

The Effect of Adding Natural Coloring from Mangosteen Peel (*Garcinia mangostana* L.) on the Organoleptic Characteristics of Putu Ayu Cake

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ABSTRACT

Mangosteen peel (Garcinia mangostana L.) is an agricultural waste product that has the potential to be used as a natural additive in food products because it contains natural pigments and various bioactive compounds. This study aims to determine the effect of adding mangosteen peel extract on the organoleptic characteristics of putu ayu cake, including color, texture, taste, and aroma, and to determine the treatment that produces the best organoleptic characteristics. The study used a quantitative experimental approach with a Completely Randomized Design (CRD) consisting of three treatments, namely P, Q, and R, with three replications. Organoleptic testing was conducted using the hedonic test method involving 15 untrained panelists. The research data were analyzed using Analysis of Variance (ANOVA) at a significance level of 5% and continued with the Least Significant Difference Test (LSD) of 5% if there were significant differences between treatments. The results showed that the addition of mangosteen peel extract had an effect on the level of panelists' preference for the organoleptic characteristics of putu ayu cake. Based on the determination of the best treatment in the draft, treatment R obtained the highest value in the color parameter of 11.93, texture of 12.00, taste of 12.47, and aroma of 13.00. Thus, treatment R was declared the best and most acceptable treatment by the panelists. This study shows that mangosteen peel extract has the potential to be used as a natural additive in the development of putu ayu cake products while increasing the added value of mangosteen peel waste.

Keywords: mangosteen peel, putu ayu cake, organoleptic, hedonic test, natural colorant.5

INTRODUCTION (font size 12pt)

The mangostan fruit, known by its late name, *Garcinia mangostana* L., belongs to the Guttiferae (Family Clusiaceae) plant family and is widely distributed in tropical regions of the world. Numerous varieties of this species offer numerous benefits, such as essential fruits, vegetables, and medicinal inhalants. The mangostan fruit is also known as the "Königin der Früchte" and is one of Indonesia's most important exports (Pratama et al., 2025). The mangosteen plant is typically only used for its pulp; the peel is frequently thrown away and seen as waste. Nonetheless, a number of studies have demonstrated that the mangosteen peel contains bioactive substances with potential uses in business and healthcare (Hartati et al., 2025).

Mangosteen peel includes a variety of secondary plant components, including alkaloids, saponins, tannins, flavonoids, phenols, triterpenoids, steroids, and glycosides (Mukharomah et al., 2025). Some of these substances have antibacterial properties, including tannins, flavonoids, and saponins. Additionally, mangosteen peel has high quantities of antioxidants and pigments. The polyphenol group's xanthenes and epicatechins are the most significant antioxidant substances. Because of their strong antioxidant action, xanthenes may help prevent a number of illnesses, including diabetes, cancer, inflammation, and liver disease. Additionally, these substances have antifungal, antibacterial, and antimalarial properties. Anthocyanins, which are found in mangosteen peels, help to bind heavy metals like iron, zinc, and copper, prevent oxidation, boost immunity, and neutralize free radicals. Mangosteen peels should therefore be used more extensively to boost their added value as a food ingredient.

A common traditional snack is putu ayu. The savory taste of the grated coconut topping and the sweetness of the sponge cake batter are its two primary characteristics. Eggs and sugar are combined, beaten

until frothy, and then mixed with flour and additional ingredients to make putu ayu. Before the batter is added, the grated coconut is placed on the bottom of a particular mold that has been steamed (Azky et al., 2024).

Granulated sugar, coconut milk, and wheat flour are commonly used to make putu ayu. However, changes to the fundamental ingredients are required to boost its nutritional content, lessen dependence on traditional ingredients, and encourage innovation in the food industry. Using mangosteen peel as an addition is one strategy that can improve the finished product's nutritional value. It is anticipated that adding mangosteen peel to the Putu Ayu dough will improve its organoleptic qualities, including flavor, color, texture, and aroma.

