

MILLET FLOUR AS A FUNCTIONAL INGREDIENT IN LOCAL CULINARY INNOVATION: A CASE STUDY ON PUKIS CAKE

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Abstract

*The increasing use of wheat flour in Indonesia has led to high dependence on imports, making it necessary to explore local alternatives to reduce reliance on wheat. Millet flour, derived from *Panicum miliaceum* L., is considered a potential substitute because it is gluten-free and rich in calcium, magnesium, and vitamin B6. This study aimed to evaluate the use of white millet flour as a partial substitute for wheat flour in the production of pukis cakes, a traditional Indonesian snack, with the goal of enhancing nutritional value and diversifying local food products. A preliminary experiment determined that 100% substitution resulted in unacceptable product characteristics, while 50% substitution produced cakes comparable to the control. Therefore, the main experiment tested formulations with 0% (control), 50%, 65%, and 80% millet flour substitution, using a completely randomized design (CRD) with three replications per treatment. Sensory evaluations, including hedonic and hedonic quality tests, were conducted with 30 semi-trained panelists to assess color, aroma, taste, and texture. The results showed that substitution levels significantly influenced product acceptability. Cakes with 50% millet flour substitution received the highest scores in terms of overall preference and quality across all sensory parameters, while higher substitution levels tended to decrease acceptance. The findings indicate that millet flour can be effectively used up to 50% in pukis cake production without compromising consumer acceptance. This research highlights the potential of millet flour as a functional local ingredient to reduce wheat flour consumption, improve nutritional intake, and promote food diversification in Indonesia.*

Keywords: White millet flour; Pukis cake; Wheat flour substitution; Sensory evaluation; Food diversification.

INTRODUCTION

The use of wheat flour in everyday life has increased in line with the growing population. (Damiana, 2023) revealed that Indonesia is fully dependent on imported wheat supplies to produce wheat flour. The USDA notes that in the middle of the 2022/2023 period, Indonesia imported 27.06 million tons of wheat flour

equivalent (Central Statistics Agency, 2024). Efforts are needed to reduce the massive use of wheat flour domestically. One way to do this is by using local food ingredients that can provide benefits and play a role comparable to wheat flour, one example being millet flour made from millet seeds. According to an analysis by , white millet flour is considered suitable as

a gluten-free flour that can be used as a substitute for wheat flour because it contains high levels of calcium (1170 mg/100g), magnesium (25 mg/100g), and vitamin B6 (0.42 mg/100g). Millet flour has benefits and nutrients that are similar to or even exceed those of wheat flour.

The raw materials used in pukis cakes do not vary, so in order to create more interesting and healthier variations using local ingredients, this study was conducted to test white millet flour (*Panicum miliaceum L.*) as a raw material for pukis cakes, using organic ingredients and no food coloring. Based on the researchers' review of previous studies, research related to the production of pukis cakes using ingredients other than wheat flour has been conducted, such as the study (Asih, 2022) on pukis cakes made from yellow sweet potato flour and tempeh flour; (Chrestella, Pranata, & Swasti, 2020) pukis cakes made from red bean flour and breadfruit flour; and (Mas'ud & Lestari, 2020) pukis cakes made from bamboo shoot flour. However, there has been no research conducted on the production of pukis cakes using millet flour as the raw material. It can be concluded that there has been no research on white millet flour pukis cakes. The expected benefits of this research are to increase the value of millet flour, reduce the use of wheat flour, increase the

nutritional content of pukis cakes, and enhance the uniqueness of pukis cake products.

LITERATURE REVIEW

Pukis Cake

China, the Bamboo Curtain country, is where pukis cake originated. Pukis cake first became known when the people of Sampang Kebumen were kidnapped by colonizers and forced to work making it. The recipe for this cake used to be a closely guarded secret and was never shared with anyone else. However, one of them learned about the ingredients used to make pukis and the process of making it. Then, one of the prisoners who knew the secret recipe shared it with his friends and tried to escape, which he succeeded in doing. After escaping, someone tried to make pukis cake himself and sell it. To this day, pukis cake has become one of the legendary cakes known to all Indonesians (Eka, 2022).

Pukis cake is a traditional cake originating from Banyumas. The distinctive shape of pukis cake is a semicircle with a brown bottom and a yellow top. This shape is obtained using a special mold used to bake this cake. The type of flour used as the main ingredient for pukis cake is regular wheat flour, not high-protein wheat flour, because pukis

cake does not require the elasticity characteristics of bread. In addition, the use of yeast in the pukis cake dough plays a role in the fermentation process and makes the cake texture more fluffy and soft (Megasari, 2023). According to (Holidya & Kristiastuti, 2019), the pukis cake baking process is carried out by pouring $\frac{3}{4}$ of the dough into a special mold with a semicircular shape so that the cake has a semicircular shape resembling a boat. Currently, many people sell pukis cakes in various flavors, such as chocolate, peanut, pandan, and cheese (Asih, 2022). Based on the above description, it is known that the characteristics of pukis cakes are that they are brown on the bottom and yellow on the top, have a soft and fairly elastic texture, and have a distinctive shape like a boat or a semicircle.

The ingredients used to make pukis cakes are wheat flour, water, chicken eggs, granulated sugar, instant yeast, coconut milk, sweetened condensed milk, and margarine.

