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## Sensory Analysis of Steamed Apem With Dragon Fruit Skin Substitution (*Hylocereus Polyhizus*)

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**Abstract:** The Indonesian traditional moist cake industry including putu cake, lapis cake, and apem cake, still relies heavily on synthetic food colorings that pose health risks. Natural colorings are a safer alternative, as they are often derived from plants or food waste, such as suji leaves, beets, and dragon fruit peel. Red dragon fruit peel (*Hylocereus polyrhizus*) has potential as a natural dye alternative because it contains high levels of betacyanin, which acts as an antioxidant while also providing a rich color. Steamed apem cake is one of Indonesia's traditional cakes that has cultural value and is widely consumed by the community. Color is one of the factors influencing product attractiveness; however, synthetic food colorants are still commonly used and may pose health risks if used improperly. Natural colorants are a safer alternative and can be obtained from various plants, such as carrots, pandan leaves, and dragon fruit. Red dragon fruit peel, a by-product of the fruit processing industry, contains betalain pigments and has the potential to be utilized as a natural food colorant. This study employed an experimental method using a Completely Randomized Design (CRD) with four treatments: 0%, 35%, 50%, and 65% substitution of dragon fruit peel extract. Product quality was evaluated through ranking and hedonic tests using a 7-point scale by 30 semi-trained panelists. Data were analyzed using Analysis of Variance (ANOVA), followed by Duncan's Multiple Range Test (DMRT) at a 5% significance level when significant differences were detected. The results showed that dragon fruit peel extract substitution significantly affected color quality ( $F = 69.64 > F_{table} = 2.71$ ) and texture ( $F = 23.60 > F_{table} = 2.71$ ), but had no significant effect on shape ( $F = 0.05 < F_{table} = 2.71$ ), aroma ( $F = 0.82 < F_{table} = 2.71$ ), or taste ( $F = 0.48 < F_{table} = 2.71$ ). In the hedonic test, the substitution significantly affected panelists' preference for color ( $F = 23.91 > F_{table} = 2.71$ ) and taste ( $F = 13.91 > F_{table} = 2.71$ ), while no significant effects were observed for shape, aroma, and texture. The best treatment was obtained with 65% dragon fruit peel extract substitution, indicating its potential as a natural food colorant while improving the sensory quality of steamed apem cake.

**Keywords:** Dragon Fruit Peel Extract, Steamed Apem Cake, Sensory Quality, Substitution, Organoleptic Test

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## INTRODUCTION

Steamed apem cake is one of the traditional Indonesian wet cakes made from rice flour and wheat flour which is processed through fermentation and steaming processes, with the characteristics of a soft-chewy texture and a savory sweet taste (Purwa Dana Atmaja, 2020). In addition to its nutritional value, apem cake also has high cultural value because it is often served in traditional and religious events, such as tahlilan, as a symbol of prayer and forgiveness (Warisno, 2017). The high cultural value is also supported by the large amount of public consumption interest in wet cakes in general, which reaches 1.5 servings per capita per week or the equivalent of 78.3 servings per capita per year based on SUSENAS 2025 data, which is about 3.7 times higher than pastries, thus showing the large market potential for traditional cake product innovation (Central Statistics Agency, 2025). The magnitude of this market potential requires manufacturers to present an attractive product appearance, considering that color is one of the factors that determine the attractiveness of steamed apem cakes in the eyes of consumers (Wulandari, 2018). Unfortunately, efforts to present these attractive colors are often pursued through the use of synthetic dyes that are considered more practical and produce bright and stable colors (Ministry of Health of the Republic of Indonesia, 2020), even though excessive consumption of synthetic dyes has the potential to cause gastrointestinal irritation to symptoms of poisoning (Sari et al., 2019). This condition encourages the need for a safe natural dye alternative while providing added value to the product.

One of the alternative natural dyes that has the potential to be used is dragon fruit peel, which is 30–35% of the fruit but has so far been widely disposed of as waste without being used (Cristina, 2022). This potential is supported by the betanin content in dragon fruit peel of  $6.8 \pm 0.3$  mg per 100 grams accompanied by antioxidant activity of 10.2% inhibition (Nurhaedar Jafar, 2022), making it a betalain group that has the opportunity to be an alternative to synthetic dyes that are safer for health (Hatuwe, 2020). This potential utilization is further supported by the availability of raw materials, considering that West Sumatra is one of the largest dragon fruit production centers in Indonesia, with Solok and Agam Regencies as the highest producers, so that the supply of dragon fruit peel is very adequate to be developed in the local food industry (Food Crop and Horticulture Statistics, 2025). The abundant availability of raw materials is also supported by a number of previous studies that have proven the potential of dragon fruit peel as a food additive, including in syrup, mochi, and tilapia sausage, but its use in steamed apem cakes based on rice flour and wheat flour has never been studied. This research gap is the basis of the pre-research that the author has conducted, namely the substitution of dragon fruit peel juice as much as 25%, 50%, and 75% in steamed apem cake, which produces an attractive pink color and encourages the author to further study the effect of the substitution on the quality of steamed apem cake.

