



Organoleptic Differences of Biscuits Made From Yellow Pumpkin Flour as a Substitution of Wheat Flour

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Abstract

Introduction: Wheat flour is made from wheat which is a sub-tropical plant that can be grown easily in tropical environment like Indonesia. In response to this, efforts need to be made to find substitutes for wheat flour through increasing local food acceptability to reduce import dependence of wheat. This study aimed to analyze and determine the organoleptic differences of biscuits made from yellow pumpkin flour.

Methods: This type of research is experimental with a completely random design consisting of 6 treatments, namely P1 (0% yellow pumpkin flour : 100% wheat flour), P2 (10% yellow pumpkin flour : 90% wheat flour), P3 (20% yellow pumpkin flour : 80% wheat flour), P4 (30% yellow pumpkin flour : 70% wheat flour), P5 (40% yellow pumpkin flour : 60% wheat flour) and P6 (50% yellow pumpkin flour : 50% wheat flour). Data were analyzed using the Kruskal Wallis test with a significance level of 1% and Mann Whitney test.

Results: The results showed that the organoleptic value of biscuits with the highest acceptability from the color aspect was at P2 (3,72), aromatic smell at P2 (3,68), taste at P1 (3,76), and texture at P1 (3,52).

Conclusion: This study may conclude the potential use of yellow pumpkin flour mixture when preparing wheat-base biscuits. Therefore, import dependency of wheat can be reduced.

Keywords: Biscuits, Organoleptic, Wheat Flour, Yellow Pumpkin

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Introduction

The needs of wheats in Indonesia highly depends on the import from other countries. Wheat plants are subtropical plants, in which they cannot be grown easily in Indonesia.¹ Indonesia's dependency on wheat flour and wheat imports is high. Based on data from the Central Statistics Agency in 2019, Indonesia has imported wheat flour up to 34,467 tons. The import figure of wheat flour increased by around 2,6 million tons from the previous year. As for wheat imports, from 2010 to 2020 Indonesia imported wheat, which is the main ingredient of wheat flour, continues to

increase. In 2010 Indonesia imported 4,8 million tons of wheat and increased to 10.3 million tons in 2020.² The growth of national wheat consumption has also placed Indonesia as one of the largest wheat importers in the world. Based on APTINDO data, in 2020 Indonesia's flour consumption has reached 6.66 million tons or a monthly average of 500 thousand tons. The wheat flour consumption increased slightly by 0,47% from the previous year's consumption. Data from the Ministry of Agriculture also showed that the growth of per capita consumption of wheat flour in 2014-2018 continues to increase per year, reaching 19.92%.³ If Indonesia continues

to depend on wheat and wheat imports to meet domestic needs, it may affect the stability of national food security.¹

Efforts need to be made to find substitutes of wheat flour that can be obtained locally or local produces. Local ingredients used are produces that have characteristics that can play a role in replacing the function of wheat flour. The ingredients chosen to replace wheat flour should prioritize local produces that have not had previous use value. These local produces can be considered for their nutritional content to increase the nutritional value of the product. One of the efforts to reduce the use of flour requires food diversification by substituting wheat flour using flour from other commodities.⁴

Previous studies have tried to find alternative produces that can reduce or eliminate the use of wheat flour. Of these are tofu pulp flour,⁵ tempeh flour,⁶ banana flour,⁷ sorghum flour,⁸ breadfruit flour and rice flour.⁹ One alternative ingredient that can be used to replace wheat flour is yellow pumpkin flour.

Yellow pumpkin (*Cucurbita moshata*) is one of the food source plants that has a high nutritional content and fine fiber so it is easily digested. The distribution of yellow pumpkin fruit is widely distributed in Indonesia, almost all islands in Indonesia have their yellow pumpkin plants. Yellow pumpkin plants have high adaptability to the environment that can grow well in the lowlands and highlands. The yellow pumpkin plant variant can grow well in dry areas with moderate rainfall at altitudes between 1.000-3.000 meters above sea level.¹⁰ The utilization of yellow gourd is still very limited. This is because people are still not aware of the potential and nutritional content of yellow pumpkin even though the availability of yellow pumpkin in Indonesia is very abundant. In 2014 it was reported that the national production of yellow pumpkin was 523,063 tons. The large amount of yellow pumpkin production in Indonesia is not directly proportional to the amount of yellow pumpkin consumption. Yellow pumpkin consumption in Indonesia is still low. Data from the Ministry of Agriculture on Food Consumption Statistics in 2020 shows that the average

consumption of pumpkin is only 1,786 kg per capita per year.²

The comparison of nutritional content in yellow pumpkin flour and wheat flour is that yellow pumpkin flour has 328 kcal of energy, 77.6 grams of carbohydrates, 5 grams of protein, and 0.5 grams of fat. While the nutritional content of wheat flour is 365 kcal energy, 77.3 grams carbohydrates, 8.9 grams protein and 1.3 grams fat. In view of the nutritional content between wheat flour and yellow pumpkin which is almost the same, yellow pumpkin can be an alternative to replace wheat flour.¹¹