Millet Flour

Millet is a large seed that comes in various colors, including reddish brown, brown, light yellow or cream, white, and black. Large millet seeds include the pearl millet (*Pennisetum glaucum*) variety. And (O, Pratiwi, & Arihantana, 2021) states that millet flour is flour derived from the

proso millet (*Panicum milliaceum*) species, which is one of the millet species widely cultivated in Indonesia.

Since prehistoric times, millet has been used as a food source for humans. Millet is a type of cereal that is suitable for cultivation in dry environments with low soil fertility and high temperatures. In addition, millet can grow well in soil with high salt content or low pH. Millet plants are able to grow and survive in areas where other cereal crops such as corn or wheat cannot.

Millet is also known as jewawut. This plant ranks sixth as the most important grain and is consumed by one-third of the world's population. To date, northern China, India, Africa, and Russia still consume pearl millet grains, with 80% of the harvest consumed directly as human food. In India, the most important use of pearl millet flour is as a leavening agent for bread and similar products such as rice and porridge. Millet is also primarily consumed in the form of thick or thin porridge (with or without fermentation), plain bread, boiled or steamed food products, snacks, alcoholic beverages, and flour mixtures in bread, cookies, and noodles in African countries (Nugraheni, 2016).

Millet is one of the main sources of energy, protein, vitamins, and minerals.

Millet seeds are relatively high in protein and have a good amino acid balance. In addition, millet also contains fairly high levels of cysteine, lysine, and methionine. Not only that, millet contains twice as much methionine as sorghum and is also relatively high in fat and linolenic acid, which makes up 4% of total fatty acids (Nugraheni, 2016).

In addition, millet is rich in vitamin E, especially niacin, B6, and folacin, as well as essential amino acids such as isoleucine, leucine, phenylalanine, and threonine. Not only that, millet also contains nitriloxide compounds which play a very important role in inhibiting the development of cancer cells (anti-carcinogenic), which can reduce the risk of heart disease such as arteriosclerosis, heart attack, stroke and hypertension (Nugraheni, 2016).

One of the most important parts of all types of millet is the endosperm. The endosperm in millet has a single layer of aleurone surrounding it. Aleurone cells are quadrangular with fairly thick walls. The pure endosperm type in the aleurone layer in all types of millet has at least one layer of peripheral endosperm. This distinctive layer has a higher protein content than other parts of the endosperm. The starch granules that make up the endosperm cells are attached to a protein matrix. When in the corneous and endosperm areas, the

spherical starch granules change shape to become polygonal. Millet has two thick epicarp layers. The mesocarp varies in thickness due to genetic factors, while the endocarp layer contains cells. Fonio, proso, and foxtail millet have several pigments in the pericarp with antinutritional substances (Nugraheni, 2016). The following is an image of the anatomical structure of millet seeds:

Millet belongs to the subfamily Panicoideae, of the grass family Poaceae. The most widely cultivated millet species in terms of global production are:

- a. Pearl millet (*Pennisetum glaucum*)
- b. Foxtail millet (*Setaria italica*)
- c. Proso millet (*Panicum miliaceum*)
- d. Finger millet (*Eleusine coracana*)

In a study (Aprilyani, 2019) related to the use of millet flour in the manufacture of Tortellini Millet Pasta products, it was stated that the higher the substitution of millet flour, the longer the boiling process. This is because the more millet flour in the dough, the less gluten content, resulting in a hard and non-chewy dough that requires additional time to cook thoroughly. Additionally, there are differences in aroma and texture between the characteristics of Tortellini and Tortellini Millet Pasta. Tortellini that is not substituted with millet flour has a chewy texture, while Tortellini Millet Pasta,

which is substituted with millet flour, has a slightly chewy texture. This is because millet flour does not contain gluten, resulting in pasta that is slightly chewy.

Then, in a study conducted by (Kharismawati, Pratiwi, & Puspawati, 2022) related to the manufacture of brownies, it was stated that brownies made from fermented millet flour and cornstarch have a darker color as the use of fermented millet flour increases. This is because fermented millet flour has a duller color than wheat flour and other types of flour. Additionally, it was stated that 100% fermented millet flour brownies are somewhat crumbly, which is due to the coarser texture of fermented millet flour compared to cornstarch.

METHODS

This study used a quantitative method with an experimental research design. In conducting the pukis cake making experiment, the researcher obtained the recipe from a chef named Budi Cristianto through one of his Instagram *posts* (@chef_budi_tian). The following are the ingredients and tools used by the researcher in conducting the pukis cake making experiment using white millet flour.