Considering that the color produced from the pre-research only shows descriptive potential, a more comprehensive study is needed to ensure the effect of dragon fruit peel substitution on all aspects of the quality of steamed apem cake, which in this study is assessed through five organoleptic parameters, namely shape, color, aroma, texture, and taste, as well as the acceptability of the panelists. Attractive colors, as mentioned earlier, have been proven to increase consumer acceptance of a food product (Wulandari, 2018). In addition to color, aroma is also an important parameter because it is influenced by the main ingredients used in the product (Fauziah & Holinesti, 2021). The chewy and tender texture of steamed apem cake is formed from the gelatinization of rice flour starch and wheat flour which takes place at the same time as the yeast fermentation process, where the CO<sub>2</sub> gas produced causes the dough to

expand and form a porous structure (Rahmawati & Sulistiani, 2021). Finally, in terms of taste, the content of natural sugars and organic acid compounds in dragon fruit peel juice is suspected to be able to provide a balance of flavor and enrich the taste of the product without losing the typical sweetness of apem cake. Based on the description above, the researcher conducted a study on the processing of steamed apem cake with the substitution of dragon fruit peel juice, so that this study aims to analyze the effect of dragon fruit peel juice substitution with concentrations of 0%, 35%, 50%, and 65% on the sensory quality of steamed apem cake.

## RESEARCH MATERIALS AND METHODS

### Research Type and Design

This study is an experimental research with a quantitative approach, namely a single experimental research because it only analyzes the influence of one factor, namely the substitution of dragon fruit peel juice, on the quality of steamed apem cake. The research design used was a Complete Random Design (RAL) with four treatments and three repetitions. The four treatments were steamed apem cake without dragon peel juice substitution ( $X_0 = 0\%$ ) as control, and steamed apem cake with dragon peel juice substitution of 35% ( $X_1$ ), 50% ( $X_2$ ), and 65% ( $X_3$ ).

### Research Time and Place

The research was carried out in May 2026 at the Culinary Laboratory, Department of Family Welfare Sciences, Faculty of Tourism and Hospitality, Padang State University.

### Tools and Materials

The equipment used consists of preparation tools such as digital scales, measuring spoons, strainers, and work cloths, as well as processing tools that include steamers, molded stoves. The composition of the ingredients can be seen from Table 1 below.

| No. | Components              | Composition of Research Materials |        |         |         |
|-----|-------------------------|-----------------------------------|--------|---------|---------|
|     |                         | 0%                                | 35%    | 50%     | 65%     |
| 1.  | Rice Flour              | 200 gr                            | 200 gr | 113 gr  | 113 gr  |
| 2.  | Wheat Flour             | 200gr                             | 200 gr | 3,39 gr | 5.65 gr |
| 3.  | Gula                    | 180 gr                            | 180 gr | 125 gr  | 125 gr  |
| 4.  | Coconut milk            | 600 ml                            | 510 ml | 390 ml  | 210 ml  |
| 5.  | Dragon Fruit Skin Juice | -                                 | 90 ml  | 110 ml  | 390 ml  |
| 6.  | Ragi                    | 8 gr                              | 8 gr   | 8 gr    | 8 gr    |
| 7.  | Vanillas                | 2 gr                              | 2 gr   | 2 gr    | 2 gr    |
| 8.  | Baking Powder           | 4 gr                              | 4 gr   | 4 gr    | 4 gr    |
| 9.  | Salt                    | 2 gr                              | 2 gr   | 2 gr    | 2 gr    |

### Research Procedure

Making Steamed Apem Cake with Dragon Fruit Peel Juice Substitution mix rice flour, sugar, yeast, coconut milk, and dragon fruit peel juice according to the predetermined formulation, then stir until all ingredients are well mixed and form a dough. Let the dough sit for some time for the fermentation process to allow the dough to rise and produce a softer texture. After the fermentation process is complete, pour the dough into the prepared apem cake mold. Steam the dough in a preheated steamer until the apem cake is perfectly cooked. Once cooked, the steamed apem cake is removed from the mold and cooled before a sensory test is performed to assess its quality based on its color, aroma, texture, and flavor

attributes. The preparation of steamed apem cake with the addition of natural dye of dragon fruit peel juice can be seen in Figure 1 as follows:



Figure 1. Research procedure

### Data Collection Instruments and Techniques

Data was collected through organoleptic tests which included level tests and hedonic tests. Tier tests were used to assess the quality of talam cakes on the parameters of shape, color, aroma, texture, and taste with a rating scale of 1–7. The hedonic test was used to measure the level of panelists' preference for the same parameter on a scale of 1 (very dislike) to 7 (very like). The test was carried out by 30 semi-trained panelists in a condition of not being hungry and not full to minimize assessment bias. Each sample was presented with a random code and panelists were asked to independently assess using an instrument sheet.



