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Proximate levels, physical characteristics, and sensory characteristics of mocaf brownies with the addition of snakehead fish (*Channa striata*)

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ABSTRAK

Latar Belakang: *Pola konsumsi snack merupakan bagian dari pola makan. Brownies merupakan makanan tinggi energi yang populer karena mempunyai rasa yang lezat dan manis. Brownies adalah sejenis kue coklat yang mempunyai tekstur padat, tidak berongga, dan tidak begitu empuk karena brownies tidak membutuhkan pengembang atau gluten. Oleh karena itu brownies dapat dibuat dari tepung mocaf. Namun kandungan protein dalam tepung mocaf rendah sehingga perlu ditambahkan sumber protein seperti ikan gabus (Channa striata) untuk meningkatkan nilai gizi.*
Tujuan: *Penelitian ini bertujuan untuk menganalisis kadar proksimat, karakteristik fisik, dan karakteristik sensori brownies mocaf dengan penambahan ikan gabus (Channa striata).*
Metode: *Penelitian eksperimen yang menggunakan rancangan acak lengkap untuk mengkaji kadar proksimat, karakteristik fisik, dan karakteristik sensori. Konsentrasi daging ikan gabus terdiri dari 4 taraf perlakuan (0 g, 60 g, 80 g, dan 100 g). Analisis statistik menggunakan uji One-Way ANOVA dan Duncan Multiple Range Test (DMRT).*
Hasil: *Brownies mocaf dengan penambahan ikan gabus mempunyai kadar air 39,2%-48,7%, kadar abu 1,4-1,5%, kadar protein 7,7-17,7%, kadar lemak 32,9-35,4%, dan kadar karbohidrat 9,4-22,2%. Analisis sifat fisik hardness, cohesiveness, gumminess elasticity, and adhesiveness masing-masing 3406,8-4228,4 g/mm, 0,4 g/mm, 1106,4-1560 g/mm, 6,6-8,7 g/mm, and 0,4-0,9 mJ. Semakin banyak penambahan ikan gabus akan menurunkan nilai kesukaan brownies mocaf.*
Kesimpulan: *Hasil penelitian menunjukkan bahwa penambahan ikan gabus berpengaruh secara signifikan terhadap kadar air, kadar protein serta sifat sensoris warna, rasa, dan tekstur brownies mocaf.*

KATA KUNCI*: brownies; ikan gabus; mocaf; pangan lokal; PMT-AS*

ABSTRACT

Background: *Snack consumption patterns are part of eating patterns. Brownies are a popular high-energy food because they have a delicious and sweet taste. They are a type of chocolate cake with a dense texture that is not hollow and is not very soft because brownies do not require a developer or gluten. Therefore, brownies can be made from mocap flour. However, the protein content in mocap flour is low, so it is necessary to add protein sources such as snakehead fish (Channa striata) to increase nutritional value.*

Objectives: *This research aims to analyze the proximate levels, physical characteristics, and sensory characteristics of brownies by adding snakehead fish.*

Methods: *Experimental research using a completely randomized design to examine proximate levels and physical and sensory characteristics. The concentration of snakehead fish consists of 4 treatment levels (0 g, 60 g, 80 g, and 100 g). Statistical analysis using One-Way ANOVA and Duncan Multiple Range Test (DMRT).*

Results: *Mocaf brownies with the addition of snakehead fish have a water content of 39.2%-48.7%, ash content of 1.4-1.5%, protein content of 7.7-17.7%, fat content of 32.9-35.4%, and carbohydrate content of 9.4-22.2%. Analysis of physical properties of hardness, cohesiveness, gumminess elasticity, and adhesive power were 3406.8-4228.4 g/mm, 0.4 g/mm, 1106.4-1560 g/mm, 6.6-8.7 g/mm, and 0.4-0.9 mj, respectively. The more snakehead fish added, the lower the preference value of mocaf brownies.*

Conclusions: *The results showed that the addition of snakehead fish had a significant effect on water content, protein content, and sensory properties of color, taste, and texture of mocaf brownies.*