Table 1. Pukis Cake Ingredients

Ingredient Name	Amount
Wheat Flour	300 g
Granulated Sugar	250 g
Vanilla <i>extract</i>	1 tsp
Egg	3
Egg yolks	1 egg
Medium coconut milk (Coconut milk and water ratio 2:1)	400 ml
Melted Margarine	50 g
Instant yeast	1 packet
Sweetened condensed milk	2 sct (76 g)
Salt	½ tsp

Source: Cristianto, 2024

Table 2. Tools

Tool Name	Specifications	Quantity
Pukis Mold	Teflon	1
Hand Mixer	Cosmos	1
Spatula	Rubber	1
Mixing Bowl	Plastic	2
Digital Scale	Tanita	1
Measuring Cup	Plastic	1
Tongs	Aluminum	1
Strainer	Aluminum	1
Chopsticks	Wood	1 pair
Small pan	Aluminum	1
Food Brush	Wood	1
Plastic Wrapping	Total	1 roll

Source: Researchers data, 2025

Research Procedure

a. Preliminary Research

Before conducting the main research, the researcher must conduct preliminary

research. In the preliminary research process, the researcher made pukis cakes using millet flour to find the limits of replacing wheat flour by conducting trials of making pukis cakes with 0%, 50%, and 100% white millet flour. This was done to see the minimum and maximum results that could be obtained so that several comparisons of the percentage of white millet flour and wheat flour used in the main research could be decided.

Table 3. Preliminary Result

Millet Flour 0%	Millet Flour 50%	Millet Flour 100%
		

Source: Researchers, 2025

The preliminary research results showed that the characteristics of pukis cakes made with 100% white millet flour were unacceptable and did not match the characteristics of normal pukis cakes, while pukis cakes made with 50% white millet flour were still acceptable and their characteristics were not much different from normal pukis cakes. Therefore, the researchers decided that the percentages of white millet flour to be used in the main test would be 50%, 65%, and 80%.

b. Main Research

In the main study, the process of making pukis cakes using white millet flour began with the selection of ingredients and the preparation of ingredients and equipment. The researchers used white millet flour in the following ratios: 0%:100% (control), 50%:50%, 65%:35%, and 80%:20%.

c. Experimental Design

The experimental design used in this study was a completely randomized design (CRD) with four trials and three replicates for each treatment using the same ingredients, composition, and manufacturing process, namely: 0%:0%, 50%:50%, 65%:35%, and 80%:20%.

Table 4. Design study

Repetition	Treatment A			
	V1	V2	V3	V4
1	631	196	285	520
2	492	386	710	361
3	825	168	953	294

Source: Researchers data, 2025

Table 5. Product Code

Code	Description
631	0% White Millet Flour
492	0% White Millet Flour
825	0% White Millet Flour
196	50% White Millet Flour
386	50% White Millet Flour
168	50% White Millet Flour
285	65% White Millet Flour
710	65% White Millet Flour
953	65% White Millet Flour
520	80% White Millet Flour

Code	Description
361	80% White Millet Flour
294	80% White Millet Flour

Source: Researchers data, 2025

d. Organoleptic Test

According to (Gusnadi, Taufiq, & Baharta, 2021), organoleptic testing is a food ingredient test based on preference and desire for a product. Organoleptic testing, also known as sensory testing, is a testing method that uses the human senses as the primary tool for measuring product acceptance. Sensory testing involves four parameters: color, aroma, taste, and texture. The sensory or organoleptic tests to be conducted are hedonic tests (liking tests) and hedonic quality tests (product quality tests) with a total of 30 panelists.

e. Hedonic Test

A hedonic test or preference test is a test conducted by a person to determine the degree of difference in quality by providing an assessment between the products to be tested and to determine the level of liking or disliking of a product. This level of liking is referred to as the hedonic scale, for example, very like, like, somewhat like, dislike, and very dislike. The hedonic test assessment is based on the panelists' level of liking. In this study, the categories created in the table consist of color, aroma, taste, and texture. The

level of liking based on the panelists is described using a numerical scale.

f. Hedonic Quality Test

Hedonic quality testing differs from hedonic testing (liking); hedonic quality testing expresses impressions of good or bad. Therefore, some experts test by incorporating hedonic quality testing into hedonic testing because hedonic quality testing can provide more specific information than just liking or disliking. The range of the hedonic scale ranges from very bad to very good. The scale used in the hedonic test is the same as in the hedonic quality test, namely a numerical scale.

g. Data Analysis

Data analysis is the process of collecting data by searching for complete information, which is then analyzed as a basis for making decisions to solve a problem. Data analysis is an activity of grouping data based on variables and types of respondents, tabulating data based on respondent variables, presenting data from the variables to be studied, performing calculations to answer each problem formulation, and performing calculations for the hypothesis test to be proposed. The researcher will analyze the data using the *One Way* ANOVA method with the SPSS application to determine the differences in quality and descriptive percentage analysis

that will be used for hedonic testing and hedonic quality testing. Then, the researcher will perform a Duncan test if there are significant differences in the previous ANOVA test results to see if there are differences between one sample and another with more specific differences.

RESULT

Hedonic Test

In the experiment conducted by the researcher, differences were found in the level of preference tested based on color, aroma, taste, and texture. The concentration of pukis cakes substituted with millet flour was 0%, 50%, 65%, and 80%. In this preference test, the researcher used a panel of 30 semi-trained panelists to assess the level of preference in terms of color, aroma, taste, and texture of millet flour pukis cake products. The average preference test scores for the parameters of color, texture, aroma, and taste can be seen in the hedonic test table.

