mixers for mixing dough, stoves and frying pans for frying, syringes or piping bags for printing churros, and a set of laboratory glassware used in proximate analysis including determination of water, ash, fat, protein, and carbohydrate content.

Research Design

This research uses an experimental method, namely the addition of tilapia fish flour in making churros based on the weight of wheat flour consisting of four treatments, namely:
Treatment A : Addition of 0% tilapia fish meal (control)
Treatment B : Addition of 5% tilapia fish meal
Treatment C : Addition of 10% tilapia fish meal
Treatment D : Addition of 15% tilapia fish meal

The determination of the addition dose of Tilapia Fish flour in this study was based on previous research indicating that the inclusion of fish flour within the range of 5–15% of total flour remains sensorily acceptable and can enhance the protein content of food products. Arvianto *et al*., (2016) reported that the addition of *Pangasius* flour up to 15% in bread products could increase protein content without reducing panelist acceptance. Similar results were observed by Ernisti *et al*., (2019), who stated that fortification with 10% *Clarias gariepinus* flour produced products with the most favorable sensory characteristics. Based on these findings, a range of 0–15% was applied in this study to determine the optimal limit of *O. niloticus* flour addition in relation to both consumer preference and the nutritional content of churros.

These four treatments were tested on 25 semi-trained panelists, consisting of fisheries students from the Faculty of Fisheries and Marine Science, Universitas Padjadjaran, to assess panelist preference for churros. The treatment most preferred by the panelists was subsequently analyzed for proximate composition to determine its nutritional content.

Procedure

Making Tilapia Fish Flour

According to Sari *et al*., (2014), the process of making tilapia fish meal begins with gutting fresh tilapia and washing it under running water. Next, the fish is steamed in a pan at 100°C for 15 minutes, then drained and cooled. After that, researchers separate the fish meat from the skin, head, and bones using tweezers and their hands. The meat that has been obtained is dried in an oven at 60°C for 4 hours, then ground using a blender until it becomes a powder. The resulting flour is then sieved with an 80-mesh sieve to obtain a fine texture. The sieved tilapia fish meal is ready to be used as an additional ingredient in making churros.

Making Churros

The modified churros-making process based on Lestari et al. (2025) begins with boiling water with margarine, sugar, and salt at 100°C for 1–2 minutes until a homogeneous mixture boils. Next, wheat flour is added to the boiling mixture, then stirred using a spatula until evenly mixed and transferred to a bowl. The dough is then left to cool and reaches room temperature of around 26°C. In the next stage, eggs and tilapia fish flour are added to the cooled dough, then the entire dough is beaten using a mixer until evenly mixed. The homogeneous dough is put into a piping bag fitted with a nozzle, then molded into the shape of churros. The molded dough is fried at 100°C for 1–2 minutes until golden brown. The cooked churros are then ready to be served.

Table 1. Churros Formulation with the Addition of Tilapia Fish Flour

Material	Treatment			
	A (0%)	**B (5%)**	**C (10%)**	**D (15%)**
Wheat flour (g)	250	250	250	250
Tilapia fish flour (g)	0	5	10	15
Water (ml)	450	450	450	450
Margarine (g)	56	56	56	56
Salt (g)	3	3	3	3
Granulated sugar (g)	40	40	40	40
Vanilla (g)	4	4	4	4
Eggs	2 item	2 item	2 item	2 item

Data Collection and Analysis Techniques

The hedonic test data were analyzed using non-parametric analysis, namely Friedman's two-way analysis of variance, to determine the effect of tilapia fish meal addition on churros' preference level. The statistical equation is as follows:

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

Information:
x^2 = Friedman test statistics
b = Repeat
k = Treatment
Rj^2 = Total ranking for each treatment

If there are the same numbers, the Correction Factor (FK) calculation is carried out using the following formula:

$$FK = 1 - \frac{\sum T}{bk\,(k^2-1)} \quad x^2c = \frac{x^2}{FK}$$

The significance value of the observation results x^2c is determined by referring to the Chi-Square distribution table, using degrees of freedom (db) of = k-1 and a significance level of α = 0.05.