METHOD

This study used an experimental quantitative technique with a one-way, completely randomized controlled trial (CRD) to examine the impact of adding mangosteen peel extract (*Garcinia mangostana* L.) as a natural colorant on the organoleptic qualities of Putu Ayu cake (Sugiyono, 2022). Three mangosteen peel extract concentrations were tested: P (150 ml), Q (250 ml), and R (350 ml). Nine trials were conducted, with each treatment being repeated three times. In every treatment, the basic recipe (250 g mocaf flour, 250 g granulated sugar, 2 eggs, and ½ tbsp soy sauce) remained the same. The study was carried out in the hamlet of Balong Rejo, Badas Village, Badas District, Kediri Prefecture, East Java, between March and June of 2025. Fifteen untrained test subjects were chosen through targeted sampling to evaluate the Putu Ayu Cake products that came from the three treatments (Sujarweni, 2022).

The tools used include a steamer, sieve, measuring cup, flower-shaped Putu Ayu Cake mold, basin, scissors, brush, spatula (solet), ladle, and tray, with ingredients in the form of dried mangosteen peel (150 g), water for extraction (1 liter), mocaf flour (250 g), chicken eggs (2 eggs), granulated sugar (250 g), SP emulsifier (½ tbsp), water for dough (50 ml), grated coconut, salt, and cooking oil to taste. The procedure begins with the extraction of dried mangosteen peel using 1 liter of boiling water for ± 1 hour, then filtered to obtain the filtrate as a natural dye. Next, eggs, granulated sugar, and SP are gradually beaten until fluffy, added water (50 ml), then mangosteen peel extract according to treatment, and mocaf flour until the dough is homogeneous; the dough is poured into a mold that has been smeared with oil and given grated coconut seasoned with salt on the bottom, then steamed for 15 minutes until cooked and cooled before being tested organoleptically.

Data were collected using a hedonic test questionnaire (preference test) with a scale of 1–5 (1 = dislike very much to 5 = like very much) for four organoleptic parameters, namely color, aroma, taste, and texture (Ghaffar & Nurhamzah, 2024). The assessment data were tabulated and the average score for each treatment was calculated, then analyzed using a one-way Analysis of Variance (ANOVA) at a significance level of 5% to test the effect of the treatment on each parameter. If the ANOVA results showed a significant effect, the analysis was continued with the Least Significant Difference Test (LSD) at a level of 5% to determine the best treatment; all data processing was carried out using Microsoft Excel and presented in tables and graphs.

RESULT AND DISCUSSION

The organoleptic test data were then analyzed using the Analysis of Variance (ANOVA) method at a 5% significance level. If the analysis results showed significant differences between treatments, then the Least Significant Difference Test (LSD) was continued at the 5% level to determine the treatment that had the best effect on the organoleptic characteristics of Kue Putu Ayu. The organoleptic test results obtained for each parameter are presented as follows.

Result

The results of the organoleptic test for the four parameters color, texture, taste, and aroma of Putu Ayu cake with added mangosteen peel extract at three treatment levels (P = 150 ml, Q = 250 ml, R = 350 ml) are presented in Table 1. A 5% significance level analysis of variance (ANOVA) showed that the addition of mangosteen peel extract had a significant effect on the panelists' preference ratings for all parameters, with a consistent pattern: the mean scores increased as the extract volume increased, so that treatment R consistently received the highest scores for all parameters.

Table 1. Average Score of the Organoleptic Test for Putu Ayu Cak

Parameter	P	Q	R	BNT 5%
Warna	10,98	11,93	9,47	1,44
Tekstur	10,60	11,13	12,00	1,29
Rasa	10,87	11,87	12,47	1,18
Aroma	9,47	10,33	13,00	1,54

The results of the organoleptic color test for Kue Putu Ayu, analyzed using analysis of variance (ANOVA), showed that the addition of mangosteen peel extract had a significant effect on the panelists' preference ratings. Based on Table 1, treatment Q had the highest mean score of 11.93, followed by treatment P at 10.98 and treatment R at 9.47. The result of the 5% BNT post-hoc test, with a value of 1.44, indicates that there are significant differences in color preference levels among the treatments. The highest mean score for treatment Q indicates that this treatment produced the color of Putu Ayu cake that was most preferred by the panelists compared to the other treatments.