Figure 2. Stages of Data Collection

### Data Analysis Techniques

The data from the organoleptic test results were tabulated and analyzed using Variant Analysis (ANOVA) at a significance level of 5%. If the results of ANOVA show a noticeable difference between treatments ( $F_{\text{count}} > F_{\text{table}}$ ), then a follow-up *Duncan Multiple Range Test* (DMRT) is performed to determine the difference between specific treatments.

## RESULTS AND DISCUSSION

The following are the tabulation of the final data of the steamed apem cake test with dragon fruit peel juice substitution can be seen in the following figure 3:

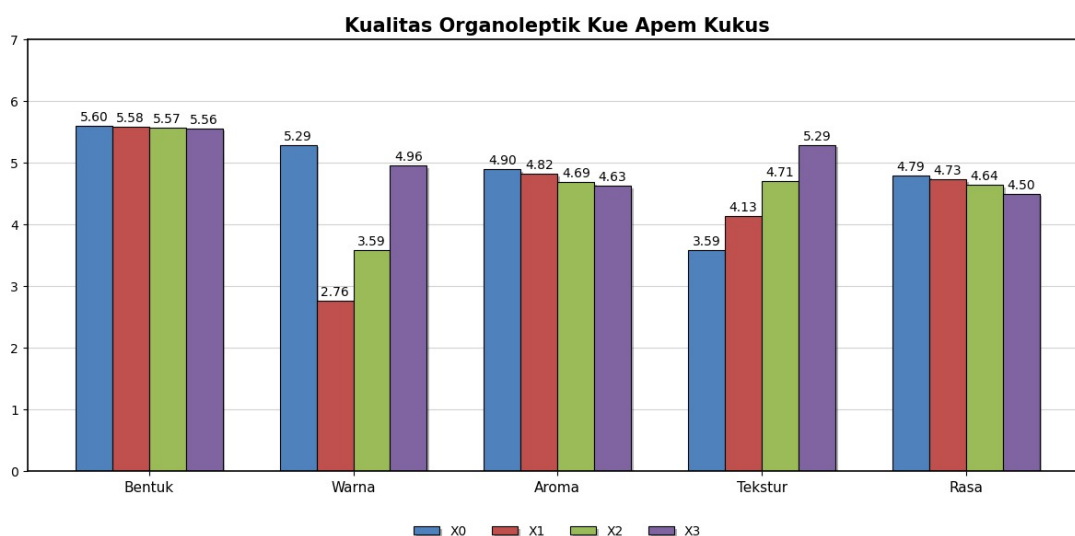


Figure 3. Average Quality Test Level of Steamed Apem Cake

The data from the study regarding the effect of dragon peel juice substitution on the quality of steamed apem cake was obtained through 3 repetitions with 4 different treatments, namely: X0 (control group without dragon peel substitution (0%), X1 (dragon peel substitution 35%), X2 (dragon peel substitution 50%), and X3 (dragon peel substitution 65%). The four treatments were assessed through organoleptic and hedonic tests with the level test method, which included aspects of shape, color, aroma, texture and taste.