One of the food products made from flour is biscuit. This biscuit product has a long shelf life because it is dry, small in shape so it is easy to pack and very attractive when served. Data from the Central Bureau of Statistics on Food Consumption Statistics in 2020 shows that the average consumption of biscuits in Indonesia is very high, namely 22,834 kg / year.² Therefore, biscuits are one of the foods that are favored by the community and even biscuits have always been a mandatory food served on every holiday.

In this study, researchers want to make different formulations in making biscuits as a form of diversifying local food by using alternative wheat flour substitutes, namely yellow pumpkin flour mixed with other ingredients. The addition of other ingredients aims to make biscuits have better nutritional composition and physical quality. The substitution of wheat flour with yellow pumpkin flour in processed biscuits is expected to increase the proportion use of yellow pumpkin and wheat. Furthermore, processed biscuits made from wheat flour mixed with yellow pumpkin flour were tested for organoleptic value. The organoleptic value of biscuits made from yellow pumpkin flour includes color, smell, taste and texture which aimed to determine the acceptability of biscuits in the community.

Methods

The study was conducted using a type of experimental research with a complete randomized design design. This study consisted of six treatments, namely P1 (0% yellow pumpkin flour : 100% wheat flour),

P2 (10% yellow pumpkin flour : 90% wheat flour), P3 (20% yellow pumpkin flour : 80% wheat flour), P4 (30% yellow pumpkin flour :70% wheat flour), P5 (40% yellow pumpkin flour : 60% wheat flour) and P6 (50% yellow pumpkin flour : 50% wheat flour).

Organoleptic testing was conducted at the Faculty of Public Health, Nusa Cendana University. The organoleptic test used a favorability or acceptability test which include color, smell, taste and texture on biscuits made from yellow pumpkin flour with wheat flour substitution. Organoleptic tests were performed on 25 untrained panelists. Panelists in this study were public health students of Nusa Cendana University. Panelists were healthy, not color blind, not hungry and do not refuse food to be tested (not allergic). The organoleptic test data that have been collected were analyzed using the Kruskal Wallis test with a significance level of 1% ($\alpha=0.001$). If there was an average difference in each parameter or aspect of the test, it was followed by the Mann Whitney test. This research has received ethical approval from the Health Research Ethics Commission, Faculty of Public Health, Nusa Cendana University with the number of 2022413-KEPK.

Tools and materials used in making biscuits substituting wheat flour with yellow pumpkin flour start from preparation, processing and packaging. The ingredients used are yellow pumpkin flour, low protein wheat flour, water, margarine, flour sugar, milk powder, eggs and cheddar cheese.

The working procedure in this study consisted of making yellow pumpkin flour, making biscuits and organoleptic tests. The type of biscuits made in the study was cat tongue biscuits. Cat tongue biscuits are cakes made from wheat flour, fat, eggs and sugar that have a shape resembling a cat's tongue, with a yellowish / golden color, crumbly, crispy and sweet taste. The biscuit manufacturing process¹²:

Material Composition:

- 1) Ingredients: 120 grams of margarine, 30 grams of flour sugar, 100 grams of low protein flour, 20 grams of finely grated cheese and 15 grams of milk powder, 3 egg white and 50 grams of flour sugar.

- 2) Topping: 100 grams of cheddar cheese, grated lengthwise.

How to make:

- 1) Mix margarine and flour sugar until white and soft.
- 2) Add flour and milk while sifting, beating using a mixer until all is well mixed. Add grated cheese, mix well.
- 3) Mix the egg whites until half fluffy.
- 4) Add flour sugar, mix again until fully fluffy.
- 5) Add egg whites to the wheat dough, mix well.
- 6) Put the dough into a plastic triangle, then cut out the ends.
- 7) Spray on a baking sheet that has been smeared with margarine to form a dough. Sprinkle grated cheese on top.
- 8) Bake in the oven at 150°C for approximately 20 minutes.