KEYWORD*:* *brownies; channa striata; mocaf; mocal food; supplementary food for school children program*

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INTRODUCTION

Children's diet plays a vital role in preventing malnutrition and reducing the risk of Non-Communicable Diseases (NCDs), such as diabetes, heart disease, stroke, and cancer. A snack diet is part of a child's diet. Snacks are foods consumed between two main meals. In general, snacks contribute 5-15% of a child's daily energy intake (1). Snack consumption significantly influences macronutrient intake, especially energy, and fat, but has a low significant influence on micronutrient intake. Children often buy and consume snacks at school in large quantities during school breaks (2,3). School-aged children are one of the nutritionally vulnerable groups who need attention because if they suffer from malnutrition, it can have a negative impact. Nutrition plays a vital role in the human life cycle. Efforts to improve nutritional status in society will contribute to the achievement of national development goals, especially in reducing the prevalence of malnutrition among elementary schoolchildren, so that, ultimately, it can improve the quality of human resources. One effort that can be made to meet nutritional needs from daily food consumption is by providing nutritional supplementation. One of the supplementation programs currently being implemented by the government is the Provision of Supplementary Food for School Children Program (PMT-AS). PMT-AS is a snack with an energy content of 144-216 calories, 3.96-5.76 grams of protein, and 5.04-7.56 grams of fat (4). Snack products can be developed using staple foods that contain energy with the addition of various other food sources so they can complement each other when combined to produce products with better nutritional value.

Brownies are a popular high-energy food because they taste delicious and sweet. Brownies are a type of chocolate cake with a dense texture, are not hollow, and are not soft because brownies do not require a leavening agent or gluten (5,6). Therefore, brownies can be made from mocaf

flour. Mocaf flour has a higher starch content compared to wheat flour. Mocaf flour also has a lower water content compared to wheat flour, so it is more resistant to microbial damage and has a long shelf life (7). The disadvantage of mocaf flour in food processing applications is the low protein content of around 1.77%(8). Snakehead fish flour is an alternative ingredient with a high protein content that has a high level of productivity and is available in Indonesia (9).

Research by Fadhilah et al. in 2020 about the optimization of snakehead fish brownies production showed that there was a difference in albumin levels between the addition of steamed snakehead fish and raw snakehead fish. Brownies with 100 grams of raw snakehead fish contain 459.29% albumin, while 100 grams of steamed snakehead fish contain 447.14%. From the aspects of taste, colour, aroma, and texture, the addition of 100 grams of steamed snakehead fish was 81.09% liked by the panelists (5). Therefore, making baked mocaf brownies with the addition of snakehead fish can be an alternative to developing PMT-AS based on local food, which can increase the malnutrition status of school-aged children.

MATERIALS AND METHODS

The materials used in this research are 120 gof mocaf flour, 35 g of cocoa powder, 100 g of dark cooking chocolate, 125 g of melted butter, 3 chicken egg yolks, 6 chicken egg whites, 100 g of granulated sugar, 10 g of vanilla, 5 g of baking powder, and add 0 g, 60 g, 80 g, and 100 g of snakehead fish to the treatment. The equipment used during this research is a pan, saucer, frying pan, blender oven, mixer, basin, stove, strainer, measuring cup, and spoon.

The experimental research is meticulously designed to examine proximate levels, physical characteristics, and sensory characteristics. The research was conducted from October 2022 – January 2023. The process of making mocaf brownies with the addition of snakehead fish was carried out with utmost care and precision in the food technology laboratory of the Faculty of Nursing and Health Sciences, University of Muhammadiyah Semarang. Testing for proximate levels was conducted at the Cendekia Nanotech Hutama (CNH) laboratory, Semarang, while testing for sensory characteristics was carried out at the organoleptic laboratory at the Faculty of Nursing and Health Sciences, University of Muhammadiyah Semarang.