Table 6. Hedonic Test

HEDONIC TEST					
Parameter	Repetition	Substitution			
		0	50	65	80
Color	1	3.30	3.03	2.77	2.67
	2	3.27	2.97	2.87	2.87
	3	3.33	3.00	2.67	2.70
Average		3.30	3.00	2.77	2.74
Aroma	1	3.40	3.00	2.87	2.77
	2	3.10	3.00	2.90	2.83
	3	3.07	2.83	2.80	2.73
Average		3.19	2.94	2.86	2.83
Taste	1	3.23	2.90	2.83	2.80
	2	3.30	2.87	2.73	2.93
	3	3.23	2.93	2.60	2.77

HEDONIC TEST					
Average		3.26	2.94	2.72	2.83
Texture	1	3.40	2.63	2.53	2.43
	2	3.40	2.83	2.43	2.73
	3	3.33	2.77	2.57	2.27
Average		3.38	2.74	2.51	2.48
General Revenue	1	3.30	2.83	2.77	2.57
	2	3.27	2.93	2.73	2.90
	3	3.27	2.90	2.73	2.53
Average		3.28	2.89	2.74	2.67
Total Average		3.28	2.90	2.72	2.71

Source: Researchers data, 2025

Before conducting the ANOVA test, researchers need to test the homogeneity of each parameter to see the similarity of the variance of the data obtained so that it can be determined whether the data is suitable for testing in the One Way ANOVA test. Then, the results obtained from each average are processed with One Way ANOVA data analysis to determine the significant changes in each treatment.

1. Color

Color in food presentation is one factor that needs to be considered because it determines the attractiveness of a product. In the case of food products, color combinations can also affect the selling value of a product and increase consumer appetite. In the color preference test, panelists assessed different percentages of white millet flour substitution (0%, 50%, 65%, and 80%).

Based on the homogeneity test results, a significance value (Sig) greater than 0.05 was obtained, so it can be concluded that the data obtained from the panelists regarding color preference for white millet

flour pukis cake products is the same or homogeneous, thus fulfilling the homogeneity assumption in the One Way ANOVA test. Following this, the results of the ANOVA statistics based on the color preference test for white millet flour pukis cake products are as follows.

Table 7. Hedonic ANOVA Test Results for Color Preference

ANOVA					
Hedonic Color					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.596	3	.199	33,913	.000
Within Groups	.047	8	.006		
Total	.643	11			

Source: Researchers data, 2025

Note:

If Sig > 0.05, then H₀ is accepted, H₁ is rejected

Sig < 0.05, then H₀ is rejected, H₁ is accepted

Calculated F = **33.913**

F table = 2.98

Calculated F < Table F, then H₀ is accepted and H₁ is rejected, meaning there is no difference

Calculated F > Table F, therefore H₀ is rejected and H₁ is accepted, therefore there is a difference.

The table above shows that F calculated is greater than F table, namely with a value of **33.913 > 2.98**, so there is a difference in the level of preference for the color of millet flour pukis cake products with different concentrations (0%, 50%, 65%, and 80%). Thus, H₀ is rejected and H₁ is accepted. With these calculation results, the next step is to perform Duncan's test. The following are the statistical results of Duncan's test:

Table 8. Duncan's Test Results for the Color Hedonic Test

Hedonic Color				
Duncan ^a				
Sample	N	Subset for alpha = 0.05		
		1	2	3
80	3	2.7467		
65	3	2.7700		
50	3		3.0000	
0	3			3.3000
Sig.		.719	1,000	1,000
Means for groups in homogeneous subsets are displayed.				
a. Uses Harmonic Mean Sample Size = 3,000.				

Source: Researchers data, 2025

Table shows the results of the hedonic test using the Duncan hedonic color test method on the color attribute with $\alpha = 0.05$ in a sample of pukis cakes with white millet flour substitution. It is stated that samples with concentrations of 0%, 50%, 65%, and 80% have differences in color preference between one product and another.

From these calculations, it can be seen that there are different levels of color preference for each concentration of white millet flour substitution, with the highest color hedonic average found in the 0% sample with a value of (3.30), which means that physically, the color sample was very much liked by the panelists, and the lowest average-average sample, the lowest was found in the 65% sample with a value of (2.77) and the 80% sample with a value of (2.74), which resulted in dislike

from the panelists. These results prove that the more white millet flour is substituted in the pukis cake dough, the lower the level of color hedonics produced by the panelists, which is dislike.

2. Aroma

One important component of a food product is aroma. Aroma itself can affect consumer appeal as detected by the sense of smell (nose). In the aroma preference test, panelists assessed different percentages of white millet flour substitution (0%, 50%, 65%, and 80%). Based on the results of the homogeneity test above, a significance value (Sig) greater than 0.05 was obtained, so it can be concluded that the data obtained from the panelists regarding aroma preference in white millet flour pukis cake products is, meaning it is the same or homogeneous, so the homogeneity assumption in the One Way ANOVA test is fulfilled. Following this, the results of the ANOVA statistics based on the aroma preference test for white millet flour pukis cake products are as follows.

