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THE EFFECT OF RED ROSELLE EXTRACT ADDITION ON PHYSICAL AND SENSORY QUALITIES OF INNOVATIVE KUE BANGKIT

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Abstract

The shift in food consumer preferences toward clean-label products has increased the demand for natural dyes, such as those derived from roselle (*Hibiscus sabdariffa* L.). Despite the potential of roselle as an anthocyanin-rich coloring agent, its application in traditional Indonesian cookies, specifically *kue bangkit*, remains unexplored. This study aims to analyze the effect of adding red roselle extract on the physical quality and sensory quality of innovative *kue bangkit*. An experimental quantitative approach was employed, utilizing roselle extract at 9%, 12%, and 15% concentrations. The research addressed challenges related to pigment stability, flavor modification, and texture maintenance during the baking process. Results indicated that increasing the concentration of roselle extract intensified the pink color and sour taste, with the 15% formulation receiving the highest scores for visual and sensory appeal. The addition of the extract did not significantly affect the *baking loss* or damage the characteristic crumbly texture of the cookies. In conclusion, a 15% concentration of red roselle extract is the recommended formulation for producing a visually appealing and sensory-acceptable innovative *kue bangkit*, supporting the potential for local food resource development in the bakery industry.

Keywords: Kue Bangkit, Natural Dye, Roselle Extract, Food Innovation

INTRODUCTION

In recent years, there has been a shift in food consumer preferences towards products with a "clean-label", namely foods that use natural ingredients without synthetic dyes. In Indonesia, this trend is also beginning to be felt, marked by an increasing demand for natural coloring agents for bakery and other processed products (Imbarex, 2025). Food coloring is a food additive that is quite important for the food industry because of its function to improve the appearance of food. Furthermore, a variety of ingredients can be utilized as natural dyes, generally derived from plants such as roselle, beetroot, butterfly pea flower, turmeric, pandan, and spinach, each of which contains characteristic pigments of anthocyanin, betalain, curcumin, or chlorophyll that give red, purple, blue, yellow, and green colors (Vega et al., 2023).

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Based on data from PRMP Perkebunan (2025), roselle is widely cultivated in the islands of Java, Bali, and Sumatra by smallholder farmers as well as on a commercial scale, making it one of the potential plants in the national plantation sector. The role of the Sweetener and Fiber Crops Research Institute (Balittas), now known as BSIP Pemanis dan Serat, under the Center for Standardization of Plantation Instruments, is very significant in the development of roselle in Indonesia. This institution focuses on plant breeding to produce superior varieties, the development of efficient cultivation technology, and post-harvest processing to increase the added value of roselle-based products. Specifically, Riau Province is one of the growing roselle cultivation areas in Sumatra, thus providing local raw materials that are easily accessible to traditional food business actors. The roselle flower plants in Riau Province are mostly found in the city areas of Pekanbaru and Kuok. The abundance of roselle flower cultivation is characterized by the many food and beverage products processed from roselle flowers as the basic ingredient, such as syrup, candied fruit, fresh vegetables, and the use of its leaves as a cleaner for fish to be cooked. This multitude of benefits from the roselle flower makes local communities cultivate this seasonal shrub into a traded product (Syafriani et al., 2021).

Roselle contains anthocyanin pigments that cause a red color at a low pH. Roselle (Hibiscus sabdariffa L) is one of the sources of anthocyanin pigments that has not been widely utilized. Roselle extract has been applied as a natural dye in several products such as powder drinks, cakes, and sheet jams, with the result that color and consumer acceptance can be affected by the dye concentration (Mahfud, 2015). Generally, roselle flowers have two types of colors, namely red roselle and purple roselle. Both have the same efficacy, but a slightly different taste sensation. Red roselle tea tastes slightly sour, while purple roselle tea is not so sour. Dried roselle flowers can be red or purple depending on the type. However, when brewed, red roselle will produce a red color, while purple roselle will be a concentrated red (Ashfiya, n.d.).

