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The Effect of Kimpul Flour Substitution (*Xanthosoma sagittifolium*) in Manufacturing *Muffins* on Consumer Acceptance and Physical Quality

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Abstract
This study aims to evaluate the effect of substitution of kimpul flour (Xanthosoma sagittifolium) at the levels of 10%, 30%, and 50% on consumer acceptance and physical quality of muffins. The study was conducted using an experimental method involving 30 semi-trained panelists as respondents. Consumer acceptance data were analyzed using the Friedman test followed by the Tukey test, while physical quality data were analyzed using analysis of variance (ANOVA) and Duncan's follow-up test. The results showed that the formulation with a 10% substitution of kimpul flour achieved the highest level of acceptance in terms of color, taste, aroma, texture, and crumb attributes. In addition, the substitution of kimpul flour had a significant effect on the rise power of the muffin, but did not show a significant difference in the value of baking loss. Based on the research results, it can be concluded that the substitution of kimpul flour by 10% is the most optimal formulation because it produces a higher level of consumer acceptance and better physical quality of the product compared to other formulations. Keywords: kimpul flour, muffin, consumer acceptance, physical quality.

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1. INTRODUCTION

Muffins are a bakery product widely consumed as a snack or breakfast item due to their sweet, convenient, and filling taste. Unlike bread, muffins are made without yeast and have a denser texture with a relatively simple production process. As bakery consumption increases in Indonesia, the demand for wheat flour, the primary ingredient, also continues to rise. This situation drives the need for food diversification through the use of local foodstuffs that have the potential to partially replace wheat flour. One local commodity with this potential is the kimpul tuber (*Xanthosoma sagittifolium*), namely tuber plants that grow abundantly in tropical regions and have a fairly high carbohydrate content (Prakoso, 2011).

Kimpul tubers are a local food source containing carbohydrates, protein, dietary fiber, vitamins, and minerals such as calcium and phosphorus. Processing kimpul tubers into flour offers various benefits, including extending shelf life, facilitating storage and distribution, and increasing the flexibility of its use as a raw material for various food products. Furthermore, developing kimpul flour as an alternative food ingredient can support food diversification programs based on local resources while reducing dependence on wheat flour, which is largely derived from imported wheat (Wariyah, 2012). However, kimpul flour has a very low gluten content, so its use in bakery products has the potential to affect the physical and sensory characteristics of the resulting product.

Several previous studies have reported the use of tuber flour as a substitute for wheat flour in muffin products. Research by Fatimah, Artanti, and Febriana (2026) on substitution of 10%, 20%, and 30% of Cilembu sweet potato flour showed that the use of tuber flour was still able to produce muffins with good physical properties and sensory quality. In this study, the 30% substitution of Cilembu sweet potato flour resulted in high rise power and sensory quality acceptable to consumers. Another study conducted by Yuda Agustian and Imania Ayu (2025) also showed that substitution of 25% and 50% of yellow sweet potato flour did not have a significant effect on the sensory characteristics of muffins, including color, aroma, taste, and texture. In addition, research by Nabila, Yulianti, and Sachriani (2025) on substitution of gembili flour in muffins showed an effect on several sensory attributes, especially the color and texture of the product skin, although most other sensory attributes did not show significant differences.

The results of this study indicate that various types of local tuber flour have the potential to substitute wheat flour in muffin products. However, research specifically examining the use of kimpul flour in muffin products is still relatively limited. Most previous studies have focused on the use of sweet potato flour, sweet potato, or gembili, while information on the effect of kimpul flour substitution on consumer acceptance and the physical quality of muffins is still scarce. In addition, the characteristics of kimpul flour, which does not contain gluten, are thought to affect the volume of development, texture, porosity, and the level of consumer acceptance of the resulting muffin products (Ligo et al., 2017).