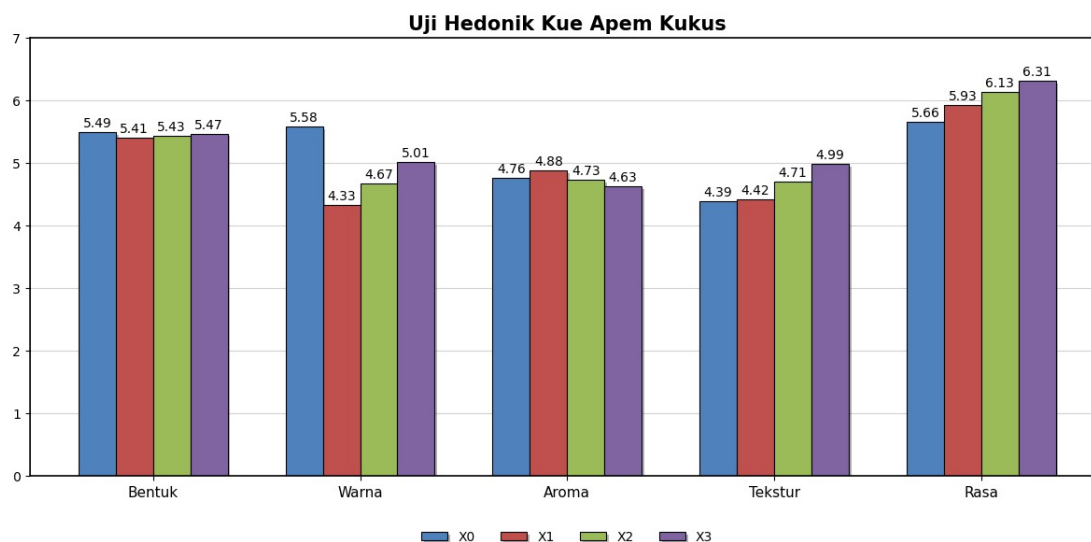


Figure 4. Average Quality Test Level of Steamed Apem Cake

The data from the study regarding the effect of dragon peel juice substitution on the quality of steamed apem cake was obtained through 3 repetitions with 4 different treatments, namely: X0 (control group without dragon peel substitution (0%), X1 (dragon peel substitution 15%), X2 (dragon peel juice substitution 35%), and X3 (dragon peel juice substitution 65%). The four treatments were assessed through organoleptic and hedonic tests with the level test method, which included aspects of shape, color, aroma, texture and taste.

## Level Test

### 1. Shape

**Table 2. Average Result of Steamed Apem Cake Shape Quality**

| X0 (0%) | X1 (35%) | X2 (50%) | X3 (65%) |
|---------|----------|----------|----------|
| 5.56    | 5.55     | 5.54     | 5.55     |

Based on table 2 presented, the average value of apem cake shape quality in the X0 treatment was 5.56, X1 was 5.55, X2 was 5.54, and X3 was 5.55 were all in the uniform category. Then the results of the variety analysis are presented in table 3 below:

**Table 3. Results of Fingerprint Analysis (ANAVA)**

| EN            | DB     | JK    | KT   | Calculation | Table |
|---------------|--------|-------|------|-------------|-------|
|               |        |       |      |             | 0,05  |
| Sample        | 3,00   | 0,03  | 0,01 | 0,05        | 2,71  |
| Panel         | 29,00  | 15,80 | 0,54 | 2,43        | 1,60  |
| Error/Residue | 87,00  | 19,50 | 0,22 |             |       |
| Total         | 119,00 | 35,33 |      |             |       |

Based on the results of the ANAVA analysis, a Fcal value of 0.05 was obtained, while Ftablel at a significance level of 5% was 2.71. Because  $F_{cal} \leq F_{tablel}$  ( $0.05 \leq 2.71$ ),  $H_0$  is accepted and  $H_a$  is rejected. Thus, it can be concluded that the substitution of dragon fruit peel juice does not have a noticeable effect on the quality of the shape (round in shape) of steamed apem cake.

These results show that the difference in the concentration of dragon fruit peel substitution from 0%, 35%, 50%, to 65% has not been able to cause a statistically significant change in shape. Although there was a slight difference in the average score between treatments, the difference was so small that it was still in the same category according to the panelists' assessment. Therefore, the substitution of dragon fruit peel juice up to 65% can be applied without degrading the quality of the steamed apem cake form.

### 2. Color

**Table 4. Average Result of Color Quality of Steamed Apem Cake**

| X0 (0%) | X1 (35%) | X2 (50%) | X3 (65%) |
|---------|----------|----------|----------|
| 5.29    | 2.76     | 3.59     | 4.96     |

Based on table 4 presented, the average value of the color quality of apem cakes in the X0 treatment was 5.56, X1 was 5.55, X2 was 5.54, and X3 was 5.55 were all in the fairly pink category. Then the results of the variety analysis are presented in table 5 below:

**Table 5. Color Quality Analysis Results (ANAVA)**

| EN            | DB     | JK     | KT    | Calculation | Table |
|---------------|--------|--------|-------|-------------|-------|
|               |        |        |       |             | 0,05  |
| Sample        | 3,00   | 126,16 | 42,05 | 69,64       | 2,71  |
| Panel         | 29,00  | 11,70  | 0,40  | 0,67        | 1,60  |
| Error/Residue | 87,00  | 52,54  | 0,60  |             |       |
| Total         | 119,00 | 190,40 |       |             |       |

Based on the results of ANAVA on the color quality (pink) of steamed apem cake with dragon fruit peel substitution, the Fcal value in the sample was 69.64 and Ftablel at the 5% significance level of 2.71. Because  $F_{calculus} > F_{tablel}$  ( $69.64 > 2.71$ ),  $H_0$  is rejected and  $H_a$  is accepted. This shows that the substitution of dragon fruit peel juice has a noticeably different

effect on the color quality (pink) of steamed apem cake. Therefore, the analysis was continued with Duncan's follow-up test to find out the differences between treatments, the results of which can be seen in the following table.