This research is motivated by a research gap in previous studies. Based on research conducted by Isnaini (2010), Nafiunisa, et al. (2017), and Nurcahyo and Kusnadi (2019), it was concluded that roselle extract can be applied to food products. Studies on the application of roselle extract to food products conducted by Aini (2022), Marak, et al. (2022), (Febrinasari et al., 2023), and (Isnaini, 2010) show that roselle extract has been applied to food products such as red velvet cake, muffins, dodol, cupcakes, layer cakes, jelly, and syrup. However, in these previous studies, the application of roselle extract to food products is still limited and has not specifically discussed the use of roselle extract in cookies. Cookies are one of the popular types of snacks in Indonesia. The classification of cookies is often based on their main ingredients. Indonesian cakes are classified based on staple ingredients such as cereals (rice, sticky rice), flours (rice, sticky rice, tapioca, sago, hunkue, cornstarch), and tubers (cassava, taro). Tapioca flour is a starch flour extracted from cassava, used as a substitute for wheat flour because it produces a crisp and dry texture without gluten. Tapioca flour produces cookies such as *kue telur gabus* and *kue kembang goyang* typical of Betawi, *kue kuping gajah* typical of Central Java, and *kue bangkit* typical of Sumatra Island, especially in Riau, North Sumatra, West Sumatra, and Jambi Provinces (Nurdamayanti, 2023).

The utilization of natural dyes in the development of food innovation can be done by utilizing potential local resources. The selection of *kue bangkit* as the research object is based

on its characteristic pale yellowish-white color, which has the opportunity to be developed from the visual aspect and innovated with the addition of a sour taste. The addition of red roselle extract is expected to increase visual appeal through anthocyanin pigments and become a new innovation. Therefore, testing of various percentages of red roselle extract is needed to determine whether the resulting visual and taste changes remain in line with the physical and sensory quality that are the standards of *kue bangkit*.

This research is driven by several existing problems that reflect community needs, namely the shift in consumption patterns towards clean-label products, especially regarding the use of natural dyes. Furthermore, the increasing interest in natural dyes has not been fully followed by an understanding of pigment stability, its impact on product quality, and its suitability for specific food applications. This is particularly crucial for *kue bangkit* which undergoes baking, meaning the roselle pigment has the potential to change color, affect texture, and modify flavor. There is also a lack of innovation regarding the addition of red roselle extract to the physical and sensory quality of *kue bangkit*. To address these issues, this study is focused on and limited to finding out whether there is an effect of adding red roselle extract on the physical and sensory quality of the innovative *kue bangkit*. This research not only has the potential to produce an alternative natural dye for traditional cookies, but also contributes to the literature on the adaptation of natural ingredients in the bakery sector, thereby supporting visually appealing local food innovation. Therefore, the main purpose of this research is to analyze the effect of adding red roselle extract to the innovative *kue bangkit*, specifically evaluated based on the aspects of physical quality and sensory quality.

IMPLEMENTATION METHOD

The research conducted is a quantitative study with an experimental method, which aims to examine the cause-and-effect relationship through the application of specific treatments to subjects in the experimental group. The sample creation and physical quality testing in this study were carried out in an informal laboratory in the form of a home kitchen that functioned as a food processing site, with the environment conditioned to meet the principles of cleanliness and food safety. The series of research activities began in September 2025. The subjects in this study consisted of 5 expert panelists who are lecturers of the Culinary Arts Education Study Program at Universitas Negeri Jakarta, and 45 semi-trained panelists who are students of the Culinary Arts Education Study Program at Universitas Negeri Jakarta who have taken or are currently taking the Organoleptic Evaluation course.

Furthermore, the population in this study is the innovative *kue bangkit* with the addition of roselle extract. The samples utilized in this study are the innovative *kue bangkit* with the addition of roselle extract at percentages of 9%, 12%, and 15%. The sampling technique used in this research is random sampling, administered to 45 panelists who were divided into 3 different groups, where each group consisted of 15 panelists. Each sample of the innovative *kue bangkit* with the addition of roselle extract was given a different code, which was only known by the researcher, in order to reduce bias in the assessment and ensure objectivity during the testing process by the panelists.

The research procedure began with a product trial experiment to determine the quality of the control product and the 3 treatment products. In the process of making the red roselle

extract, the extraction process was carried out by heating through boiling. First, the water was boiled, then the dried red roselle flowers and citric acid were added and extracted by simmering at a temperature of 50˚C for 30 minutes in a closed container, followed by filtering and volume standardization to 50 ml. For the process of making the innovative *kue bangkit*, sago flour and pandan leaves were roasted using a very small heat for 10 minutes. Then, powdered sugar, egg yolks, instant thick coconut milk, and the red roselle extract were mixed until homogeneous to form a cream. After that, the cooled roasted sago flour was added to the cream while stirring evenly. The dough printed using a flower-shaped mold, arranged on a baking tray lined with a silicone mat, and baked in an oven that had been previously heated at a temperature of 140°C for 30 minutes.