Based on the study, the novelty of this research lies in the use of kimpul flour (*Xanthosoma sagittifolium*) as a substitute for wheat flour in making muffins with substitution variations of 10%, 30%, and 50%, as well as a simultaneous assessment of its effects on consumer acceptance and the physical quality of the product. Evaluation was carried out on sensory attributes including color, aroma, taste, texture, and crumb, as well as physical quality attributes in the form of rising power and *baking loss.* This research is expected to provide scientific information regarding the optimal level of kimpul flour substitution to produce muffins with characteristics that are acceptable to consumers and have good physical quality.

Based on the description, the research problem formulation in this study is whether the substitution of kimpul flour at various concentration levels affects consumer acceptance and the physical quality of muffins. The research hypothesis states that there is an effect of the level of kimpul flour substitution on consumer acceptance and the physical quality of muffins. Therefore, this study aims to analyze the effect of kimpul flour substitution (*Xanthosoma sagittifolium*) of 10%, 30%, and 50% on consumer acceptance and physical quality of muffins.

2. RESEARCH METHODS

2.1 Research Method

Research in product manufacturing *muffin* Kimpul flour substitution was carried out in the laboratory. *Pastry* And *Bakery*, Culinary Arts Education Study Program, Faculty of Engineering, Jakarta State University, since January 2023. The research subjects in this study are *muffins* with the substitution of kimpul flour, which were tested by consumer acceptance and physical quality with a somewhat trained panel of panelists, namely students of the Culinary Arts Education Study Program at Jakarta State University who had taken the Continental Cake and Organoleptic Assessment course. The population in this study was *muffins* with the substitution of

kimpul flour. The samples used in this study were *muffins* with substitution of 10%, 30%, and 50% kimpul flour.

This study uses an experimental method to determine the effect of substitution of kimpul flour (*Xanthosoma sagittifolium*) on consumer acceptance and physical quality of *muffins.* The research design used was one-way ANOVA, namely the percentage of substitution of kimpul flour for wheat flour consisting of three treatment levels, namely:

P1 (10% kimpul flour: 90% wheat flour)
P2 (30% kimpul flour: 70% wheat flour)
P3 (50% kimpul flour: 50% wheat flour)

The experimental method is used because it allows researchers to control research variables so that the effect of treatment on product characteristics can be observed objectively (Sugiyono, 2009).

2.2 Data Collection and Analysis Techniques

The research was conducted through several stages including preparation of ingredients, making muffins, testing physical quality, and testing consumer acceptance. The preparation stage was carried out by preparing all ingredients consisting of wheat flour, kimpul flour, butter, eggs, caster sugar, yogurt, baking powder, vanilla, salt, mineral water, and *chocolate chips*. Next, the ingredients are weighed according to the established formula for each treatment. The muffin-making process begins by mixing the ingredients until a homogeneous dough forms, followed by molding the dough into muffin tins or *muffin cases*, then baking at 180°C for 25 minutes. Once cooked, the muffins are cooled on a *cooling rack* before testing (Prakoso, 2011).

In general, the research procedure can be explained as follows:

1. Preparation of research materials and tools.
2. Making muffin dough according to the treatment formulation.
3. Bake the muffins at 180°C for 25 minutes.
4. Cool the product to room temperature.
5. Physical quality testing includes expansion power and *baking loss*.
6. Consumer acceptance testing using hedonic testing.
7. Data processing and analysis.
8. Concluding.

Physical quality testing is carried out on the parameters of expansion power and *baking loss*. The rising power is measured by comparing the size of the muffin before and after baking using a vernier caliper. Meanwhile, the *baking loss value is c*alculated based on the difference in dough weight before and after baking using a digital scale. This measurement aims to determine the weight loss of the product during the baking process due to evaporation of water and other volatile components (Pudjirahaju, 2017).

Consumer acceptance testing was conducted using a hedonic test method involving 30 semi-trained panelists. Panelists were asked to provide assessments of the attributes of color, aroma, sweetness, crunchiness, texture, and crumb using a five-level hedonic scale, namely very dislike (1), dislike (2), somewhat like (3), like (4), and very like (5). The hedonic test is a method commonly used to determine the level of consumer acceptance of a food product based on its sensory characteristics (Setyaningsih, D., A. Apriyantono, 2010).