**Table 6. Color Quality DMRT Advanced Test Results**

| Treatment | Average | LSR + average | notasi |
|-----------|---------|---------------|--------|
| X0 (0%)   | 5,29    | 5,69          | a      |
| X3 (65%)  | 4,96    | 5,38          | a      |
| X2 (50%)  | 3,59    | 4,02          | b      |
| X1 (35%)  | 2,76    |               | c      |

A noticeable influence on the pink color of steamed apem cake. The pink color produced is influenced by the content of the betasianin pigment in the skin of the dragon fruit which acts as a natural dye. At the substitution of 65% (X3), the intensity of pink increased again and was close to the control treatment (X0), while at the substitution of 35% (X1) and 50% (X2) the pink color produced was still lower based on the panelists' assessment

### 3. Aroma

**Table 7. Average Result of Color Quality of Steamed Apem Cake**

| X0 (0%) | X1 (35%) | X2 (50%) | X3 (65%) |
|---------|----------|----------|----------|
| 4,92    | 4,84     | 4,72     | 4,64     |

Based on table 7 presented, the average value of the aroma quality of apem cake in the treatment of X0 is 4.92, X1 is 4.84, X2 is 4.72, and X3 is 4.64 are all in the category of aromatic typical of apem cake. Then the results of the variety analysis are presented in table 8 below:

**Table 8. Average Result of Color Quality of Steamed Apem Cake**

| EN            | DB     | JK    | KT   | Calculation | Table |
|---------------|--------|-------|------|-------------|-------|
|               |        |       |      |             | 0,05  |
| Sample        | 3,00   | 1,34  | 0,45 | 0,82        | 2,71  |
| Panel         | 29,00  | 31,82 | 1,10 | 2,01        | 1,60  |
| Error/Residue | 87,00  | 47,55 | 0,55 |             |       |
| Total         | 119,00 | 80,71 |      |             |       |

Based on the results of the analysis of various fingerprints (ANAVA) on the quality of aroma (typical aroma of apem cake) of steamed apem cake with the substitution of dragon fruit peel juice, the value of Fcal in the sample was 0.82 and Ftable at a significance level of 5% of 2.71. Because  $F_{cal} \leq F_{table}$  ( $0.82 \leq 2.71$ ),  $H_0$  is accepted and  $H_a$  is rejected. This shows that the substitution of dragon fruit peel juice does not have a noticeable difference in the quality of aroma (typical aroma of apem cake). Thus, the difference in treatment X0, X1, X2, and X3 has not been able to cause statistically significant changes in aroma so that the aroma of the product is still acceptable to the panelists.

### 4. Tekstur

**Table 9. Average Result of Texture Quality of Steamed Apem Cake**

| X0 (0%) | X1 (35%) | X2 (50%) | X3 (65%) |
|---------|----------|----------|----------|
| 3,59    | 4,13     | 4,71     | 5,29     |

Based on table 9 presented, the average value of the texture quality of apem cake in the X0 treatment was 3.59, X1 was 4.13, X2 was 4.71, and X3 was 5.29 were all in the very soft category. Then the results of the variety analysis are presented in table 10 below:

**Table 10. Results of Fingerprint Analysis (ANAVA)**

| EN            | DB     | JK     | KT    | Calculation | Table |
|---------------|--------|--------|-------|-------------|-------|
|               |        |        |       |             | 0,05  |
| Sample        | 3,00   | 48,37  | 16,12 | 23,60       | 2,71  |
| Panel         | 29,00  | 31,62  | 1,09  | 1,60        | 1,60  |
| Error/Residue | 87,00  | 59,44  | 0,68  |             |       |
| Total         | 119,00 | 139,42 |       |             |       |

The results of ANAVA's analysis on the texture quality (soft) of steamed apem cake with dragon fruit peel juice substitution, obtained a Fcal value in the sample of 23.60 and Ftabel at a significance level of 5% of 2.71. Because Fcount > Ftabel (23.60 > 2.71),  $H_0$  is rejected and  $H_a$  is accepted. This shows that the substitution of dragon fruit peel juice has a noticeably different effect on the texture quality (soft) of steamed apem cake. Therefore, the analysis was continued with Duncan's follow-up test to find out the differences between the treatments as follows:

**Table 11. DMRT Advanced Test Results Texture Quality**

| Treatment | Average | LSR + average | notasi |
|-----------|---------|---------------|--------|
| X3 (65%)  | 5,29    | 5,71          | a      |
| X2 (50%)  | 4,71    | 5,16          | b      |
| X1 (35%)  | 4,13    | 4,60          | c      |
| X0 (0%)   | 3,59    |               | d      |

The results showed that the higher the percentage of substitution of dragon fruit peel juice, the softer the texture of steamed apem cake tends to be. This is suspected because dragon fruit peel juice contains water and dietary fiber, especially pectin, which is able to increase the dough's ability to bind water so that it produces a softer texture after the steaming process.