Table 9. Results of the Hedonic ANOVA Test for Aroma Preference

ANOVA					
Hedonic Aroma					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.288	3	.096	7,994	.009
Within Groups	.096	8	.012		
Total	.385	11			

Source: Researchers data, 2025

The table above shows that F calculated is greater than F table, namely with a value of $7.994 > 2.98$, so there is a difference in the level of preference for the aroma of millet flour pukis cake products with different concentrations (0%, 50%, 65%, and 80%). Thus, H_0 is rejected and H_1 is accepted. With these calculation results, the next step is to perform Duncan's test. The following are the statistical results of Duncan's test:

Table 10. Duncan's Test Results for the Aroma Hedonic Test

Hedonic Aroma			
Duncan ^a			
Sample	N	Subset for alpha = 0.05	
		1	2
80	3	2.7767	
65	3	2.8567	
50	3	2.9433	
0	3		3.1900
Sig.		.112	1.000
Means for groups in homogeneous subsets are displayed.			
a. Uses Harmonic Mean Sample Size = 3,000.			

Source: Researchers data, 2025

Table shows the results of the hedonic test using the Duncan hedonic aroma test method on the aroma attribute with $\alpha = 0.05$ in a sample of pukis cakes with white millet flour substitution. It is stated that samples with concentrations of 0%, 50%, 65%, and 80% have differences in aroma preference between one product and another.

From these calculations, it can be seen that there are different levels of aroma preference for each concentration of white millet flour substitution, with the highest

average aroma hedonic score found in the 0% sample with a value of (3.19), which means that physically, the aroma sample was very much liked by the panelists, and the lowest average-average sample with the lowest aroma preference was found in the 65% sample with a value of (2.86) and the 80% sample with a value of (2.78), which produced a dislike from the panelists. These results prove that the more white millet flour is substituted in the pukis cake dough, the lower the level of aroma preference produced by the panelists, which is a dislike.

3. Taste

The taste of a food product is very important because it can affect consumer appeal and purchasing interest. If consumers do not like the taste of a food product, they are unlikely to be interested in buying it. Conversely, if consumers like the taste of a product, they are likely to be interested in buying it. In the taste preference test, the panelists assessed the taste with different percentages of white millet flour substitution (0%, 50%, 65%, and 80%). Based on the homogeneity test results, a significance value (Sig) greater than 0.05 was obtained, so it can be concluded that the data obtained from the panelists regarding taste preference for white millet flour pukis cake products is the same or homogeneous, thus fulfilling

the homogeneity assumption in the One Way ANOVA test. After that, the following are the results of the ANOVA statistics based on the taste preference test on white millet flour pukis cake products.

Table 11. Results of the Hedonic ANOVA Taste Preference Test

ANOVA					
Hedonic Taste					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.477	3	.159	27,545	.000
Within Groups	.046	8	.006		
Total	.523	11			

Source: Researchers data, 2025

The table above shows that F calculated is greater than F table, namely with a value of **27.545 > 2.98**, so there is a difference in the level of taste preference for millet flour pukis cake products with different concentrations (0%, 50%, 65%, and 80%). Thus, H₀ is rejected and H₁ is accepted. With these calculation results, the next step is to conduct Duncan's test. The following are the statistical results of Duncan's test:

Table 12. Duncan's Test Results for the Hedonic Taste Test

ANOVA					
Hedonic Texture					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.567	3	.522	29,053	.000
Within Groups	.144	8	.018		
Total	1,710	11			

Source: Researchers data, 2025

Table shows the results of the hedonic test using the Duncan hedonic taste test method on the taste attribute with $\alpha = 0.05$ on a sample of pukis cakes with white millet flour substitution. It is stated that samples with concentrations of 0%, 50%, 65%, and 80% have differences in taste preference between one product and another.

From these calculations, it can be seen that there are different levels of taste preference for each concentration of white millet flour substitution, where the highest average hedonic taste is found in the 0% sample with a value of (3.26), which means that physically, the taste sample produced a very high level of liking from the panelists, and the lowest average-lowest sample was found in the 65% sample with a value of (2.72), which produced a dislike from the panelists. These results prove that the more white millet flour substitution in the pukis cake dough, the lower the hedonic taste level produced by the panelists, which is a dislike.

4. Texture

The texture of a food product can be felt by the sense of touch. The texture of a food product can be felt physically when touching and consuming the product. In the texture preference test, panelists assessed different percentages of white millet flour substitution (0%, 50%, 65%, and 80%). Based on the homogeneity test

results, a significance value (Sig) greater than 0.05 was obtained, so it can be concluded that the data obtained from the panelists regarding texture preference in white millet flour pukis cake products is the same or homogeneous, thus fulfilling the homogeneity assumption in the One Way ANOVA test. Following that, the results of the ANOVA statistics based on the texture preference test for white millet flour pukis cake products are as follows.

Table 13. Results of the Hedonic ANOVA Test for Texture Preference

Hedonic Taste				
Duncan ^a				
Sample	N	Subset for alpha = 0.05		
		1	2	3
65	3	2.7200		
80	3	2.8333	2.8333	
50	3		2.9000	
0	3			3.2533
Sig.		.105	.314	1.000
Means for groups in homogeneous subsets are displayed.				
a. Uses Harmonic Mean Sample Size = 3,000.				

Source: Researchers data, 2025

Note:

If Sig > 0.05, then H₀ is accepted, H₁ is rejected

Sig < 0.05, then H₀ is rejected, H₁ is accepted

Calculated F = **29.053**

F table = 2.98

Calculated F < Table F, then H₀ is accepted and H₁ is rejected, meaning there is no difference

Calculated F > Table F, then H₀ is rejected and H₁ is accepted, so there is a difference.