Regarding the data collection techniques, the physical quality evaluation involved measuring the baking loss to determine the percentage of water evaporation during baking using a kitchen scale, calculated by comparing the weight of the raw dough before baking and the weight of the baked cookies after cooling. Meanwhile, the data collection technique for the sensory quality test used organoleptic test sheets distributed to the 45 semi-trained panelists. The panelists observed and tasted the provided samples, then assessed the aspects of color, roselle aroma, coconut milk aroma, sour roselle taste, sweet taste, and texture. Finally, the data analysis technique for physical quality was conducted by recording the test results, summarizing them in a table, and analyzing them using the One Way ANOVA test with a significance level of $\alpha = 0.05$, followed by the Duncan test if significant differences were found. On the other hand, the data analysis for the sensory test results was carried out using the Kruskal-Wallis test with a significance level set at alpha (α) = 0.05, because the research involved three different treatments and the collected data were categorical, followed by Tuckey's post-hoc test if significant differences were found.

RESULTS AND DISCUSSION

The data in this study were obtained through three types of testing, namely validation tests, physical quality tests, and sensory quality tests. The tested product was the innovative *kue bangkit* with the addition of red roselle extract at 9%, 12%, and 15%. The validation test of the innovative *kue bangkit* with the addition of red roselle extract was carried out on 5 expert panelists using an instrument consisting of aspects of color, roselle aroma, coconut milk aroma, sour roselle taste, sweet taste, and texture with the following results. To present the data efficiently according to journal standards, the frequency, percentage, and mean scores of all validation aspects are consolidated into Table 1 below.

Table 1. Validation Test Results of Innovative Kue Bangkit by Expert Panelists

Assessment Aspect	Score	9%		12%		15%	
		n	%	n	%	n	%
Color (Mean)		(3.0)		(4.0)		(5.0)	
Pink	5	0	0	0	0	5	100
Slightly Brownish Pink	4	0	0	5	100	0	0
Brownish Pink	3	5	100	0	0	0	0
Faded Brownish Pink	2	0	0	0	0	0	0
Brownish Light Yellow	1	0	0	0	0	0	0

Roselle Aroma (Mean)		**(2.4)**		**(2.6)**		**(3.0)**	
Roselle-scented	5	0	0	0	0	1	20
Quite Roselle-scented	4	1	20	1	20	0	0
Slightly Roselle-scented	3	0	0	1	20	2	40
Less Roselle-scented	2	4	80	3	60	2	40
Not Roselle-scented	1	0	0	0	0	0	0
Coconut Milk Aroma (Mean)		**(3.6)**		**(3.8)**		**(3.6)**	
Coconut Milk-scented	5	1	20	2	40	1	20
Quite Coconut Milk-scented	4	1	20	0	0	1	20
Slightly Coconut Milk-scented	3	3	60	3	60	3	60
Less Coconut Milk-scented	2	0	0	0	0	0	0
Not Coconut Milk-scented	1	0	0	0	0	0	0
Sour Roselle Taste (Mean)		**(4.2)**		**(4.6)**		**(5.0)**	
Tasting Sour Roselle	5	2	40	3	60	5	100
Quite Tasting Sour Roselle	4	2	40	2	40	0	0
Slightly Tasting Sour Roselle	3	1	20	0	0	0	0
Less Tasting Sour Roselle	2	0	0	0	0	0	0
Not Tasting Sour Roselle	1	0	0	0	0	0	0
Sweet Taste (Mean)		**(4.4)**		**(4.4)**		**(4.6)**	
Sweet	5	3	60	3	60	3	60
Quite Sweet	4	1	20	1	20	2	40
Slightly Sweet	3	1	20	1	20	0	0
Less Sweet	2	0	0	0	0	0	0
Not Sweet	1	0	0	0	0	0	0
Texture (Mean)		**(4.4)**		**(4.4)**		**(4.8)**	
Fragile	5	3	60	3	60	4	80
Quite Fragile	4	1	20	1	20	1	20
Slightly Fragile	3	1	20	1	20	0	0
Less Fragile	2	0	0	0	0	0	0
Not Fragile	1	0	0	0	0	0	0

The validation test results demonstrate that increasing the percentage of red roselle extract significantly intensifies the product's color and sour taste, with the 15% concentration achieving the highest scores for both. While roselle aroma also improved with higher concentrations, the coconut milk aroma exhibited a peak at the 12% treatment level, though it remained consistently well-detected across all formulations. Furthermore, the addition of the extract did not negatively impact the product's sweet taste or its characteristic fragile, crumbly texture, which remained consistent throughout the testing.