## Taste

**Table 12. Average Result of Taste Quality of Steamed Apem Cake**

| X0 (0%) | X1 (35%) | X2 (50%) | X3 (65%) |
|---------|----------|----------|----------|
| 4,80    | 4,75     | 4,65     | 4,52     |

Based on table 12 presented, the average value of apem cake flavor quality in the X0 treatment was 4.80, X1 was 4.75, X2 was 4.65, and X3 was 4.52 were all in the sweet category. Then the results of the variety analysis are presented in table 13 below:

**Table 13. Taste Quality DMRT Advanced Test Results**

| EN            | DB     | JK     | KT   | Calculation | Table |
|---------------|--------|--------|------|-------------|-------|
|               |        |        |      |             | 0,05  |
| Sample        | 3,00   | 1,43   | 0,48 | 0,48        | 2,71  |
| Panel         | 29,00  | 36,06  | 1,24 | 1,25        | 1,60  |
| Error/Residue | 87,00  | 86,51  | 0,99 |             |       |
| Total         | 119,00 | 124,00 |      |             |       |

The results of ANAVA's analysis on the taste quality (sweetness) of steamed apem cake with dragon fruit peel juice substitution, obtained a Fcal value in the sample of 0.48 and Ftabel at a significance level of 5% of 2.71. Because  $F_{cal} \leq F_{tabel}$  ( $0.48 \leq 2.71$ ),  $H_0$  is accepted and  $H_a$  is rejected. This shows that the substitution of dragon fruit peel juice does not have a noticeably different effect on the taste quality (sweetness) of steamed apem cake. Thus, the difference in treatment of X0, X1, X2, and X3 has not been able to cause statistically significant changes in taste so that it can be accepted by the panelists.

## Hedonic Test (Preference Force)

### Shape Preference

**Table 14. Average Results of Apem Cake Shape Preferences**

| X0 (0%) | X1 (20%) | X2 (30%) | X3 (40%) |
|---------|----------|----------|----------|
| 5.49    | 5.83     | 5.88     | 6.06     |

Based on table 15, the average value of the panelists' preference level for the form of steamed apem in the X0 treatment was 5.49, X1 was 5.83, X2 was 5.88, and X3 was 6.06, all in the like category. The increase in the average value showed that the substitution of dragon fruit juice increased the level of the panelists' preference for the steamed apem form. However, the difference in the scores obtained between treatments was relatively small. To find out whether the difference in average values between treatments is significant, a fingerprint analysis (ANAVA) was performed. The results of the analysis are presented in the following table.

**Table 15. ANAVA Analysis Results**

| EN            | DB     | JK    | KT   | Calculation | Table |
|---------------|--------|-------|------|-------------|-------|
|               |        |       |      |             | 0,05  |
| Sample        | 3,00   | 0,11  | 0,04 | 0,13        | 2,71  |
| Panel         | 29,00  | 11,20 | 0,39 | 1,38        | 1,60  |
| Error/Residue | 87,00  | 24,39 | 0,28 |             |       |
| Total         | 119,00 | 35,70 |      |             |       |

Based on the results of the fingerprint analysis (ANAVA), a Fcal value of 0.13 was obtained, while Ftable at a significance level of 5% was 2.71. Because  $F_{cal} < F_{table}$  ( $0.13 < 2.71$ ),  $H_0$  is accepted and  $H_a$  is rejected. Thus, it can be concluded that there is no significant difference in the level of preference of the panelists for the shape of the steamed apem cake with the substitution of dragon fruit peel juice in various treatments resulting in the shape of the steamed apem cake that is relatively preferred by the panelists.

### Color

**Table 16. Average Results of Favorite Apem Cake Colors**

| X0 (0%) | X1 (20%) | X2 (30%) | X3 (40%) |
|---------|----------|----------|----------|
| 5.58    | 4.33     | 4.67     | 5.01     |

Based on table 16, the average value of the panelists' preference level for the color of the apem cake in the X0 treatment was 5.58, X1 was 4.33, X2 was 4.67, and X3 was 5.01, all of which were in the category of somewhat liked. The increase in the average value showed that the substitution of steamed apem tended to increase the level of panelists' preference for the color of steamed apem. However, the difference in the scores obtained between treatments was relatively small. To find out whether the difference in average values between treatments is significant, a fingerprint analysis (ANAVA) was performed. The results of the analysis are presented in the following table:

**Table 17. Color Preference ANAVA Analysis Results**

| EN            | DB     | JK    | KT   | Calculation | Table |
|---------------|--------|-------|------|-------------|-------|
|               |        |       |      |             | 0,05  |
| Sample        | 3,00   | 25,42 | 8,47 | 23,91       | 2,71  |
| Panel         | 29,00  | 19,93 | 0,69 | 1,94        | 1,60  |
| Error/Residue | 87,00  | 30,83 | 0,35 |             |       |
| Total         | 119,00 | 76,18 |      |             |       |