Table above shows that F calculated > F table, namely with a value of **29.053** > **2.98**, so there is a difference in the level of preference for the texture of millet flour pukis cake products with different concentrations (0%, 50%, 65%, and 80%). Thus, H₀ is rejected and H₁ is accepted. With these calculation results, the next step

is to conduct Duncan's test. The following are the statistical results of Duncan's test:

Table 14. Duncan's Test Results for the Texture Hedonic Test

Hedonic Texture				
Duncan ^a				
Sample	N	Subset for alpha = 0.05		
		1	2	3
80	3	2.4767		
65	3	2.5100	2.5100	
50	3		2.7433	
0%	3			3.3767
Sig.		.769	.066	1.000
Means for groups in homogeneous subsets are displayed.				
a. Uses Harmonic Mean Sample Size = 3,000.				

Source: Researchers data, 2025

Table shows the results of the hedonic test using the Duncan hedonic texture test method on the texture attribute with $\alpha = 0.05$ on a sample of pukis cake products with white millet flour substitution. It is stated that samples with concentrations of 0%, 50%, 65%, and 80% have differences in texture preference between one product and another.

From these calculations, it can be seen that there are different levels of texture preference for each concentration of white millet flour substitution, with the highest average hedonic texture found in the 0% sample with a value of (3.38), which means that physically, the texture of the sample was very much liked by the panelists, and the lowest average-lowest average sample was found in the 65% sample with a value of (2.51) and the 80%

sample with a value of (2.48), which resulted in dislike from the panelists. These results prove that the more white millet flour is substituted in the pukis cake dough, the lower the hedonic texture level produced by the panelists, which is dislike.

Hedonic Quality Test

Hedonic quality testing was conducted to test the quality differences of the samples in terms of color, aroma, taste, and texture in millet flour pukis cake products. In this hedonic quality test, the researcher used a panel of 30 semi-trained panelists. The average quality test scores for the parameters of color, texture, aroma, and taste can be seen in the hedonic quality test table.

Table 15. Hedonic Quality Test

HEDONIC QUALITY TEST					
Parameter	Repetition	Substitution			
		0	50	65	80
Color	1	3.37	2.87	2.30	2.50
	2	3.50	2.83	2.87	2.83
	3	3.33	2.83	2.60	2.80
Average		3.40	2.84	2.59	2.71
Aroma	1	2.93	2.63	2.30	2.37
	2	2.83	2.57	2.40	2.50
	3	2.80	2.57	2.43	2.53
Average		2.86	2.59	2.38	2.47
Taste	1	3.27	3.03	3.07	3.00
	2	3.20	3.10	2.73	3.07
	3	3.27	3.07	2.80	2.87
Average		3.24	3.07	2.87	2.98
Texture	1	3.40	2.83	2.57	2.53
	2	3.37	2.93	2.80	3.07
	3	3.37	2.77	2.60	2.67
Average		3.38	2.84	2.66	2.76
Total Average		3.22	2.84	2.62	2.73

Source: Researchers data, 2025

Based on the above description, the researcher can conclude that there are differences in the results of the hedonic test and hedonic quality for each parameter tested on pukis cake products with white millet flour substitution, resulting in different levels of preference and quality for each sample. The level of preference and quality (color, aroma, taste, and texture) of pukis cakes with various concentrations of white millet flour substitution are generally considered to be as good as wheat flour pukis cakes with a fluffy and soft texture and a yellow color (Megasari, 2023). The experimental results indicate that the most preferred sample with the highest quality is the white millet flour pukis cake with a 50% concentration of white millet flour, featuring a light brown color, a fragrant vanilla aroma, a moderately sweet and savory taste, and a sufficiently soft texture.

1. Color

Based on the homogeneity test results, a significance value (Sig) greater than 0.05 was obtained, so it can be concluded that the data obtained from the panelists regarding the color quality aspect of white millet flour pukis cake products is the same or homogeneous, thus fulfilling the homogeneity assumption in the One Way ANOVA test. After that, the following are the results of the ANOVA statistics based

on the hedonic quality test on the color aspect of white millet flour pukis cake products.

Table 16. ANOVA Results of the Color Hedonic Quality Test

ANOVA					
Color Hedonic Quality					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.154	3	.385	12,504	.002
Within Groups	.246	8	.031		
Total	1,400	11			

Source: Researchers data, 2025

Note:

If Sig > 0.05, then H₀ is accepted, H₁ is rejected

Sig < 0.05, then H₀ is rejected, H₁ is accepted

Calculated F = **12.504**

F table = 2.98

Calculated F < Table F, then H₀ is accepted and H₁ is rejected, meaning there is no difference

Calculated F > Table F, then H₀ is rejected and H₁ is accepted, so there is a difference.