Consumer acceptance test data were analyzed using the Friedman test because the data obtained were in the form of ordinal data from panelist assessments. If the

Friedman test results showed a significant difference, then the Tukey test was continued to determine the differences between treatments. Physical quality data included swelling power and *baking loss,* analyzed using analysis of variance (*Analysis of Variance*/ ANOVA) at a 5% significance level. If a significant effect was found, the analysis was continued using Duncan's test to determine the best treatment. All data analysis was conducted using statistical software to obtain information regarding the effect of kimpul flour substitution on consumer acceptance and the physical quality of muffins.

3. RESULTS AND DISCUSSION

Data Description Results

The research results for this product were obtained in two stages. The first stage involved a product validation test involving five expert panelists, including lecturers from the Culinary Arts Education Study Program at Jakarta State University. The second stage involved consumer acceptance testing, and the third stage involved physical quality testing.

The consumer acceptance test was conducted using an assessment by 30 semi-trained panelists who were students from the Culinary Arts Education study program at Jakarta State University. Data analysis was performed using the Friedman Test and continued with Tukey's Test if there was a substantial difference (H_0 rejected).

Physical quality tests are carried out to measure the expansion power and *baking loss* with different tools. The measurement of expansion power is done with a vernier caliper, while the measurement of *baking loss is done* using a digital scale to measure the weight of the sample dough. After conducting physical quality tests, hypothesis testing was carried out using a one-way ANOVA test and continued with the Duncan Multiple Range Test (DMRT) if there were significant differences between treatments to identify differences in characteristics in each treatment.

1. Hypothesis Test Results for Consumer Acceptance Analysis of Color Aspects

Testing Criteria	x^2 count	x^2table	Conclusion
Color aspect	7,12	5,99	x^2count >x^2table, then **H0 is rejected, and Ha is accepted.**

Based on the results of the ANOVA test on color *muffin* substitution of kimpul flour, it was found that X count was 7.12 and X table was 5.99. It was found that X count > X table, so it can be concluded that there is an effect of kimpul flour substitution with a percentage of 10%, 30%, and 50% on the color aspect of the cake *muffin* against consumer acceptance tests.

If Xcount > Xtable, then the analysis continues with *Tukey's test* to determine the most preferred formulation among the three samples tested. Summary of the comparative test results: *Tukey* to the percentage *of* Kimpul flour substitutes can be seen in the table below.

Difference Between Each Treatment	Comparison of Results	Conclusion
| A – B | = | 4,27 – 4,07 | = 0,20	0,20 < 0,61	**No Real Difference**
| A – C | = | 4,27 – 3,73 | = 0,54	0,54 < 0,61	**No Real Difference**

| B – C | = | 4,07 – 3,73 | = 0,34	0,34 < 0,61	**No Real Difference**

Information:
A: *muffin* 10% flour substitute
B: *muffin* 30% flour substitute
C: *muffin* 50% flour substitution

Based on the results of the Tuckey's color aspect test in the table above, it shows that the comparison of the results: *muffin* substitutions of 10% with 30%, 10% with 50%, and 30% with 50% of kimpul flour showed no significant differences. This proves that panelists equally liked both product comparisons.

2. Hypothesis Test Results for Consumer Acceptability Analysis of Sweetness Aspect

Testing Criteria	x^2 count	x^2table	Conclusion
Aspects of sweetness	0,76	5,99	x^2count <x^2table, then **H0 is accepted, and Ha is rejected.**

Based on the results of the ANOVA test on sweet taste *muffin* substitution of kimpul flour, it was found that X count was 0.76 and X table was 5.99. So it can be concluded that there is no difference in the aspect of sweetness *muffin* substitution with kimpul flour on consumer acceptance.