The rules for decision making in hypothesis testing are as follows:
H_0 = The addition of tilapia fish flour to churros did not have a significant effect on the level of panelists' preference.
H_1 = The addition of tilapia fish flour to churros had a significant effect on the panelists' level of preference.

The test criteria are set that if:

- value x_c^2 count less than x_c^2 table, then H_0 accepted and H_1 rejected.
- if value x_c^2 count greater than x_c^2 table, then H_1 accepted and H_0 rejected.

If H_1 is accepted, this indicates a significant difference between treatments, so the analysis is continued with a multiple comparison test to determine the location of the differences between treatments. To determine the differences between treatments, use the multiple comparison test formula as follows:

$$\left|R_i - R_j\right| \geq Z\left\{\left[\frac{\alpha}{k}(k-1)\right]\right\}\sqrt{bk\,(k+1)/\,6}$$

Information:
$\left|R_i - R_j\right|$ = average ranking difference
Ri = average rank of the i-th sample
Rj = average rank of the jth sample
α = wise error experiment
b = amount of data / repetition
k = many treatments
Z = values in the Z table for multiple comparison

Proximate test data analysis for the control and most preferred churros was conducted descriptively and comparatively with SNI 2973;2022. The research results are presented in the form of a scientific narrative from which conclusions can be drawn.

RESULTS

Likeability Level

Appearance

Appearance is a parameter that can be seen visually, attracting the attention of panelists before liking other quality properties. Appearance is the first and quite important organoleptic parameter, because if the panelists give a good and favorable impression of the appearance, the panelists will look at other organoleptic parameters, namely aroma, texture, and taste (Husen, 2023). The average appearance value of churros with the addition of tilapia fish flour can be seen in Table 2.

Table 2. Average Appearance of Churros with the Addition of Tilapia Fish Flour

Tilapia Fish Meal Churros Treatment (%)	Median	Average Appearance
A (0%)	7	7,2$_a$
B (5%)	7	7,7$_a$
C (10%)	9	8,0$_a$
D (15%)	7	7,1$_a$

Note: The average treatment figures followed by the same letter indicate no significant difference according to the multiple comparison test at the 5% level

Figure 1. Churros with the addition of Tilapia Fish Meal

Aroma

Aroma is one of the factors that will determine consumers' choice of a product because aroma can attract consumers' attention to the food product (Delwiche 2004). The average aroma value for churros with added tilapia fish flour can be seen in Table 3.

Table 3. Average Aroma of Churros with the Addition of Tilapia Fish Flour

Tilapia Fish Meal Churros Treatment (%)	Median	Average Appearance
A (0%)	7	$7{,}0_a$
B (5%)	7	$6{,}5_a$
C (10%)	7	$6{,}3_a$
D (15%)	5	$6{,}2_a$

Note: The average treatment figures followed by the same letter indicate no significant difference according to the multiple comparison test at the 5% level.

Texture

Texture is one of the hedonic test parameters assessed in a food product. Texture assessment is conducted by feeling the product with the sense of touch. Texture assessment is conducted to determine panelists' acceptance of the churros' texture. The results of the assessment of the level of preference for the churros' texture from four different treatments are shown in Table 4.

Table 4. Average Texture of Churros with the Addition of Tilapia Fish Flour

Tilapia Fish Meal Churros Treatment (%)	Median	Average Appearance
A (0%)	7	$6{,}8_a$
B (5%)	7	$7{,}0_a$
C (10%)	7	$7{,}4_a$
D (15%)	5	$6{,}6_a$

Note: The average treatment figures followed by the same letter indicate no significant difference according to the multiple comparison test at the 5% level.

Flavor

Taste is a determining factor in consumer acceptance of food products (Husen, 2023). Even if other parameters are better, consumers will still reject a product if it tastes bad (Winarno, 2004). The average taste scores for mantou with mackerel surimi are shown in Table 5.