Process of making mocaf brownies (7) with the addition of snakehead fish (5)

Snakehead fish filets are washed until clean. The snakehead fish is then marinated in lime to avoid a fishy smell. After that, the fish is mashed using a blender until smooth and set aside. Mocaf flour and cocoa powder are roasted briefly in low heat until warm, and then it is filtered. Then melt the margarine and dark cooking chocolate in low heat and set it aside. White and yellow eggs are mixed, and sugar and baking powder are added until mixed, then the ingredients that have been roasted and melted are added and stirred until evenly mixed. Finally, stir the delicate snakehead fish meat until it is evenly mixed. Next, the baking sheet is lined with baking paper, then smeared with margarine, and the dough is put into the pan and baked in the oven at 80ºC for 15 minutes.

Procedures for testing proximate levels, physical characteristics, and sensory characteristics

The water content test was measured using the AOAC method (1990), while the ash content was measured using the oven method. The protein content of the samples was measured using the Micro Kjeldahl method, the fat content using the Soxhlet method, and the carbohydrate content was measured using the difference method. The physical characteristics of mocaf brownies with the addition of snakehead fish were assessed using a texture analyzer. Sensory characteristics are assessed using hedonic quality and a hedonic scale.

The hedonic scale (preference test) components tested by the panelists include colour, aroma, taste, and texture using four hedonic scales, namely (1) dislike very much, (2) dislike slightly, (3) like slightly, and (4) very like. The assessment of hedonic quality is measured by color, taste, aroma, and texture. The color scale consists of brown (4), light brown (3), dark brown (2), and blackish brown (1). The taste scale consists of very fishy (4), fishy (3), no fishy (2), and very no fishy (1). The aroma scale consists of very

fishy (4), fishy (3), no fishy (2), and very no fishy (1). The texture scale consists of very soft (4), soft (3), not soft (2), and very not soft (1). The assessment scale is measured by color, taste, aroma, and texture. The color scale consists of brown (4), light brown (3), dark brown (2), and blackish brown (1). The taste scale consists of very fishy (4), fishy (3), no fishy (2), and very no fishy (1). The aroma scale consists of very fishy (4), fishy (3), no fishy (2), and very no fishy (1). The texture scale consists of very soft (4), soft (3), not soft (2), and very not soft (1). A total of 25 semi-trained panelists from Universitas Muhammadiyah Semarang were invited for the evaluation.

Statistic Analysis

Data was analyzed using a computer program. The normality test used is Shapiro Wilk. Data on proximate levels, physical characteristics, and sensory characteristics were normally distributed, so they were analyzed using the one-way ANOVA test to see the differences between treatments, then continued with the Duncan Multiple Range test. All obtained data were analyzed using the SPSS 26.0 at a significant level of 0.05.

RESULTS AND DISCUSSIONS

Proximate content of mocaf brownies with the addition of snakehead fish

The result of the analysis of proximate levels shows that the more snakehead fish are used, the nutrient levels produced also vary **(Table 1).** The average water content of mocaf brownies with the addition of snakehead fish ranges from 39.20% - to 48.72%. The highest water content was obtained from the treatment of the addition of snakehead fish at 60 g, while the lowest level was found at an addition of 100 g. The results of statistical tests using one-way ANOVA obtained a p-value of 0.005. This means that the addition of snakehead fish significantly influenced the water content.

Table 1. Proximate levels in mocaf brownies with the addition of snakehead fish

Proximate Levels	Control	Snakehead Fish Addition		
		60 g	80 g	100 g
Water content (%)	42.5 ± 7.18^{a}	48.7± 3.33^{b}	40.6 ± 1.71^{a}	39.2 ± 2.27^{a}
Ash content (%)	1.5 ± 0.08^{a}	1.5 ± 0.08^{a}	1.4 ± 0.27^{a}	1.4 ± 0.25^{a}
Protein content (%)	15.3 ± 6.28^{ab}	7.7 ± 6.06^{a}	9.3 ± 2.94^{a}	17.7 ± 7.97^{b}
Fat content (%)	33.0 ± 2.33^{a}	33.5 ± 3.23^{a}	35.4 ± 5.34^{a}	32.9 ± 2.20^{a}
Carbohydrate content (%)	9.4 ± 6.00^{a}	14.9 ± 6.44^{a}	21.4 ± 6.58^{a}	22.2 ± 2.49^{a}