3. Hypothesis Test Results for Consumer Acceptance Analysis of Kimpul Flavor Aspect

Testing Criteria	x^2count	x^2table	Conclusion
Aspects of the sense of smell	7,18	5,99	x^2count >x^2table, then **H0 is rejected, and Ha is accepted.**

Based on the results of the ANOVA test on the aspect of the taste of the kimpul *muffin* substitution of kimpul flour, it was found that X count was 7.18 and X table was 5.99. It was found that X count > X table, so it can be concluded that there is an effect of kimpul flour substitution with a percentage of 10%, 30%, and 50% on the color aspect of the cake *muffin* against consumer acceptance tests.
If Xcount > Xtable, then the analysis continues with *Tukey's test* to determine the most preferred formulation among the three samples tested. Summary of the comparative test results: *Tukey* to the percentage *of* Kimpul flour substitutes can be seen in the table below.

Difference Between Each Treatment	Comparison of Results	Conclusion
| A – B | = | 3,97 – 3,80 | = 0,17	0,17 < 0,52	**No Real Difference**
| A – C | = | 3,97 – 3,53 | = 0,44	0,44 < 0,52	**No Real Difference**
| B – C | = | 3,80 – 3,53 | = 0,27	0,27 < 0,52	**No Real Difference**

Information:
A: *muffin* 10% flour substitute
B: *muffin* 30% flour substitute
C: *muffin* 50% flour substitution

Based on the results of the Tuckey's color aspect test in the table above, it shows that the comparison of the results of *muffin* substitutions of 10% with 30%, 10% with 50%,

and 30% with 50% of kimpul flour showed no significant differences. This proves that panelists equally liked both product comparisons.

4. Hypothesis Test Results of Consumer Acceptance Analysis of Aroma Kimpul Aspects

Testing Criteria	x^2 count	x^2table	Conclusion
Aroma aspect of kimpul	3,71	5,99	x^2count <x^2table, then **H0 is accepted, and Ha is rejected.**

Based on the results of the ANOVA test on sweet taste *muffin* substitution of kimpul flour, it was found that X count was 3.71 and X table was 5.99. So, it can be concluded that there is no difference in the aroma aspect of kimpul *muffin* kimpul flour substitution on consumer acceptance.

5. Hypothesis Test Results for Consumer Acceptance Analysis of Texture Aspects

Testing Criteria	x^2 count	x^2table	Conclusion
Texture Aspect	9,16	5,99	x^2count >x^2table, then **H0 is rejected, and Ha is accepted.**

Based on the results of the ANOVA test on the texture aspect of *muffin* substitution of kimpul flour, it was found that X count was 9.16 and X table was 5.99. It was found that X count > X table, so it can be concluded that there is an effect of kimpul flour substitution with a percentage of 10%, 30%, and 50% on the texture aspect *of muffins* against consumer acceptance tests.

If Xcount > Xtable, then the analysis continues with Test of *Tuckey* to determine the most preferred formulation among the three samples tested. Summary of the comparative test results: *Tukey* to the percentage *muffin* Kimpul flour substitutes can be seen in the table below.

Difference Between Each Treatment	Comparison of Results	Conclusion
| A – B | = | 4,33 – 3,80 | = 0,53	0,53 < 0,62	**No Real Difference**
| A – C | = | 4,33 – 3,73 | = 0,60	0,60 < 0,62	**No Real Difference**
| B – C | = | 3,80 – 3,73 | = 0,07	0,07 < 0,62	**No Real Difference**

Information:
A: *muffin* 10% flour substitute
B: *muffin* 30% flour substitute
C: *muffin* 50% flour substitution

Based on the results of Tukey's test, the texture aspect in the table above shows that the comparison of the results: *muffin* substitutions of 10% with 30%, 10% with 50%, and 30% with 50% of kimpul flour showed no significant differences. This proves that panelists equally liked both product comparisons.

6. Hypothesis Test Results for Consumer Acceptance Analysis of the Crumb Aspect

Testing Criteria	x^2 count	x^2table	Conclusion
Crumb Aspect	6,10	5,99	x^2count >x^2table, then

H0 is rejected, and Ha is accepted.