The results of the organoleptic texture test showed that treatment R obtained the highest average score of 12, followed by treatment Q at 11.13 and treatment P at 10.6. Based on the 5% BNT test result of 1.29, treatment R had a higher texture likability score than treatment Q. The highest average score for treatment R indicates that the panelists preferred the texture of the Putu Ayu cake in that treatment over the others.

The results of the organoleptic taste test showed that treatment R obtained the highest average score of 12.47, followed by treatment Q at 11.87 and treatment P at 10.87. Based on the 5% BNT test result of 1.18, treatment R had a higher level of taste preference than treatment P, while treatment Q fell between the two. The highest average score for treatment R indicates that the panelists preferred the taste of the Putu Ayu cake from that treatment over the others.

The results of the aroma organoleptic test showed that treatment R obtained the highest average score of 13.00, followed by treatment Q at 10.33 and treatment P at 9.47. Based on the 5% BNT test result of 1.54, treatment R had a higher aroma likability rating than treatments P and Q. The highest average score for treatment R indicates that the aroma of Kue Putu Ayu in that treatment was preferred by the panelists over the other treatments.

The mean organoleptic scores for each parameter indicate that treatment R obtained the highest score compared to treatments P and Q. For the color parameter, treatment R obtained a mean score of 11.93, while treatment Q scored 10.80 and treatment P scored 9.47. For the texture parameter, treatment R had an average score of 12.00, higher than treatment Q at 11.13 and treatment P at 10.60. For the taste parameter, treatment R also showed the highest average score at 12.47, followed by treatment Q at 11.87 and treatment P at 10.87. Similar results were observed for the aroma parameter, where treatment R had a mean score of 13.00, while treatment Q had 10.33 and treatment P had 9.47. The high mean score for treatment R indicates that the panelists preferred the color, texture, taste, and aroma characteristics produced by that treatment.

Discussion

For the color parameter, the difference in mean values between treatments R and P (2.46) exceeded the 5% BNT value (1.44), indicating a significant difference, while the difference between Q and both P and R was close to the BNT threshold, suggesting that its acceptability level fell between the two. The deeper color observed at higher extract volumes is likely due to the increased anthocyanin content in mangosteen peel, which rises with the volume of the addition, resulting in a distinctive color gradient that remains acceptable to the panelists.

The addition of mangosteen peel extract has an effect on the level of panelists' preference for the color aspect of Putu Ayu Cake, where the higher the concentration of the added extract, the color of the cake changes from the typical bright green of Putu Ayu Cake to darker due to the anthocyanin pigment content in mangosteen peel; treatment R with the highest extract concentration obtained the highest color preference value (11.93), followed by treatment Q (10.80) and P (9.47), which indicates that even though the color changes to be more intense, the appearance actually produces unique and attractive characteristics

so that it can still be accepted well by the panelists compared to other treatments. These findings are consistent with those of (Kirana et al., 2022), who reported that the addition of mangosteen peel powder to yogurt improved the color organoleptic score compared to products without mangosteen peel, as well as (Astuti, 2022), who showed that mangosteen peel flour in milk pies produced a color in the “good” category.

In terms of texture parameters, treatment R (12.00) differed significantly from P (10.60) because the difference (1.40) exceeded the 5% BNT (1.29), while Q occupied an intermediate position. The increase in extract volume is thought to have affected the moisture content and dough structure during steaming; however, these changes still resulted in a soft texture that was acceptable to the panelists.

The addition of mangosteen peel extract also influenced the panelists' preference for the texture of Kue Putu Ayu, which is thought to be related to the effect of extract volume on the moisture content and structure of the dough during the steaming process; treatment R, with the highest extract volume, received the highest texture preference score (12.00), followed by treatments Q (11.13) and P (10.60), indicating that the addition of extract at these levels was still able to maintain the characteristic soft, fluffy, and non-crumby texture of Kue Putu Ayu, so that the texture of the cake at all concentration levels was still considered acceptable by the panelists. These results are consistent with those of Jannah et al. (2024), who reported that the addition of mangosteen peel extract up to a certain level was still acceptable to panelists in terms of texture parameters, as well as Kirana et al. (2022), who noted changes in texture due to the addition of mangosteen peel compared to the control product.