The water content in food ingredients determines acceptability, freshness, durability of ingredients, chemical reactions, enzyme activity, and growth of microorganisms. Understanding the water content of foods is crucial as it significantly impacts their appearance, texture, and flavor. This measurement serves as a key determinant of freshness and longevity. High moisture levels can lead to the proliferation of bacteria, molds, and yeasts, leading to undesirable changes in food composition (10). Until now, no Indonesian National Standard (SNI) regulates brownie quality standards, so the determination of water content uses bread quality standards. The maximum water content in breading, according to SNI 01-3840-1995, is 40% (11). Therefore, mocaf brownies with the addition of 100 grams of snakehead fish have met the quality standards determined by SNI. The water content in brownies with the addition of snakehead fish is influenced by the initial water content of the raw material, cooking method, shape, size, time, temperature, and water that evaporates during the baking process, as well as the amount of starch and fiber contained in the brownies (6).

The average ash content of mocaf brownies with the addition of snakehead fish ranged from 1.39% - 1.46% (**Table 1**). The results of statistical tests using one-way ANOVA obtained a p-value of 0.906. This means that the addition of snakehead fish does not influence the ash content. The amount of ash content in a material is influenced

by the type of raw material used, the temperature, and the duration of roasting (11). The highest ash content was obtained from the treatment without the addition of snakehead fish, while the lowest ash content was found in the treatment with the addition of snakehead fish at 100 g. The ash content is related to the mineral content in brownies with the addition of snakehead fish (12). The components contained there include potassium, calcium, sodium, iron, magnesium, and manganese (6).

The average protein content of mocaf brownies with the addition of snakehead fish ranged from 7.7 – 17.7% (**Table 1**). The highest protein content was obtained from the treatment with an addition of 100 g, while the lowest protein content was obtained from the treatment with the addition of 60 g. The results of statistical tests using one-way ANOVA obtained a p-value of 0.001. This means that the addition of snakehead fish significantly influenced the protein content. Snakehead fish contains 17 of the 22 essential amino acids found in nature. These essential amino acids are histidine, isoleucine, leucine, lysine, methionine, valine, Phenylalanine, aline, Threonine, and Tryptophan. Meanwhile, the nonessential amino acids are tyrosine, aspartic acid, glutamic acid, serine, glycine, arginine, alanine, and proline (13).

The average fat content of mocaf brownies with the addition of snakehead fish ranged from 32.89% - 35.34% (**Table 1**). The highest fat content was obtained from the treatment with the addition of 80 g, while the treatment with the addition of 100 g had the lowest fat content. The results of statistical tests using one-way ANOVA obtained a p-value of 0.596. This means that the addition of snakehead fish does not influence the fat content. Fat can improve the taste and slow down the hardening of the texture, making it softer (14). Sources of fat in brownies with the addition of snakehead fish include chocolate, butter, eggs, and snakehead fish.

The average carbohydrate content of brownies with the addition of snakehead fish ranged from 14.88% - 22.78% (**Table 1**). The highest carbohydrate content was obtained from the treatment with the addition of 100 g of snakehead fish, while the lowest carbohydrate content was found in the treatment with the addition of 60 g of snakehead fish. The results of statistical tests using one-way ANOVA obtained a p-value of 0.227. This means that the addition of snakehead fish does not influence the carbohydrate content. The primary source of carbohydrates in these brownies is mocaf flour. Mocaf flour contains 85% carbohydrates (6)(15). Mocaf is cassava flour modified through a fermentation process by lactic acid bacteria, which can change its functional properties and replace food products made from wheat flour (6).