Table 5. Average Flavor of Churros with the Addition of Tilapia Fish Flour

Tilapia Fish Meal Churros Treatment (%)	Median	Average Appearance
A (0%)	7	$6{,}8_a$
B (5%)	7	$7{,}0_a$
C (10%)	7	$7{,}4_a$
D (15%)	5	$6{,}6_a$

Note: The average treatment figures followed by the same letter indicate no significant difference according to the multiple comparison test at the 5% level.

Proximate Analysis of Churros

Proximate analysis is a method used to identify the basic nutritional composition of food and drink (Suherman *et al*. 2024). Proximate analysis included moisture content, ash content, protein content, fat content, and carbohydrate content. The proximate test was conducted on control churros (untreated) and churros with the addition of tilapia fish meal, which was most preferred by panelists with the highest average value, namely the 10% treatment. The results of the mantou proximate test are presented in Table 6.

Table 6. Chemical Test Results of Churros Treatment A Control (0%) and C (10%)

No.	**Analysis Parameters**	**Chemical Analysis Results (%)**	
		Fish Meal 0%	**Fish Meal 10%**
1	Water content	19,41	17,38
2	Ash Content	1,53	1,47
3	Protein Content	10,45	11,88
4	Fat Content	40,06	42,63
5	Carbohydrate Levels	45,82	43,60

Note: Testing per 100-gram sample

DISCUSSION

Likeability Level

Appearance

The statistical analysis using the Friedman test presented in Table 2 indicates that the addition of Tilapia (*Oreochromis niloticus*) fish flour to churros did not have a significant effect or create a notable difference in the appearance of the resulting churros. The treatments of 0%, 5%, and 15% Tilapia fish flour addition yielded a median score of 7 with mean scores of 7.2, 7.7, and 7.1, respectively. The 10% Tilapia fish flour treatment produced a median score of 9 with a mean score of 8.0. Across all treatments, the churros exhibited a bright appearance, yellowish-brown coloration, and intact shape. The appearance of churros with 0%, 5%, 10%, and 15% Tilapia fish flour can be seen in Figure 1.

The addition of Tilapia fish flour tended to induce a more brownish color in the churros; however, this difference was not significant. This observation aligns with Ernisti *et al.,* (2019), who reported that the color of fish crackers is influenced by the color of added ingredients, such as fish meat flour; the greater the amount of fish meat flour added, the browner the fried product becomes. The browning of churros is attributed to the proteins and sugars present in both Tilapia fish flour and wheat flour, which undergo the Maillard reaction upon heating. According to Martins *et al.,* (2000), the Maillard reaction is a chemical reaction between reducing sugars and the amino groups of proteins or amino acids. This reaction produces brown-colored compounds known as melanoidins. The accumulation of these brown pigments serves as an indicator of Maillard reactions occurring in protein- and carbohydrate-containing foods (Bastos *et al.,* 2012).

The findings of this study demonstrate that fortifying churros with Tilapia fish flour significantly affects consumer preference. A 10% concentration was found to be optimal, as it increased the protein content without producing excessive fishy odor. In contrast, the 15% concentration decreased consumer liking due to the overly dominant aroma and flavor of fish.

Aroma

The panelist evaluation results presented in Table 3 regarding the aroma of churros showed that the highest mean score was obtained for the 0% treatment, which served as the control without the addition of Tilapia (*Oreochromis niloticus*) fish flour. Conversely, the lowest mean score was observed in the 15% treatment. This outcome is attributed to the incorporation of Tilapia fish meat flour. This finding aligns with Arvianto *et al.,* (2016), who reported that increasing the amount of fish flour reduces the consumer preference for the aroma of the resulting product. The decreased liking is due to the residual odor of dried fish present in biscuits made with Dumbo catfish (*Clarias gariepinus*) fish flour. Such fishy odor is suspected to lower panelist ratings, as the Indonesian population is generally unaccustomed to the scent of fish in biscuits. Aroma often indicates the palatability of food, as noted by Winarno (2004). Perceptions of odor can vary due to psychological and physiological factors.