Table above shows that F calculated > F table, namely with a value of **12.504** > **2.98**, so there is a difference in hedonic quality in terms of color in millet flour pukis cake products with different concentrations (0%, 50%, 65%, and 80%). Thus, H₀ is rejected and H₁ is accepted. With the calculation results of , the next step is to conduct Duncan's test. The following are the statistical results of Duncan's test:

Table 17. Duncan's Test Results for the Color Hedonic Quality Test

Hedonic Quality Color			
Duncan ^a			
Sample	N	Subset for alpha = 0.05	
		1	2
65	3	2.5900	
80	3	2.7100	
50%	3	2.8433	
0	3		3.4000
Sig.		.128	1.00

Means for groups in homogeneous subsets are displayed.
a. Uses Harmonic Mean Sample Size = 3,000.

Source: Researchers data, 2025

Table shows the results of the hedonic quality test using the Duncan color quality test method on the color attribute with $\alpha = 0.05$ on a sample of pukis cakes with white millet flour substitution. It is stated that samples with concentrations of 0%, 50%, 65%, and 80% have differences in color quality between one product and another.

From these calculations, we can see the phenomenon of different color quality levels in each concentration of white millet flour substitution, where the highest average hedonic color quality is found in the 0% sample with a value of (3.40), which means that physically, the sample generally produces a yellow color, and the lowest average-average sample was found in the 65% white millet flour substitution sample with a value of (2.59), producing a yellowish-brown color. These results prove that the more white millet flour is substituted in the pukis cake batter, the more the resulting color will change to brown.

2. Aroma

Based on the homogeneity test results, a significance value (Sig) greater than 0.05 was obtained, so it can

be concluded that the data obtained from the panelists regarding the aroma quality aspect of white millet flour pukis cake products is the same or homogeneous, so the homogeneity assumption in the One Way ANOVA test is fulfilled. Following that, the results of the ANOVA statistics based on the hedonic quality test on the aroma aspect of white millet flour pukis cake products are as follows.

Table 18. ANOVA Results of the Hedonic Quality Test for Aroma

ANOVA					
Aroma Hedonic Quality					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.386	3	.129	29,090	.000
Within Groups	.035	8	.004		
Total	.422	11			

Source: Researchers data, 2025

Note:

If Sig > 0.05, then H0 is accepted, H1 is rejected

Sig < 0.05, then H0 is rejected, H1 is accepted

Calculated F = **29.090**

F table = 2.98

Calculated F < Table F, then H0 is accepted and H1 is rejected, meaning there is no difference

Calculated F > Table F, then H0 is rejected and H1 is accepted, so there is a difference

Table above shows that F calculated > F table, namely with a value of **29.090** > **2.98**, so there is a difference in hedonic quality in terms of aroma in millet flour pukis cake products with different concentrations (0%, 50%, 65%, and 80%). Thus, H0 is rejected and H1 is accepted. With these calculation results, the next step is to conduct Duncan's test. The following are the statistical results of Duncan's test:

Table 19. Duncan's Test Results for the Aroma Hedonic Quality Test

Aroma Hedonic Quality				
Duncan ^a				
Sample	N	Subset for alpha = 0.05		
		1	2	3
65	3	2.3767		
80	3	2.4667	2.4667	
50	3		2.5900	
0	3			2.8533
Sig.		.136	.053	1.000
Means for groups in homogeneous subsets are displayed.				
a. Uses Harmonic Mean Sample Size = 3,000.				

Source: Researchers data, 2025

Table shows the results of the hedonic quality test using the Duncan aroma quality test method on the aroma attribute with $\alpha = 0.05$ on a sample of pukis cakes with white millet flour substitution. It is stated that samples with concentrations of 0%, 50%, 65%, and 80% have differences in aroma quality between one product and another.

From these calculations, it can be seen that there is a phenomenon of different levels of aroma quality in each concentration of white millet flour substitution, where the highest average aroma hedonic quality is found in the 0% sample with a value of (2.86), which means that physically the sample produces a vanilla aroma, and the lowest average sample is found in the 65% sample with a value of (2.38), which produces a slightly fragrant vanilla aroma. These results prove that the more white millet flour is

substituted in the dough, the more the aroma quality decreases.-average aroma quality was found in the 65% sample with a value of (2.38), which produced a slightly fragrant vanilla aroma. These results prove that the more white millet flour is substituted in the pukis cake batter, the less vanilla aroma is produced.

3. Taste

Based on the homogeneity test results above, a significance value (Sig) greater than 0.05 was obtained, so it can be concluded that the data obtained from the panelists regarding the taste quality of white millet flour pukis cake products is the same or homogeneous, thus fulfilling the homogeneity assumption in the One Way ANOVA test. Following that, the results of the ANOVA statistics based on the hedonic quality test on the taste aspect of the white millet flour pukis cake product are as follows.

Table 20. ANOVA Results of the Hedonic Quality Test for Taste

ANOVA					
Hedonic Quality Taste					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.231	3	.077	6,790	.014
Within Groups	.091	8	.011		
Total	.322	11			

Source: Researchers data, 2025

Table above shows that F calculated > F table, namely with a value of **6.790** >

2.98, so there is a difference in hedonic quality in terms of taste in millet flour pukis cake products with different concentrations (0%, 50%, 65%, and 80%). Thus, H₀ is rejected and H₁ is accepted. With these calculation results, the next step is to conduct Duncan's test. The following are the statistical results of Duncan's test:

Table 21. Duncan's Test Results for Hedonic Quality Taste

Hedonic Quality Taste			
Duncan ^a			
Sample	N	Subset for alpha = 0.05	
		1	2
65	3	2.8667	
80	3	2.9800	
50	3	3.0667	3.0667
0	3		3.2467
Sig.		.058	.072
Means for groups in homogeneous subsets are displayed.			
a. Uses Harmonic Mean Sample Size = 3,000.			