Based on the results of the fingerprint analysis (ANAVA), a  $F_{cal}$  value of 23.91 was obtained, while  $F_{table}$  at a significance level of 5% was 2.71. Because  $F_{cal} > F_{table}$  (23.91 > 2.71),  $H_0$  is rejected and  $H_a$  is accepted. Thus, it can be concluded that there is a significant difference in the level of preference of the panelists for the color of steamed apem cake with the substitution of dragon fruit peel juice. The analysis continued with Dunca's follow-up test:

**Table 18. Color Preference DMRT Test Results**

| Treatment | Average | LSR + average | notasi |
|-----------|---------|---------------|--------|
| X0 (0%)   | 5,58    | 5,88          | a      |
| X3 (65%)  | 5,01    | 5,33          | b      |
| X2 (50%)  | 4,67    | 5,00          | c      |
| X1 (35%)  | 4,33    |               | d      |

The X0 (0%) treatment is still the most preferred treatment because it produces the typical color of apem cake that is most familiar to the panelists. Meanwhile, an increase in dragon peel juice substitution of up to 65% resulted in a color that returned to favor over the 35% and 50% treatments, although the preference level was still lower than the controls. Thus, the variation in the concentration of dragon fruit peel substitution affects the panelists' acceptance of the color of steamed apem cake.

## Aroma

**Table 19. Average Results of Apem Cake Aroma Preferences**

| X0 (0%) | X1 (20%) | X2 (30%) | X3 (40%) |
|---------|----------|----------|----------|
| 4,75    | 4,87     | 4,73     | 4,61     |

Based on table 19, the average value of the panelists' preference level for the color of the apem cake in the X0 treatment was 4.75, X1 was 4.87, X2 was 4.73, and X3 was 4.61, all in the like category. The increase in the average value showed that dragon fruit juice substitution tended to increase the level of panelists' preference for the aroma of steamed apes. However, the difference in the scores obtained between treatments was relatively small. To find out whether the difference in average values between treatments is significant, a fingerprint analysis (ANAVA) was performed. The results of the analysis are presented in the following table:

**Table 20. Results of Fingerprint Analysis of Variety of Aromas**

| EN            | DB     | JK    | KT   | Calculation | Table |
|---------------|--------|-------|------|-------------|-------|
|               |        |       |      |             | 0,05  |
| Sample        | 3,00   | 0,91  | 0,30 | 0,61        | 2,71  |
| Panel         | 29,00  | 31,50 | 1,09 | 2,18        | 1,60  |
| Error/Residue | 87,00  | 43,43 | 0,50 |             |       |
| Total         | 119,00 | 75,83 |      |             |       |

The results of ANAVA's analysis showed that the  $F_{cal}$  value was 0.61, while the  $F_{table}$  at the significance level of 5% was 2.71. Because  $F_{calculus} < F_{table}$  (0.61 < 2.71),  $H_0$  is accepted and  $H_a$  is rejected. Thus, it can be concluded that there is no significant difference in the level of preference of the panelists for the aroma of steamed apem cake with the substitution of dragon fruit peel juice in various treatments.

## Tekstur

**Table 21. Average Results of Apem Cake Texture Preferences**

| X0 (0%) | X1 (20%) | X2 (30%) | X3 (40%) |
|---------|----------|----------|----------|
| 5.66    | 5.93     | 6.13     | 6.31     |

Based on table 21, the average value of the panelists' preference level for the texture of steamed apem in the X0 treatment was 5.66, X1 was 5.93, X2 was 6.13, and X3 was 6.31, all in the like category. The increase in average values showed that it tended to increase the level of the panelists' preference for the texture of steamed apem cake. However, the difference in the scores obtained between treatments was relatively small. To find out whether the difference in average values between treatments is significant, a fingerprint analysis (ANAVA) was performed. The results of the analysis are presented in the following table:

**Table 22. Results of Fingerprint Analysis Variety of Texture**

| EN            | DB     | JK    | KT   | Calculation | Table |
|---------------|--------|-------|------|-------------|-------|
|               |        |       |      |             | 0,05  |
| Sample        | 3,00   | 7,12  | 2,37 | 13,91       | 2,71  |
| Panel         | 29,00  | 5,91  | 0,20 | 1,19        | 1,60  |
| Error/Residue | 87,00  | 14,85 | 0,17 |             |       |
| Total         | 119,00 | 27,88 |      |             |       |

Based on the results of the fingerprint analysis (ANAVA), a Fcal value of 13.91 was obtained, while Ftable at a significance level of 5% was 2.71. Because Fcount > Ftable (13.91 > 2.71),  $H_0$  is rejected and  $H_a$  is accepted. Thus, it can be concluded that there is a significant difference in the level of preference of the panelists for the taste of steamed apem cake with the substitution of dragon fruit peel juice. Therefore, the analysis continued with Duncan's further test to find out the differences between treatments.