Texture

Based on the mean scores presented in Table 4, the control treatment without Tilapia (*Oreochromis niloticus*) fish flour (0%) and the 5% supplementation treatment exhibited relatively similar values, namely 6.8 and 7.0, respectively. The 10% Tilapia fish flour treatment achieved the highest mean texture score of 7.4, indicating the most optimal churros texture. This finding suggests that the appropriate concentration of Tilapia fish flour can enhance churros texture quality. In contrast, the 15% supplementation treatment resulted in a decreased mean texture score of 6.6. Panelist evaluations indicated that the churros in this treatment became denser, less aerated, and lost some of their characteristic attributes (crispy on the outside and soft on the inside). The decline in texture quality at 15% Tilapia fish flour is likely related to an imbalance in the dough composition due to the high protein content. According to Nishinari *et al.,* (2014), the crispness of a food product strongly depends on the balance of its constituent components, particularly amylose, amylopectin, and protein content. Excessive protein addition can affect product expansion during frying due to its interactions with water and starch in the dough. Incomplete gelatinization inhibits dough expansion, resulting in a denser product. Nawaz *et al.,* (2019) also reported that animal proteins, such as those from fish flour, cannot form the elastic network structure that gluten provides in wheat flour, causing the dough to lose its optimal expansion capability.

Flavor

The analysis presented in Table 5 indicates that the median taste scores across all treatments ranged from 7 to 9. These values fall within the "liked" category, demonstrating that all churros products, with or without Tilapia (*Oreochromis niloticus*) fish flour, were still acceptable to the panelists. However, differences were observed in the mean taste scores, ranging from 6.7 to 7.8. The highest mean taste score of 7.8 was obtained in the treatment with 10% Tilapia fish flour. The 10% supplementation produced the highest mean taste score (7.8) due to the contribution of the natural savory taste from amino acids, particularly glutamate, which enhances umami flavor (Yamaguchi, 2000), as well as the formation of flavor compounds via Maillard reactions between protein and reducing sugars during frying (Zhang *et al.*, 2019). Conversely, supplementation up to 15% decreased preference (6.7) due to the dominance of fish-specific aroma and taste caused by volatile compounds from excess protein (Nawaz *et al.*, 2019). Excessive protein content can also generate a bitter or metallic aftertaste if not balanced with other flavor components (Tunick, 2013). Therefore, the addition level of Tilapia fish flour must be controlled to remain within the optimal range that is organoleptically acceptable.

Chemical Characteristics

Water Content

Moisture content is a critical factor affecting sensory quality, shelf life, and safety of food products, as high moisture levels can accelerate microbial growth and deleterious chemical reactions (Yuniastri *et al.*, 2019). The results of this study indicate that the moisture content of churros without Tilapia (*Oreochromis niloticus*) fish flour was 19.41%, whereas the addition of 10% fish flour reduced it to 17.38%. This decrease of 2.03% demonstrates that the protein in Tilapia fish flour has a stronger water-binding capacity, allowing moisture to be more readily released during frying (Charoenphun *et al.*, 2016). Moreover, the increased viscosity of the batter due to protein results in smaller pores, facilitating rapid water vapor release and reducing final moisture content (Mardiah *et al.*, 2019). These findings align with Putri (2020), who reported that the incorporation of Tilapia fish flour in flour-based products can lower moisture content at moderate concentrations. The rapid frying process at high temperatures (±170–180°C) further accelerates water evaporation and the development of crispiness, as explained by Nawaz *et al.*, (2019), ensuring that churros with 10% fish flour remain crispy on the outside while soft on the inside.

Ash Content

Ash content reflects the total mineral content of a food product, which is influenced by the type of ingredient, natural mineral composition, and processing method (Fikriyah & Nasution 2021). The results showed that the ash content of control churros (0%) was 1.53%, decreasing to 1.47% in the treatment with 10% tilapia fish meal. This value is still relatively high compared to the maximum threshold of SNI 2973-2022 for dry biscuits (1.5%). The decrease in ash content in the fortification treatment is thought to be related to the low mineral content of tilapia fish meal because it only uses boneless meat or organs, which typically contribute higher mineral content (Ofstad, 2006). Wheat flour itself contains moderate amounts of minerals (Muchtadi, 2010), and the combination with fish meal can affect the total mineral composition of the dough. Although minerals are heat-stable and can concentrate when water evaporates, the results of this study indicate no concentration effect, possibly due to the low initial mineral content of the fish meal or some of the minerals dissolving in the oil during frying.