Physical characteristics of mocaf brownies with the addition of snakehead fish

Texture is one of the most critical parameters of a food product's quality. Texture parameters are grouped into hardness, cohesiveness, viscosity, elasticity, and adhesiveness (16). The average texture hardness of brownies with the addition of snakehead fish ranged from 3,406.8 g/mm – to 4,228.4 g/mm (**Table 2**). The highest texture hardness was obtained from the treatment by adding 60 g of snakehead fish, while the lowest texture hardness was found with the treatment by adding 100 g of snakehead fish. The results of statistical tests using one-way ANOVA obtained a p-value of 0.333. This means that the addition of snakehead fish does not influence the hardness of mocaf brownies. The increase in hardness value shows that the brownie's texture becomes harder with the addition of snakehead fish. The hardness of the texture is influenced by the degree of gelatinization, water absorption index, volume absorption index, and water content (17).

The hardness of mocaf brownies with the addition of snakehead fish is influenced by mocaf flour which does not contain gluten. As a result, it is less able to bind and retain water, so the water content evaporates during the baking process and produces a dry and hard texture (18). The average elasticity of brownie texture with the addition of snakehead fish ranged from 6.5 g/mm - to 8.7 g/mm (**Table 2**). The highest texture elasticity was obtained from the treatment without the addition of snakehead fish. In contrast, the lowest texture elasticity was found in the treatment with the addition of 60 g of snakehead fish. The results of statistical tests using one-way ANOVA obtained a p-value of 0.134. This means that the addition of snakehead fish does not influence the elasticity of

mocaf brownies. The elasticity of the texture of brownies is influenced by several factors, such as high sugar and liquid content, low fat, high proportion of eggs, flour with high protein content, and gluten formation during the kneading process (19). Gluten is not found in mocaf flour. Gluten consists of gliadin and glutenin, which affect dough development because gluten can hold gas. Gluten is also elastic and chewy (20).

Table 2. Physical characteristics in mocaf brownies with the addition of snakehead fish

Physical Characteristics	Snakehead Fish Addition			
	0 g	60 g	80 g	100 g
Hardness (g/mm)	3757.8 ± 751.73[a]	4228.4 ± 748.97 [a]	4148.1 ± 980.03 [a]	3406.8 ± 880.36 [a]
Elasticity (g/mm)	6.5 ± 1.23 [a]	8.7 ± 1.03 [b]	7.4 ± 1.91 [ab]	7.0 ± 1.76 [ab]
Cohessivenes	0.4 ± 0.21 [a]	0.4 ± 0.27 [a]	0.4 ± 0.24 [a]	0.4 ± 0.26 [a]
Adhesion (mJ)	0.4 ± 0.17 [a]	0.8 ± 0.34 [a]	0.6 ± 0.62 [a]	0.9 ± 0.56 [a]
Gumminess (g/mm)	1560.4 ± 1184.44 [a]	1522.6 ± 1055.67 [a]	1423.3 ± 1395.10 [a]	1106.4 ± 1430.09 [a]

The average cohesiveness of mocaf brownies with the addition of snakehead ranged from 0.31 – 0.43 (**Table 2**). The highest cohesiveness was obtained from the treatment without the addition of snakehead fish, while the lowest cohesiveness was found in the treatment with the addition of 100 g of snakehead fish. The results of statistical tests using one-way ANOVA obtained a p-value of 0.842. This means that the addition of snakehead fish does not influence the cohesiveness of mocaf brownies. The cohesiveness of brownies with the addition of snakehead fish describes the extent to which the product isn't damaged when bitten (21). Cohesiveness in the product is influenced by water and lecithin content (22). The lecithin from mocaf brownies, with the addition of snakehead fish, comes from egg yolk, which functions as an emulsifier (21).

The average adhesion of mocaf brownies with the addition of snakehead fish ranged from 0.4 – 0.9 mj (**Table 2**). The highest adhesion was obtained from the addition of 100 g of snakehead fish, while the lowest adhesion was found in the treatment without the addition of snakehead fish. The results of statistical tests using one-way ANOVA obtained a p-value of 0.361. This means that the addition of snakehead fish does not influence the adhesion of mocaf brownies. Adhesion texture properties are related to amylose content and starch retrogradation. Products with high amylose content usually have low adhesion values (23).