Physical Quality Test Results (Baking Loss)

The physical quality test for *baking loss* on the innovative *kue bangkit* with the addition of red roselle extract was conducted to determine how much the innovative *kue bangkit* lost its dough weight during the baking process. The determination of *baking loss* on the innovative *kue bangkit* with the addition of red roselle extract was measured by comparing the weight before and after the baking process. The testing was carried out in 3 repetitions. The results of the weight before and after the baking process, along with the calculated *baking loss*, are consolidated into a single efficient table format below.

Table 2. Physical Quality Data and Calculation of Baking Loss

Repetition	9% Treatment			12% Treatment			15% Treatment		
	A (g)	B (g)	Baking Loss (%)	A (g)	B (g)	Baking Loss (%)	A (g)	B (g)	Baking Loss (%)
1	6.0	5.2	13.33	5.0	4.4	12.00	5.8	5.1	12.07
2	6.1	5.4	11.48	4.9	4.2	14.29	5.7	5.0	12.28
3	5.8	5.0	13.79	4.9	4.3	12.24	5.9	5.3	10.17
Mean ± SD	**12.87 ± 1.23**			**12.84 ± 1.25**			**11.51 ± 1.16**		

Note: A = Weight of innovative kue bangkit dough before baking, B = Weight of innovative kue bangkit after baking.

Based on the table, the average percentage of the physical quality test for *baking loss* on the innovative *kue bangkit* with the addition of red roselle extract for the 9% treatment is 12.87% ± 1.23. Furthermore, the 12% treatment has an average value of 12.84% ± 1.25, while the 15% treatment has an average value of 11.51% ± 1.16. Subsequently, hypothesis testing was carried out for the physical quality test of *baking loss* on the innovative *kue bangkit* with the addition of red roselle extract.

Hypothesis Testing

To ascertain if the addition of red roselle extract significantly impacted the *baking loss*, an Analysis of Variance (One-Way ANOVA) was utilized.

Table 3. One-Way ANOVA Test Results for Physical Quality (Baking Loss)

Source of Variation (SK)	df	Sum of Squares (JK)	Mean Square (KT)	F-count	F-table	Conclusion
Treatment	2	3.64	1.82	1.23	5.14	F-count < F-table; H0 accepted, H1 rejected
Error	6	8.86	1.48			
Total	8	12.50				

It is known that the F-count (1.23) < F-table (5.14), so H0 is accepted and H1 is rejected, which means there is no effect of adding red roselle extract on the physical quality of the innovative *kue bangkit* in terms of the *baking loss* aspect. Because the result was not statistically significant, the analysis was therefore not continued to the Duncan post-hoc test.

Sensory Quality Test Results

The sensory quality test of the innovative *kue bangkit* with the addition of red roselle extract was conducted on 45 semi-trained panelists who were divided into 3 groups, where each panelist only assessed 1 sample. The assessment was carried out using an instrument that includes aspects of color, roselle aroma, coconut milk aroma, sour roselle taste, sweet taste, and texture.

To present the data efficiently according to journal standards, the descriptive results (mean scores and percentages) for all sensory aspects are consolidated into Table 4, followed by the Kruskal-Wallis hypothesis test results in Table 5, and Tuckey's post-hoc test results for the significant aspects in Table 6.