Based on the results of the ANOVA test on the crumb aspect *muffin* substitution of kimpul flour, it was found that X count was 6.10 and X table was 5.99. It was found that X count > X table, so it can be concluded that there is an effect of kimpul flour substitution with a percentage of 10%, 30%, and 50% on the texture aspect *of muffins* against consumer acceptance testing.

If Xcount > Xtable, then the analysis continues with *Tukey's test* to determine the most preferred formulation among the three samples tested. Summary of the comparative test results: *Tukey* to the percentage of *muffin* Kimpul flour substitutes can be seen in the table below.

Difference Between Each Treatment	Comparison of Results	Conclusion
| A – B | = | 4,20 – 4,07 | = 0,13	0,13 < 0,50	**No Real Difference**
| A – C | = | 4,20 – 3,77 | = 0,43	0,43 < 0,50	**No Real Difference**
| B – C | = | 4,07 – 3,77 | = 0,30	0,30 < 0,50	**No Real Difference**

Information:
A: *muffin* 10% flour substitute
B: *muffin* 30% flour substitute
C: *muffin* 50% flour substitution

Based on the results of Tukey's test, the texture aspect in the table above shows that the comparison of the results of *muffin* substitutions of 10% with 30%, 10% with 50%, and 30% with 50% of kimpul flour showed no significant differences. This proves that panelists equally liked both product comparisons.

7. Hypothesis Results of Development Power Analysis *Muffin* Kimpul Flour Substitution

Evaluation Criteria	F count	F table	Conclusion
Development Power	36,11	5,14	F count > F table, then rejected and H_1accepted

Based on the results of the ANOVA test on the development power of m*uffin* substitution of kimpul flour, it was found that the calculated F was 36.11 and the table F was 5.14. Where the calculated F > table F, it can be concluded that H0 is rejected and H1 is accepted. This means that there is a significant influence between treatment and repetition on the development of power *muffin* kimpul flour substitution. To identify treatments that show significant differences, a multiple range test or *Duncan Multiple Range Test (DMRT)*.

Component	Development Power Results *Muffin* Kimpul Flour Substitution		
	P1	P2	P3
Development Power	84,29a	66.04b	61.78b

Description: a,b,c = similar letter notation means there is no real difference at the Duncan test level with a value of 5%

Q1: *Muffin* Kimpul Flour Substitution 10%
P2: *Muffin* Kimpul Flour Substitution 30%
P3: *Muffin* Kimpul Flour Substitution 50%

The results showed that the 10% kimpul flour substitution treatment (P1) produced a significantly different swelling power compared to the 30% (P2) and 50% (P3) kimpul flour substitution treatments. Meanwhile, the 30% and 50% kimpul flour substitution treatments were not significantly different from each other because they had the same letter notation (b). Thus, increasing the percentage of kimpul flour substitution from 10% to 30% and 50% resulted in a decrease in swelling power of the *muffin*; however, increasing substitution from 30% to 50% did not provide a significant difference in the development power *muffin*.

8. Hypothesis Test Analysis Results *Baking Loss Muffin* Kimpul Flour Substitution

Evaluation Criteria	F count	F table	Conclusion
Baking Loss Muffin	1,18	5,14	F count < F table, then H_0 accepted and H_1 rejected

Based on the results of the ANOVA test on*baking loss*For corn flour substituted cream puffs, it was found that the calculated F was 1.18 and the table F was 5.14. It was found that the calculated F < table F, so it can be concluded that there was no significant effect on the physical test of *baking loss in muffin* kimpul flour substitution with percentages of 10%, 30%, and 50%.

Discussion

1. Discussion of Validation Test

Based on the results of the validation test on the color aspect of *muffins,* which was tested on 5 expert panelists showed that in the manufacture *of muffins.* The 10% substitution of kimpul flour had the highest average value compared to the 30% and 50% substitutions. From this average value, it can be concluded that the higher the substitution, the more concentrated the color produced in the product *Muffin* kimpul flour substitution. This is in line with Rafika's (2012) research, which stated that increasing the proportion of kimpul flour results in a color change. *Cake* become more brownish than the *cake* without flour substitution

Validation test results for the sweet taste aspect *of the muffin.* The substitution of kimpul flour showed that substitutions of 10% and 30% had the same high average values. At 50%, the average value obtained was the smallest in the sweetness aspect of the *muffin* kimpul flour substitution. The three treatments did not produce significant results, so all three remain in the same category, namely sweet.