The average gumminess of mocaf brownies with the addition of snakehead fish ranged from 1,106.4 g/mm– 1,560.4 g/mm (**Table 2**). The highest gumminess was obtained from the treatment without adding snakehead fish, while the lowest gumminess was found in the treatment with adding 100 g of snakehead fish. The results of statistical tests using one-way ANOVA obtained a p-value of 0.924. This means that the addition of snakehead fish does not influence the gumminess of mocaf brownies. The protein content influences the gumminess of the texture in brownies. A 3-dimensional matrix is formed between the myofibril protein in snakehead fish meat and the starch in mocaf flour, thus forming a sticky texture (24).

Sensory Characteristics

Color

Table 3 shows the results from analysis based on taste, aroma, texture, and color by hedonic scale and hedonic quality scores. The mean panelists' hedonic scale for the color attribute of mocaf brownies with the addition of snakehead fish varied between 2.4 and 2.7, which mean dislike slightly. Statistically, the analysis of one-way ANOVA reveals a significant effect on the color of of mocaf brownies with the addition of snakehead fish (p=0.001). Duncan's test results showed that there is no difference in the addition of variations of snakehead fish. While the mean hedonic quality score for the color of mocaf brownies with the addition of snakehead fish varied between 1.6 and 2.3, which means blackish brown and dark brown.

Statistically, the analysis of one-way ANOVA reveals a significant effect on the color of of mocaf brownies with the addition of snakehead fish (p=0.043). Duncan's test results showed that the

difference is only in addition to snakehead fish 60 g and 80 g. Research by Afianti and Indrawati (2015) stated that the higher the concentration of snakehead fish flour, the lowest the appearance of the crackers-like colour (25). Dark brown is the typical color of brownies, which is influenced by the composition of the food's raw materials and chemical properties (26). The use of raw materials in the form of chocolate in brownies provided changes in colour, texture, and distinctive smell. In addition, the brown colour occurs when the Maillard reaction occurs in the roasting process. This reaction is the browning process of food due to the response between carbohydrates (reducing sugar) and amino acids from proteins, which will produce a brown colour (27).

Table 3. Sensory characteristics (hedonic scale and hedonic quality score) in mocaf brownies with the addition of snakehead fish

	Snakehead Fish Addition			
	0 g	**60 g**	**80 g**	**100 g**
Hedonic Scale				
Color	3.2 ± 0.47 [a]	2.7 ± 0.46 [a]	2.7 ± 0.68 [a]	2.4 ± 0.71 [a]
Taste	2.9 ± 0.62 [a]	2.8 ± 0.62 [a]	3.0 ± 0.54 [a]	2.2 ± 0.78 [b]
Aroma	2.7 ± 0.56 [a]	2.5 ± 0.65 [ab]	2.3 ± 0.69 [ab]	2.2 ± 0.71 [ab]
Texture	3.1 ± .,53 [a]	2.7 ± 0.74 [a]	2.6 ± 0.58 [a]	2.0 ± 0.61 [a]
Hedonic Quality Score				
Color	1.8 ± 0.99 [ab]	2.3 ± 0.80 [b]	1.6 ± 0.76 [a]	2.1 ± 1.04 [ab]
Taste	1.6 ± 0.76 [a]	2.4 ± 0.64 [a]	2.4 ± 0.7 [a]	3.0 ± 1.00 [a]
Aroma	1.6 ± 0.71 [a]	2.1 ± 0.76 [a]	2.2 ± 0.71 [a]	3.0 ± 1.00 [a]
Texture	2.6 ± 0.65 [a]	2.2 ± 0.71 [ab]	2.5 ± 0.59 [a]	2.0 ± 0.89 [b]

Taste

Foods are known for their salty, sweet, sour, and bitter tastes, caused by substances that can dissolve in the mouth (28). The results of the hedonic scale and hedonic quality score on the taste of mocaf brownies with the addition of snakehead fish are presented in **Table 3**. The mean panelist taste from the hedonic scale for mocaf brownies with the addition of snakehead fish spanned from 2.2 to 3. Notably, the highest average value was recorded in adding 80 g snakehead fish, indicative of a liking level characterized as “like slightly” on the hedonic scale. Statistically, the analysis indicates a significant effect on the taste of mocaf brownies with the addition of snakehead fish ($p<0,001$).