Protein Content

Protein is an essential nutrient that functions as a source of energy, tissue builder, and regulator of metabolic processes (Winarno, 2004). The results of this study indicate that the protein content of churros without Tilapia (*Oreochromis niloticus*) fish flour was 10.45% and increased to 11.88% with the addition of 10% fish flour, both exceeding the minimum protein standard of SNI 2973-2022 (≥ 7%). This increase is associated with the high protein content of Tilapia fish flour, which can reach 71.02% (Manteu *et al.*, 2017), as well as the presence of essential amino acids such as lysine, methionine, and glutamine, which are important for growth and immunity (Pratiwi, 2013). Fish flour is also easily digestible and contains essential minerals and vitamins (Oluwamukomi & Adeyemi, 2015). These findings are consistent with Safitri *et al.*, (2023), who reported that protein content in fish flakes increased with higher concentrations of fish flour. In addition to the ingredient factor, final moisture content also affects protein concentration; the more water evaporates during frying, the higher the dry protein percentage (Pratama *et al.*, 2014). The addition of Tilapia protein contributes to a denser texture, savory umami taste, and characteristic aroma, so its use must be proportionally controlled to avoid compromising the churros' desirable crisp exterior and soft interior (Oluwamukomi & Adeyemi, 2015).

Fat Content

Fat content plays a crucial role in providing energy, flavor, crispness, and texture in fried products such as churros (Suhadi, 2013). Analysis results showed that the fat content of the control churros was 40.06% and increased to 42.63% with the addition of 10% Tilapia (*Oreochromis niloticus*) fish flour, far exceeding the minimum standard of SNI 2973-2022 for cookies (≥ 9.5%). This increase is influenced by the natural fat content of Tilapia fish flour, which can reach 6–8% (Manteu *et al.*, 2017), as well as the frying process, which allows the porous dough to absorb oil. The addition of fish flour also increases protein content, which enlarges the dough pores and accelerates oil absorption (Taufik & Atma, 2021). Thus, the higher the concentration of fish flour, the higher the fat content of the churros. Although a high fat content can enhance flavor and crispness, this condition also has the potential to accelerate rancidity if the product is not properly packaged or consumed promptly.

Carbohydrate Content

Carbohydrates are the primary source of energy and an essential component in flour-based products such as churros, as starch from wheat flour contributes to forming a porous structure that is crispy on the outside and soft on the inside when gelatinized (Mahfuz *et al.*, 2017). The analysis showed that the carbohydrate content of the control churros was 45.82% and decreased to 43.60% with the addition of 10% Tilapia (*Oreochromis niloticus*) fish flour, which is below the SNI 2973-2022 standard for biscuits (≥ 70%), although churros are not classified within this category. This decrease resulted in a denser texture, a less sweet and savory taste, and a less brownish color due to reduced Maillard reactions. The carbohydrate content was calculated by the by-difference method, so that increases in protein and fat content automatically reduced the carbohydrate percentage (Pratama *et al.*, 2014). Furthermore, the addition of high-protein fish flour along with other ingredients such as eggs and margarine reduces the proportion of wheat flour as the main carbohydrate source, while the frying process can lead to starch decomposition into simpler compounds (Irianto & Giyatmi, 2009).

CONCLUSION

Based on the results of the study, it can be concluded that the addition of tilapia fish meal affects the organoleptic characteristics and nutritional content of churros. The results of the hedonic test showed that all treatments were still acceptable by the panelists, with the highest value obtained by treatment A (control) and treatment C (10%) as the treatment with the highest value based on the parameters of appearance, aroma, texture, and taste among churros formulations with the addition of tilapia fish meal. The average value of treatment C (10%) on the appearance parameter was 8.0 (like), followed by texture 7.4 (like), and taste 7.4 (like). The addition of 10% tilapia fish meal to churros resulted in a water content of 17.38%, protein 11.88%, fat 42.63%, ash 1.47%, and carbohydrate 43.60%.

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