**Table 23. Texture Preference DMRT Test Results**

| Treatment | Average | LSR + average | notasi |
|-----------|---------|---------------|--------|
| X3 (65%)  | 6,31    | 6,52          | a      |
| X2 (50%)  | 6,13    | 6,36          | from   |
| X1 (35%)  | 5,93    | 6,16          | bc     |
| X0 (0%)   | 5,66    |               | d      |

The substitution of dragon fruit peel juice up to a concentration of 65% still produces a steamed apem cake texture that is relatively preferred by the panelists with a level of preference that does not differ significantly between treatments.

## Taste

**Table 21. Average Results of Apem Cake Taste Preferences**

| X0 (0%) | X1 (20%) | X2 (30%) | X3 (40%) |
|---------|----------|----------|----------|
| 5.66    | 5.93     | 6.13     | 6.31     |

Based on table 15, the average value of the panelists' preference level for the taste of steamed apem cake in the X0 treatment was 5.66, X1 was 5.93, X2 was 6.13, and X3 was 6.31, all in the like category. The increase in average scores showed that it tended to increase the level of panelists' preference for steamed apem cakes. However, the difference in the scores obtained between treatments was relatively small. To find out whether the difference in average values between treatments is significant, a fingerprint analysis (ANAVA) was performed. The results of the analysis are presented in the following table:

**Table 22. Results of Fingerprint Analysis of Various Flavors**

| EN            | DB     | JK    | KT   | Calculation | Table |
|---------------|--------|-------|------|-------------|-------|
|               |        |       |      |             | 0,05  |
| Sample        | 3,00   | 7,12  | 2,37 | 13,91       | 2,71  |
| Panel         | 29,00  | 5,91  | 0,20 | 1,19        | 1,60  |
| Error/Residue | 87,00  | 14,85 | 0,17 |             |       |
| Total         | 119,00 | 27,88 |      |             |       |

Based on the results of the fingerprint analysis (ANOVA), a  $F_{cal}$  value of 13.91 was obtained, while  $F_{table}$  at a significance level of 5% was 2.71. Because  $F_{count} > F_{table}$  (13.91 > 2.71),  $H_0$  is rejected and  $H_a$  is accepted. Thus, it can be concluded that there is a significant difference in the level of preference of the panelists for the taste of steamed apem cake with the substitution of dragon fruit peel juice. Therefore, the analysis continued with Duncan's further test to find out the differences between treatments.

**Table 23. Taste Preference DMRT Test Results**

| Treatment | Average | LSR + average | notasi |
|-----------|---------|---------------|--------|
| X3 (65%)  | 6,31    | 6,52          | a      |
| X2 (50%)  | 6,13    | 6,36          | ab     |
| X1 (35%)  | 5,93    | 6,16          | BC     |
| X0 (0%)   | 5,66    |               | d      |

The results showed that the substitution of dragon fruit peel juice had a real influence on the panelists' level of preference for the taste of steamed apem cake. The higher the concentration of dragon fruit peel substitution, the level of panelists' preference for taste tends to increase. The X3 treatment (65%) resulted in the highest level of taste preference, although statistically no significant difference from the X2 treatment (50%). Thus, 65% of dragon fruit peel substitution was the most preferred treatment by the panelists in terms of taste, while the 50% treatment provided a statistically equivalent level of preference.

## CONCLUSION

This study proves that the substitution of dragon fruit peel juice has a real effect on the quality of steamed apem cake, especially on color and texture parameters, while the shape, aroma, and taste parameters are not significantly affected. In terms of acceptability, the substitution of dragon fruit peel juice had a real effect on the level of color and taste preference, while the preference for shape, aroma, and texture did not differ significantly between treatments.

The X3 treatment (65%) produced the best color and texture quality with an average score of 4.96 and 5.29, respectively, while obtaining the highest level of taste preference from the panelists with an average score of 6.31. The quality of shape, aroma, and taste was statistically best in the control treatment without substitution (X0), but because the difference from the substitution treatment was not significant, the typical characteristics of steamed apem cake could still be maintained even when substituted to the highest concentration. Taking into account the balance between improving color and texture quality and taste acceptance without compromising the basic characteristics of the product, a substitution of 65% (X3) dragon fruit peel juice can be recommended as the optimal formulation in the manufacture of steamed apem cakes.

These findings make a real contribution to the development of traditional Indonesian cake products, especially in terms of replacing synthetic dyes with natural dyes based on local food waste. The use of dragon fruit peel juice as a natural dye has been proven to not only produce an attractive pink color, but also increase the texture and taste preference level of the

product at the same time, thus providing double added value that is not obtained from the use of conventional synthetic dyes. This approach also supports the use of dragon fruit peel waste that has been underutilized, especially in West Sumatra as one of the largest dragon fruit production centers in Indonesia, into value-added and environmentally friendly food products. For further research, it is recommended to conduct a study on nutritional content, antioxidant activity, shelf life, and consumer acceptance rate on a wider scale for steamed apem cake with dragon fruit peel substitution.

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