The implementation of organoleptic tests were carried out by the following procedures: Each biscuit sample was made based on a predetermined recipe, namely by substituting wheat flour with yellow pumpkin flour. Sample P1 (0% yellow pumpkin flour: 100% wheat flour) was used as a standard or control biscuit. Biscuit samples were presented in different codes in the following way: each panelist was faced with five types of biscuit samples and one standard/control biscuit type. In its presentation, sample biscuits were given together or standard biscuits first and then samples. Panelists conducted organoleptic tests on color, smell, taste and texture on biscuit samples and wrote responses on questionnaires that had been provided. Every time the sample changes, panelists had to drink water first to neutralize the sense of taste.

Results

Organoleptic Test Results on Color

Color is a very important component to determine the quality or degree of acceptance of biscuits. A food product although considered delicious and very good texture, but if it has a color that is less attractive or gives the impression of deviating from the color it should be, then it should not be consumed. Determining the

quality of a food product generally depends on color, because color appears first.

Biscuits made from yellow pumpkin flour as a substitute for wheat flour consisting of six treatments were tested for organoleptic values from the aspect of color with questionnaires on untrained

panelists using Likert scale. To assess the overall biscuit favorability of each treatment, the scores given by panelists on the questionnaire were calculated as an average score. The results of organoleptic assessment of biscuits substituting wheat flour with yellow pumpkin flour on color to 25 panelists can be seen in **Table 1**.

Table 1. Organoleptic Test Results of Wheat Flour Substitution Biscuits with Yellow Pumpkin Flour

Parameter	Average Value of Biscuit Organoleptic Test						P-value
	P1	P2	P3	P4	P5	P6	
Color	3.36±0.86 ^a	3.72±0.84 ^a	3.48±0.82 ^a	3.28±0.89 ^a	3.64±0.99 ^a	3.60±1.08 ^a	0.500

Information: ^{a, b} Similar letter notation means there is no noticeable difference in the Mann-Whitney test grade having a value of 1%.

Table 1 shows that the average value of biscuit organoleptic test on color ranges from 3.28 – 3.72. Panelists acceptability of biscuit color was highest in P2 treatment (10% yellow pumpkin flour: 90% wheat flour) with an average value of 3.72 or like category while the lowest biscuit acceptability was in P4 treatment (30% yellow pumpkin flour : 70% wheat flour) with an average value of 3.28 or at the level of the somewhat like category.

Based on the Kruskal-Wallis statistical test at a 99% confidence level, a p-value of 0.500 was obtained, so it can be concluded that there is no significant average difference in biscuit color (p-value > 0.01).

Because the results of Wallis' crucial test showed that there was no real difference in color (p-value > 0.01), there was no need to continue with the Mann Whitney test.

Organeleptic Test Results of Biscuits Against Smell or Aromatic

Aroma is one aspect that supports biscuits will be liked by panelists or not, with a fragrant aromatic that will attract someone to taste it. The results of organoleptic assessment of biscuits substituting wheat flour with yellow pumpkin flour on aroma to 25 panelists can be seen in **Table 2**.

Table 2. Organoleptic Test Results of Biscuit Aroma Substitution of Wheat Flour with Yellow Pumpkin Flour

Parameter	Average Value of Biscuit Organoleptic Test						P-value
	P1	P2	P3	P4	P5	P6	
Aroma	3.36±1.19 ^a	3.68±0.90 ^a	3.6 ± 0.82 ^a	3.4 ± 0.87 ^a	3.52±1.00 ^a	2.96±0.89 ^a	0.096

Information: ^{a, b} Similar letter notation means there is no noticeable difference in the Mann-Whitney test grade having a value of 1%.

Table 2 shows that the average value of biscuit organoleptic test on aroma ranges from 2.96 – 3.68. Panelists' acceptability to biscuit aroma was the highest in P2 treatment (10% yellow pumpkin flour : 90% wheat flour) with an average value of 3.68 or like category while biscuit acceptability was lowest in P6 treatment (50% yellow pumpkin flour : 50% wheat flour) with an average value of 2.96 or at the level of somewhat like category.

Based on the Kruskal-Wallis statistical test at a 99% confidence level, a p-value of

0.096 was obtained, so it can be concluded that there is no significant average difference in biscuit smell (p > 0.01). Because the results obtained are greater than the value of the significance level, there is no need for further tests.

Biscuit organoleptic test results on taste

Taste is the most important aspect in determining the quality of a biscuit after texture, color, and aroma. Taste arises due to chemical stimuli received by the sense of taste, namely the tongue. The results of the

organoleptic assessment of biscuits substituting wheat flour with yellow

pumpkin flour on taste to 25 panelists can be seen in **Table 3**.