Source: Researchers data, 2025

Table shows the results of the hedonic quality test using the Duncan taste quality test method on the taste attribute with $\alpha = 0.05$ on a sample of pukis cakes with white millet flour substitution. It is stated that samples with concentrations of 0%, 50%, 65%, and 80% have differences in taste quality between one product and another.

From these calculations, it can be seen that there are different levels of taste quality in each concentration of white millet flour substitution, where the highest average hedonic taste quality is found in the 0% sample with a value of (3.24), which means that physically, the sample produces a fairly sweet and savory taste, and the lowest average-lowest sample was found in

the 65% sample with a value of (2.87), producing a less sweet and savory taste. These results prove that the more white millet flour is substituted in the pukis cake batter, the more it will slightly alter the taste of the resulting product.

4. Texture

Based on the homogeneity test results, a significance value (Sig) greater than 0.05 was obtained, so it can be concluded that the data obtained from the panelists regarding the quality of the texture aspect of white millet flour pukis cake products is the same or homogeneous, so the homogeneity assumption in the One Way ANOVA test is fulfilled. Following that, the following are the results of the ANOVA statistics based on the hedonic quality test on the texture aspect of the white millet flour pukis cake product.

Table 22. ANOVA Results of the Texture Hedonic Quality Test

ANOVA					
Hedonic Quality Texture					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.939	3	.313	12.397	.002
Within Groups	.202	8	.025		
Total	1.141	11			

Source: Researchers data, 2025

Note:

If Sig > 0.05, then H₀ is accepted, H₁ is rejected

Sig < 0.05, then H₀ is rejected, H₁ is accepted

Calculated F = 12.397

F table = 2.98

Calculated F < Table F, then H₀ is accepted and H₁ is rejected, meaning there is no difference

Calculated F > Table F, then H₀ is rejected and H₁ is accepted, so there is a difference.

Table above shows that F calculated $> F$ table, namely with a value of **12.397** > 2.98 , so there is a difference in hedonic quality in terms of texture in millet flour pukis cake products with different concentrations (0%, 50%, 65%, and 80%). Thus, H_0 is rejected and H_1 is accepted. With these calculation results, the next step is to conduct Duncan's test. The following are the statistical results of Duncan's test.

Table 23. Duncan's Test Results for Hedonic Quality of Texture

Hedonic Quality Texture			
Duncan ^a			
Sample	N	Subset for alpha = 0.05	
		1	2
65	3	2.6567	
80	3	2.7567	
50	3	2.8433	
0	3		3.3800
Sig.		.205	1.000
Means for groups in homogeneous subsets are displayed.			
a. Uses Harmonic Mean Sample Size = 3,000.			

Source: Researchers data, 2025

Table shows the results of the hedonic quality test using the Duncan texture quality test method on the texture attribute with $\alpha = 0.05$ on pukis cake samples with white millet flour substitution. It is stated that samples with concentrations of 0%, 50%, 65%, and 80% have differences in texture quality between one product and another.

From these calculations, it can be seen that there are different levels of texture quality in each concentration of white millet flour substitution, where the highest average hedonic texture quality is found in the 0% sample with a value of (3.38), which means that physically, the sample produces a very soft texture, and the lowest average lowest average sample is found in the 65% sample with a value of (2.66), which produces a fairly soft texture. These results prove that the more white millet flour is substituted in the pukis cake dough, the more it will reduce the softness of the resulting product.

The Optimal Concentration of Millet Flour as a Substitute in Pukis Cake Production

Based on the above description, the researchers can conclude that there are differences in the results of the hedonic quality test for each parameter tested on pukis cake products with white millet flour substitution, resulting in different quality levels for each sample. Therefore, the quality of pukis cake with white millet flour substitution is quite good. Through the experiment of making pukis cakes with white millet flour substitution, it can be seen that there are differences in the

organoleptic characteristics (color, aroma, taste, and texture) of pukis cake products made from wheat flour and white millet flour. Therefore, the best sample of pukis cake substituted with white millet flour in terms of color, aroma, taste, and texture is pukis cake with a 50% concentration of white millet flour.

CONCLUSION

Based on the observations, data analysis, and discussion, it can be concluded that pukis cakes with different percentages of white millet flour substitution affect the panelists' acceptance of the product in terms of color, aroma, taste, texture, and overall acceptance, as well as color quality, aroma quality, taste quality, and texture quality in pukis cakes. Then, based on the organoleptic test on millet flour pukis cakes, the product with 50% millet flour substitution was the sample with the highest level of preference and quality in terms of color, aroma, taste, and texture.

This study has limitations in terms of understanding and time related to the methodology in drawing conclusions about the research results by the researcher, as well as the limitations of the researcher's energy and time in conducting the main research. However, it is hoped that the trial production of pukis cakes with white millet

flour substitution can serve as a reference for the public to process and utilize millet seeds into food products or snacks that can meet the body's fiber and nutritional needs.

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