Table 4. Descriptive Results of Sensory Quality Tests

Assessment Aspect	9% Treatment	12% Treatment	15% Treatment
Color (Mean)	**3.13**	**4.00**	**4.67**
- Pink	0% (n=0)	6.67% (n=1)	66.67% (n=10)
- Slightly Brownish Pink	13.33% (n=2)	86.67% (n=13)	33.33% (n=5)
- Brownish Pink	86.67% (n=13)	6.67% (n=1)	0% (n=0)
Roselle Aroma (Mean)	**2.53**	**3.40**	**3.93**
- Roselle-scented	0% (n=0)	13.33% (n=2)	26.67% (n=4)
- Quite Roselle-scented	6.67% (n=1)	13.33% (n=2)	40.00% (n=6)
- Slightly Roselle-scented	40.00% (n=6)	73.33% (n=11)	33.33% (n=5)
- Less Roselle-scented	53.33% (n=8)	0% (n=0)	0% (n=0)
Coconut Milk Aroma (Mean)	**4.33**	**4.07**	**3.33**
- Coconut Milk-scented	46.67% (n=7)	20.00% (n=3)	6.67% (n=1)
- Quite Coconut Milk-scented	40.00% (n=6)	66.67% (n=10)	20.00% (n=3)
- Slightly Coconut Milk-scented	13.33% (n=2)	13.33% (n=2)	73.33% (n=11)
Sour Roselle Taste (Mean)	**4.47**	**4.67**	**4.87**
- Tasting Sour Roselle	53.33% (n=8)	66.67% (n=10)	86.67% (n=13)
- Quite Tasting Sour Roselle	40.00% (n=6)	33.33% (n=5)	13.33% (n=2)
- Slightly Tasting Sour Roselle	6.67% (n=1)	0% (n=0)	0% (n=0)
Sweet Taste (Mean)	**4.20**	**4.00**	**3.53**
- Sweet	33.33% (n=5)	33.33% (n=5)	0% (n=0)
- Quite Sweet	53.33% (n=8)	33.33% (n=5)	53.33% (n=8)
- Slightly Sweet	13.33% (n=2)	33.33% (n=5)	46.67% (n=7)
Texture (Mean)	**4.20**	**4.53**	**4.07**
- Fragile	46.67% (n=7)	60.00% (n=9)	33.33% (n=5)
- Quite Fragile	26.67% (n=4)	33.33% (n=5)	40.00% (n=6)
- Slightly Fragile	26.67% (n=4)	6.67% (n=1)	26.67% (n=4)

Table 5. Kruskal-Wallis Hypothesis Test Results

Assessment Aspect	X2-count	X2-table	Conclusion
Color	27.57	5.991	X2-count > X2-table; H0 rejected, H1 accepted
Roselle Aroma	16.54	5.991	X2-count > X2-table; H0 rejected, H1 accepted
Coconut Milk Aroma	12.38	5.991	X2-count > X2-table; H0 rejected, H1 accepted
Sour Roselle Taste	2.66	5.991	X2-count > X2-table; H0 accepted, H1 rejected
Sweet Taste	5.49	5.991	X2-count > X2-table; H0 accepted, H1 rejected
Texture	2.34	5.991	X2-count > X2-table; H0 accepted, H1 rejected

Table 6. Tuckey's Post-Hoc Test Results for Significant Aspects

Aspect	Difference Between Treatments	Comparison Result	Conclusion
Color (Q-table = 3.42, Crit. Diff = 0.32)	|9% - 12%| = |3.13 - 4.00| = 0.87	0.87 > 0.32	Significantly Different
	|9% - 15%| = |3.13 - 4.67| = 1.53	1.53 > 0.32	Significantly Different
	|12% - 15%| = |4.00 - 4.67| = 0.67	0.67 > 0.32	Significantly Different
Roselle Aroma (Q-table = 3.42, Crit. Diff = 0.35)	|9% - 12%| = |2.53 - 3.40| = 0.87	0.87 > 0.35	Significantly Different
	|9% - 15%| = |2.53 - 3.93| = 1.40	1.40 > 0.35	Significantly Different
	|12% - 15%| = |3.40 - 3.93| = 0.53	0.53 > 0.35	Significantly Different
Coconut Milk Aroma (Q-table = 3.42, Crit. Diff = 0.26)	|9% - 12%| = |4.33 - 4.07| = 0.27	0.27 > 0.26	Significantly Different
	|9% - 15%| = |4.33 - 3.33| = 1.00	1.00 > 0.26	Significantly Different
	|12% - 15%| = |4.07 - 3.33| = 0.73	0.73 > 0.26	Significantly Different

DISCUSSION

Physical Quality Analysis (Baking Loss)