Table 3. Organoleptic Test Results of Biscuit Flavor Substitution of Wheat Flour with Yellow Pumpkin Flour

Parameter	Average Value of Biscuit Organoleptic Test						P-value
	P1	P2	P3	P4	P5	P6	
Taste	3.76±0.88 ^{abc}	3.56±0.96 ^{ad}	3.64±0.95 ^{aef}	3.16±0.80 ^{ah}	2.92±1.00 ^{bdeh}	2.8±1.08 ^{cdgh}	0.002
Information:	^{a, b} Similar letter notation means there is no noticeable difference in the Mann-Whitney test grade having a value of 1%.						

Table 3 shows that the average value of biscuit organoleptic test on taste aspects ranges from 2.8 – 3.76. Panelists' acceptance of biscuit taste was the highest in P1 treatment (0% yellow pumpkin flour : 100% wheat flour) with an average value of 3.76 or like category. While the lowest biscuit acceptability is in the P6 treatment (50% yellow pumpkin flour : 50% wheat flour) with an average value of 2.8 or at the level of the somewhat like category.

Based on the Kruskal-Wallis statistical test at a 99% confidence level, a p-value of 0.002 was obtained so that there was a significant average difference in biscuit flavor organoleptics ($p < 0.01$). Because there was a significant difference in average, the analysis was continued with the Mann Whitney test to see which treatments have differences in average

values. The results of the mann whitney test showed a significant average difference between P1 treatment with P5, P1 with P6, and P3 with P6.

Biscuit organoleptic test results on texture

Texture is the second most important aspect in biscuit standards that determines whether or not the quality of biscuits is good. Panelists tended to prefer crispy textured biscuits over regular ones. Texture is a sensation of pressure that can be observed with the mouth when bitten, chewed, and swallowed or touched with fingers. Texture is one of the important assessment aspects in biscuit organoleptic testing. The results of organoleptic assessment of biscuits substituting wheat flour with yellow pumpkin flour on color to 25 panelists can be seen in **Table 4**.

Table 4. Organoleptic Test Results of Biscuit Texture Substitution of Wheat Flour with Yellow Pumpkin Flour

Parameter	Average Value of Biscuit Organoleptic Test						P-value
	P1	P2	P3	P4	P5	P6	
Texture	3.52±0.96 ^a	3.28±0.98 ^a	3.16±1.03 ^a	3.32±0.90 ^a	2.6±0.96 ^a	3.04±1.31 ^a	0.057
Information:	^{a, b} Similar letter notation means there is no noticeable difference in the Mann-Whitney test grade having a value of 1%.						

Table 4 shows that the average value of biscuit organoleptic test on texture aspects ranges from 2.6 – 3.52. Panelists' acceptance of biscuit texture was the highest in P1 treatment (0% yellow pumpkin flour : 100% wheat flour) with an average value of 3.52 or like category. While the biscuits with the lowest acceptability are P5 treatment (40% yellow pumpkin flour : 60% wheat flour) with an average value of 2.6 or at the level of the somewhat like category.

Based on the Kruskal-Wallis statistical test at a 99% confidence level, a p-value of 0.057 was obtained so that there was no

significant average difference in biscuit texture ($p > 0.01$). Because the results of Kruskal Wallis's test said that there was no real difference in color ($p\text{-value} > 0,01$), there was no need to continue with the Mann Whitney test.

Discussion

Color largely determines the panelists' assessment of a product to look like it or not. The color factor is an initial parameter that subjectively and visually must be considered because it can lead to acceptance or rejection of the product.¹³ A food ingredient served will first be assessed

in terms of color. Although the nutritional content is good, if the color is not attractive to look at and gives the impression that it has deviated from the color it should be, consumers will give a bad assessment.

In the formula with variations in the addition of yellow pumpkin flour, it shows that the more yellow pumpkin flour used to replace wheat flour, the color of the biscuits produced is more yellowish. This yellow color is produced by yellow pumpkin flour which contains beta carotene. Beta carotene determines the yellow/orange color of the resulting fruit.¹⁴ The color change is due to the Maillard reaction between reducing sugars and amino acids and the end result is melanoidin.¹⁵ The results of this study are in line with the other research which shows the manufacture of yellow pumpkin substitution biscuits 10%, 20% and 30% of the color of the biscuits produced tends to be darker and yellowish so that the level of panelists on color decreases.¹⁶ Yellow pumpkin has a high lycopene and lutein content which is the source of yellow color in yellow pumpkin, so the more carotenoid content in yellow pumpkin, the more yellow color will appear in product.¹⁷

The aromatic smell of the food produced will determine the deliciousness of the food, therefore it is one of the factors in determining quality. In general, the smell received by the nose and brain is more a variety of herbs or a mixture of four main odors, namely fragrant, sour, rancid and charred. In this case, the aroma has more to do with the five senses of smell. A distinctive and attractive aroma can make food more preferred by consumers so it needs to be considered in the processing of a food ingredient.