For the taste and aroma parameters, treatment R obtained the highest scores (12.47 and 13.00) and differed significantly from treatment P (taste difference of $1.60 > \text{BNT } 1.18$; aroma difference of $3.53 > \text{BNT } 1.54$), while Q ranked intermediate for both parameters. The characteristic savory-sweet flavor of Kue Putu Ayu remained dominant even as the level of extract addition increased, while the stronger aroma in treatment R is believed to stem from the interaction of volatile compounds in the mangosteen peel extract with the dough ingredients during steaming.

The findings demonstrated that the test subjects' preferences for the flavor and aroma of Kue Putu Ayu were affected by the inclusion of mangosteen peel extract. With an average score of 12.47, treatment R received the highest rating for the taste parameter. This implies that the test subjects found the extract concentration in this treatment to be acceptable and that it did not affect the distinctive flavor of Kue Putu Ayu. The flavor of the product remained dominated by the savory taste of grated coconut, the sweet taste of sugar, and the other ingredients. However, because of its tannin and polyphenol content, larger extract concentrations started to evoke the distinctive, slightly astringent taste of the mangosteen peel. Conversely, with an average score of 10.87, Treatment P had the lowest score. With an average score of 13.00, Treatment R also received the highest score for the fragrance parameter. This is probably because the concentration of mangosteen peel extract produced a distinctive and pleasing scent that melded with Kue Putu Ayu's foundation scent. The cake's contents reacted with volatile chemicals from the mangosteen peel extract during the steaming process, giving the test subjects a more enticing scent. Variants P and Q, on the other hand, had a comparatively milder scent, which resulted in a lower preference. Thus, in terms of flavor and scent, the test subjects preferred variant R. This indicates that the acceptability of Kue Putu Ayu can be raised by adding mangosteen peel extract at a particular concentration.

Based on all parameters, treatment R (350 ml mangosteen peel extract addition) was determined to be the best treatment because it consistently achieved the highest average scores for color, texture, flavor, and aroma. These results indicate that mangosteen peel extract has the potential to be utilized as a functional natural colorant in the development of Putu Ayu cake products without reducing consumer acceptance, while also providing added value for the utilization of mangosteen peel waste. The acceptability of the taste and aroma at these higher concentrations is consistent with the findings of Kirana et al. (2022) and Astuti (2022), who both reported good acceptance of the flavor and aroma in products with added mangosteen peel, and is consistent with the criteria for high-quality Kue Putu Ayu according to Herryani & Santi (2019), who emphasize a balance between savory and sweet flavors and the characteristic aroma of coconut milk and pandan.

Based on all parameters, treatment R (addition of 350 ml of mangosteen peel extract) was determined to be the best treatment because it consistently achieved the highest average scores for color, texture, taste, and aroma. These results indicate that mangosteen peel extract has the potential to be utilized as a functional natural colorant in the development of Putu Ayu cake products without reducing consumer acceptance, while also providing added value for the utilization of mangosteen peel waste.

CONCLUSIONS

The organoleptic characteristics of Kue Putu Ayu, including as color, texture, taste, and scent, are affected by the inclusion of mangosteen peel extract. The test respondents' preferences for each organoleptic characteristic varied as a result of the various treatments, according to analysis of variance (ANOVA). With an average color score of 11.93, a texture score of 12.00, a taste score of 12.47, and an aroma score of 13.00, treatment R emerged as the best in the organoleptic test. In comparison to the other treatments, treatment R produced the finest organoleptic qualities of Kue Putu Ayu and was the concentration of mangosteen peel extract that the test subjects found most acceptable. Mangosteen peel waste can be made more valuable by using mangosteen peel extract as a natural colorant in Kue Putu Ayu, which also produces culinary items that consumers will find palatable.

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