Based on the physical quality test results on the *baking loss* aspect, it was shown that there is no significant effect of adding red roselle extract on the physical quality of the innovative *kue bangkit*. The average physical quality values for the *baking loss* aspect with percentages of 9%, 12%, and 15% were 12.87%, 12.84%, and 11.51%, respectively. The higher the percentage of roselle extract, the lower the *baking loss* value, which is influenced by the water content contained in the roselle extract (Mahfud, 2015). The *baking loss* value of the innovative *kue bangkit* with the addition of red roselle extract is affected by water evaporation during the baking process. The raw materials used, such as sago flour, powdered sugar, egg yolks, thick coconut milk, and red roselle extract, have different water contents, thus affecting the amount of weight loss of the product after baking (Prasetyo et al., 2019). Sago flour has a high starch content with a fairly high ability to absorb water (Afrianti et al., 2016), while coconut milk and red roselle extract contribute to increasing the moisture content of the dough.

Color Analysis

Based on the sensory quality test results for the color aspect, it is indicated that the higher the concentration of red roselle extract added, the better the resulting color quality, as it more closely approaches a pink color. The difference in color produced across the three treatments is closely related to the amount of anthocyanin pigments contained in the red roselle extract. Roselle flowers (*Hibiscus sabdariffa* L.) contain a red pigment produced by anthocyanins, which can be utilized as a natural dye in food products (Mahfud, 2015). Anthocyanins are water-soluble pigments that produce purple, blue, blackish, to red pigments

found in plants, and they have a strong and sharp red color at pH 2–5 (Perdani, 2023). Therefore, the more red roselle extract added to the *kue bangkit* dough, the higher the concentration of anthocyanins that act as coloring agents, meaning the intensity of the pink color in the final product increases. In addition, the brownish color change in the cookies is also caused by the Maillard reaction, resulting from the caramelization process of sugar present in the dough, which produces a brownish hue (Hosry et al., 2025).

Aroma Analysis

Regarding the sensory quality test results for the roselle aroma aspect, roselle (*Hibiscus sabdariffa* L.) has a characteristic aroma that is slightly sour and floral. The higher the concentration of the extract added, the more volatile compounds are contained within the product, increasing the intensity of the aroma smelled by the panelists (Hastuti & Kusnadi, 2016). However, the baking process of *kue bangkit* carried out at high temperatures likely causes some of the volatile compounds in the roselle extract to evaporate. Consequently, the intensity of the resulting aroma is not too strong even though the added extract concentration is quite large (Maghfira et al., 2021). Meanwhile, on the coconut milk aroma aspect, when the concentration of red roselle extract is increased, the characteristic volatile compounds of roselle, which are acidic and floral, increasingly dominate. As a result, this sensorially suppresses or masks the coconut milk aroma.

Taste Analysis

Furthermore, on the sour roselle taste aspect, the three treatments showed a consistent trend; the higher the concentration of red roselle extract added, the higher the intensity of the sour roselle taste perceived by the panelists. Conversely, based on the sensory quality test results for the sweet taste aspect, the three treatments showed a tendency for the sweetness intensity to decrease as the concentration of red roselle extract increased. Inter-taste interactions can occur in the form of suppression, where the presence of one type of taste in a high concentration can suppress or reduce the perception of other tastes (Dou et al., 2026). In this study, the increase in acid concentration from the red roselle extract suppressed the perception of the sweet taste produced by the sugar in the *kue bangkit* formulation.

Texture Analysis

Based on the sensory quality test results for the texture aspect, the addition of red roselle extract did not damage the characteristic texture of the *kue bangkit*. Looking at the average values, there is only a slight difference in scores, and all three treatments were included in the rather fragile category. Ultimately, the texture of the innovative *kue bangkit* successfully maintained the defining characteristics of traditional *kue bangkit*, remaining fragile, crumbly, and easily melting in the mouth.

CONCLUSION

In conclusion, the addition of red roselle extract significantly influences the sensory characteristics of the innovative *kue bangkit*, particularly in terms of color, roselle aroma, and coconut milk aroma, while having no significant effect on its physical *baking loss* or its taste and texture profile. The 15% red roselle extract treatment is recommended as the optimal formulation, as it yielded the most favorable color intensity, the highest roselle aroma score, and a pronounced sour taste, all while maintaining the traditional fragile and crumbly texture characteristic of *kue bangkit*. Future research is encouraged to further examine the functional properties of these cookies, including their antioxidant activity, vitamin C content, total anthocyanin levels, and shelf-life stability, to provide a more comprehensive understanding of the product's quality and potential health benefits.

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