The increasing percentage of using yellow pumpkin flour to substitute wheat flour has increased. Biscuit products with the addition of yellow pumpkin flour have a '*langu*' aroma. The research is in line with the other research that the aroma of '*langu*' is caused by flavonoid chemical compounds in yellow pumpkin. This also has an impact on biscuit products that panelists like. The more yellow pumpkin flour was used, the panelists' assessment of organoleptic aroma tended to decrease.¹⁸ This change in aroma is also determined by the composition of the

ingredients and the mechanism of the Maillard reaction, so that the aroma caused is thought to be a combination of glucose degradation results, namely formaldehyde and furaldehyde.¹³

The taste of food is one of the determining factors of food ingredients. Food that has a good and attractive taste will be liked by consumers. The taste of a product affects the level of consumer acceptance. Although the other parameters are good, if the taste is not liked then the product will be rejected.¹³

In this study, the biscuit flavor most preferred by panelists was biscuits in P1 treatment with a value of 3.76 (in the like category) which was a control treatment without the addition of yellow pumpkin flour, where biscuits did not have the typical taste of yellow pumpkin. Meanwhile, after adding yellow pumpkin flour and the higher the addition of yellow pumpkin flour, the change in the taste of the yellow pumpkin mixture on biscuits is stronger. As for biscuit treatment outside the control of biscuit taste, the most preferred by panelists is biscuits with P3 treatment with a value of 3.64 (in the like category).

The more substitutions of yellow pumpkin flour used, the more pronounced the distinctive taste of yellow pumpkin. The taste formed in biscuit cake is sweetness, caused by the carbohydrate content contained in yellow pumpkin flour and the percentage amount of yellow pumpkin flour used. The greater the percentage of pumpkin flour used in making biscuits, the sweeter the biscuit flavor will be.

Organoleptic tests based on taste show that the most preferred taste was the taste in the first formula which was also a standard formula without yellow pumpkin flour substitution. The same results were also obtained that the addition of yellow pumpkin to biscuit products where the biscuit recipe without the addition of yellow pumpkin flour is a biscuit product with the most preferred taste of panelists. In this study, of the six treatment groups with yellow pumpkin flour substitution, they showed a tendency to decrease liking for taste along with the addition of yellow pumpkin flour.

The higher the percentage of yellow pumpkin flour used in biscuit formulations, the sweeter the resulting taste will be.

Yellow pumpkin flour contains reducing sugars which, in addition to triggering Maillard reactions that affect color, also give sweetness to the product. The sugar content in yellow pumpkin flour was 19.27-21.34%.

Texture is an external appearance of biscuits that can be felt using the tongue, namely hard or soft biscuits. The texture of biscuits with yellow pumpkin flour substitution was influenced by the thickness of dough forming. The texture of biscuit products is related to the composition and type of raw materials used. Wheat flour is the main component in most biscuit doughs which can provide an elastic texture due to its gluten content and provides a dense texture after baking. Starch is another important component in wheat flour and other flours. Water is bound by starch when gelatinization occurs and will be lost at the time of roasting. This causes the dough to turn crispy in baked products. The texture of a food ingredient is one of the physical properties of food.

The texture of the resulting biscuits tends not to be crispy. The higher the use of yellow pumpkin flour, the more texture it produces. The texture formed in biscuits is caused by less gluten content in the dough and makes the biscuits less fluffy. This is in line with the other research that the content of amylose (9.86%) and amylopectin (1.22%) contained in yellow pumpkin flour is very small compared to wheat flour, this makes yellow pumpkin flour sticky and wet when added water.¹³ So that the use of yellow pumpkin flour in making biscuits must be accompanied by the use of wheat flour containing amylopectin and high amylose so that food products can expand not sticky and sticky.

Conclusion

It is concluded that the organoleptic level of biscuits in the P1-P6 treatment from the aspects of color, aromatic smell, taste, and texture are each in the category of like preferences. There is an average difference in the results of the organoleptic value of biscuits on the taste aspect, while there was no difference in the aspects of color, aromatic smell and texture. The highest acceptable biscuit treatment in terms of color and aromatic smell is P2 (10% yellow pumpkin flour: 90% wheat

flour), while in terms of taste and texture is P1 (0% yellow pumpkin flour: 100% wheat flour). This study can highlight the potential use of yellow pumpkin flour mixture when preparing the wheat-base biscuits.

Ethics approval

This research has received ethical approval from the Health Research Ethics Commission, Faculty of Public Health, Nusa Cendana University with number: 2022413-KEPK.

Availability of data and materials

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Author Contribution

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