In the results of the validation test of the kimpul taste aspect, *muffin* kimpul flour substitution, with 10% substitution being the highest average value compared to 30% and 50% substitution. This result shows that there is a significant difference in the taste aspect of kimpul in *muffin* kimpul flour substitution, supported by the results of research conducted by Kumara (2018), which explains that an increase in the percentage of kimpul flour substitution in sponge cake reduces the level of panelists' preference for the product.

In the results of the validation test on the aroma of kimpul on *muffin* Regarding the substitution of kimpul flour, the 10% substitution percentage obtained the highest average value compared to the 30% and 50% substitutions. These results indicate that the use of kimpul flour as a substitute for wheat flour affects the aroma of the *muffin*. The higher the proportion of kimpul flour used, the more pronounced the distinctive aroma of kimpul in the product becomes, thus influencing the panelists' organoleptic assessment (Rafika et al., 2012).

Based on the results of the texture aspect validation test obtained in the study, the results of the 10% substitution of kimpul flour showed the highest value compared to the 30% and 50% substitutions. This result is based on the fact that the less kimpul flour used, the softer the resulting texture *of the muffin* will be and resemble the control product. Too much substitution of kimpul flour causes the texture to be poor. The quality of kimpul flour decreases because it lacks gluten. The absence of gluten reduces the dough's ability to retain gas during baking, which affects the volume and texture of the product of *bakery* (Paramita et al., 2017)

In the results of the validation test on the crumb aspect in the study of *muffin* Regarding the substitution of kimpul flour, the 10% substitution percentage had the highest average value compared to the 30% and 50% substitutions. The three treatments did not have very significant results, so the three treatments were still in the same category scale, namely rather large.

2. Discussion of Consumer Acceptance Test Results

Consumer acceptance test conducted by 30 semi-trained panelists on *muffin* substitution of kimpul flour obtained different data in each aspect. Based on the Friedman test, there was no influence on the aspects of sweetness and kimpul aroma, while there was an influence on the aspects of color, kimpul taste, texture, and crumb, so the Tukey test was needed as a follow-up test.

In terms of color in *muffin* kimpul flour substitution, based on the results of the Friedman test, data were obtained: count 7.12 $>x^2$table 5.99, which means H0 is rejected, and Ha is accepted, so there is a real influence on color in *muffin* kimpul flour substitution. To determine which groups had significant differences, a Tukey test was performed. The Tukey test showed that there were no significant differences between the three treatments (10%, 30%, and 50%). This indicates that the average rank difference is smaller than the critical value, so there is no significant difference between the treatment pairs.

Based on the results of consumer acceptance tests on the sweet taste aspect of *muffins with* kimpul flour substitution, there was no real effect in the Friedman test method with datax^2count 0.76 $<x^2$table 5.99, which means H0 is accepted and there is no real effect on sweet taste *muffin. Muffin* with 10% substitution of kimpul flour is the recommended product for production.

The results of the Friedman test on the taste aspect of kimpul *muffin* kimpul flour substitution state that there is an effect of kimpul flour substitution on the *muffin.* The Friedman test value showsx^2count 7.18 $>x^2$table 5.99, which means H0 is rejected, and Ha is accepted, so there is a real effect on the taste of kimpul muffin kimpul flour substitution. To find out which groups have real differences, we continued with Tukey's test. The results of the Tukey's test calculation show that the three treatments (10%, 30%, and 50%) do not have a real difference in the kimpul taste aspect; this shows the value of the difference in the average ranking is smaller than the critical value, so there is no real difference between the treatment pairs.