The progressive addition of snakehead fish correlates with an intensified fishy in mocaf brownies. The mean panelist taste from the hedonic quality score on addition 60 g and 80 g are 2,4, indicating a no fishy. Still, on the addition of 100 g, was 3,0, indicating a fishy taste. The fishy taste in fish is caused by nitrogen components, namely guanidine, trimethyl amine oxide (TMAO), and imidazole derivatives (29). Research made by Putra et al. (2015) stated that the higher the addition of snakehead fish, the more the hedonic taste of crackers decreases (30). Snakehead fish meat added to the product produces a distinctive fish taste. Research by Afianti and Indrawati (2015) stated that adding snakehead fish flour significantly affected the taste of crackers, which had the highest value of 3.17 (25).

Texture

The mean panelists’ hedonic scale for the texture attribute of mocaf brownies with the addition of snakehead fish varied between 2.0 and 2.7, which mean dislike slightly. Statistically, the analysis of one-way ANOVA reveals a significant effect on the color of of mocaf brownies with the addition of snakehead fish ($p=0.021$). Duncan’s test results showed that there is no difference in the addition of variations of snakehead fish. While the mean hedonic quality score for the texture of mocaf brownies with the addition of snakehead fish varied between 2.0 and 2.5, which means not soft. Statistically, the analysis of one-way ANOVA reveals a significant effect on the texture of of mocaf brownies with the addition of snakehead fish ($p=0,043$). The protein content in snakehead fish causes this. Fish containing proteins decrease

the swelling power, thereby decreasing the texture of the product (31). Research by Yunisah, Herpandi, and Sudirman (2022) stated that the addition of snakehead fish decreased the resulting texture, so the panelists didn't like it (32). Research by Siahaan et al. (2015) stated that adding a concentration of snakehead fish to kwetiau dough could make the texture of the dough hard, making it unpopular among panelists (33). Generally, panelists like soft brownies (26).

Aroma

Aroma is a critical factor that contributes to the delicacy of a food product. It can stimulate the sense of smell and increase appetite (29). The results of the hedonic scale and hedonic quality score on the aroma of mocaf brownies with the addition of snakehead fish are presented in Table 3. The mean panelist aroma from the hedonic scale for mocaf brownies with the addition of snakehead fish spanned from 2.2 to 2.5, indicative of a liking level characterized as “dislike slightly”. Statistically, the analysis indicates a nonsignificant effect on the aroma of mocaf brownies with the addition of snakehead fish ($p=0.062$). The mean panelist aroma from a hedonic quality score of mocaf brownies with the addition of snakehead fish ranges from 2.1-3.0, which means no fishy and fishy. This implies that the augmented addition of snakehead fish corresponds to an enhanced fishy aroma in mocaf brownies. The Maillard reaction produces volatile compounds that form aromas. Higher protein content results in a more potent aroma from this reaction (34).

Research by Yuliani et al. (2018) stated that the addition of snakehead fish caused a decrease in the liking of the aroma of the crackers produced (23). Research by Yunisah, Herpandi, and Sudirman (2022) states that the addition of snakehead fish causes a decrease in the aroma value of the gandus cake produced (32). This is caused by the amino acid content in fish, which can cause a distinctive fish aroma that the panelists do not prefer. The distinctive aroma of fish is caused by free amino acids from protein content and free fatty acids (35).

CONCLUSIONS AND RECOMMENDATIONS

This study is of great significance as it evaluates the addition of snakehead fish to the proximate levels and physical and sensory characteristics of mocaf brownies. The results show that the addition of snakehead fish significantly affects the water content, protein content, color, taste, and texture of mocaf brownies. While the addition of snakehead fish can increase protein levels, the panelists' preferences decrease. Therefore, it is necessary to carry out a preliminary process on snakehead fish, which can be done to increase consumer acceptance of this product.

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