In the results of the consumer acceptance test for the aroma aspect of kimpul *muffin, it* shows that there is no significant effect of kimpul flour substitution on the kimpul aroma aspect *muffin*. The results of the Friedman test showx^2count 3.71 < a table of 5.99, which means H0 is accepted and there is no real influence on the aroma of the *muffin. Muffin* with 10% substitution of kimpul flour is the recommended product for production.

In consumer acceptance tests on the texture aspect of *muffin* kimpul flour substitution, the results showed that there was an effect of kimpul flour substitution on the texture of the *muffin.* The Friedman test value shows x^2count 9.16 > x^2table 5.99, which means Ho is rejected, and Ha is accepted, so there is a real influence o*f* kimpul flour substitution. To determine which groups had significant differences, a Tukey's test was performed. The results of the Tukey's test showed that the three treatments (10%, 30%, and 50%) had no significant differences in texture. This indicates that the average ranking difference is smaller than the critical value, so there is no significant difference between the treatment pairs.

Results of consumer acceptance tests on the crumb aspect: M*uffin* substitution of kimpul flour shows that there is an effect of substitution of kimpul flour on crumb *muffin.* The Friedman test value showsx^2count 6.10 >x^2table 5.99, which means H0 is rejected, and Ha is accepted, so there is a real influence on crumb *muffin* substitution of kimpul flour. The results of Tukey's test showed that the three treatments (10%, 30%, and 50%) did not have a significant difference in the crumb aspect; this indicates that the average ranking difference value is smaller than the critical value, so there is no significant difference between the treatment pairs.

3. Discussion of Physical Quality Test Results

Based on the results of physical quality tests on the aspect of expansion power, *muffin* substitution of kimpul flour with a dough height before baking of 26.8 – 29.3 mm will produce a height *muffin* which varies depending on the percentage of substitution used. The results of the ANOVA test show that there is a significant influence of *muffin* substitution of kimpul flour with different percentages. Decreased expansion power of the *muffin.* As the percentage of kimpul flour substitution increases, it is thought to be due to the absence of gluten in kimpul flour. Gluten functions to form an elastic network that can retain carbon dioxide gas during the baking process. The higher the proportion of kimpul flour used, the less gluten is formed, resulting in a decrease in the dough's ability to retain gas and a decrease in the volume of expansion; the *muffin* becomes lower (Kumara, 2018). To determine which treatment provided a significant difference, a Duncan Multiple Range Test (DMRT) was conducted as a follow-up test. The results of the Duncan test, as presented in Table 4.24, show that the three treatments had significant differences from all other treatments in terms of flower development power *muffin* flour substitute.

In the physical quality test aspect, *baking loss muffin* Substitution of kimpul flour with a dough weight of 60 grams before baking will produce different dough weights after the baking process depending on the percentage of substitution used. Based on the results of the ANOVA test, it can be concluded that *muffin* Substitution of kimpul flour with percentages of 10%, 30%, and 50% had no significant effect on *baking loss.*

4. CONCLUSION

This study proves that the substitution of kimpul flour (*Xanthosoma sagittifolium*) in muffin making affects the level of consumer acceptance and the physical quality of the

product. This influence is seen in the sensory attributes of color, kimpul flavor, texture, and crumb, as well as in the physical characteristics of muffin rise. Meanwhile, kimpul flour substitution does not have a significant effect on the attributes of sweetness, kimpul aroma, and *baking loss*.

Based on the sensory and physical quality evaluation results, the muffin formulation with a 10% substitution of kimpul flour was the most optimal substitution level. This formulation produced muffins with characteristics most acceptable to consumers and had better physical quality than those with higher substitution levels. These findings indicate that kimpul flour has the potential to be used as a partial substitute for wheat flour in muffin products while supporting the development of locally sourced food products.

Thus, the research hypothesis stating that the level of kimpul flour substitution affects consumer acceptance and the physical quality of muffins is accepted. This research provides a scientific contribution to the use of kimpul flour as an alternative raw material in bakery products and serves as a basis for the development of more diverse and value-added local food products.

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