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# Acceptance of Burger Bun with the Addition of Kluwek as A Natural Color

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## ABSTRACTS

In 2012, burger buns with various colors gained popularity in Japan, attracting consumer attention due to their unique appearance. However, concerns have emerged regarding the potential health and environmental risks posed by the use of synthetic food colorings such as Chocolate Brown FH and Chocolate Brown HT. As an alternative, natural food colorings derived from animals, plants, and microbes have gained interest. One such natural source is kluwek seeds (Pangium edule), which contain tannins and flavonoids that can serve as natural coloring agents. This study aims to determine the appropriate formula for burger buns using kluwek as a natural colorant and to evaluate the product's acceptability among consumers. The research employed a Quantitative Descriptive Analysis (QDA) method using expert panelists to assess product attributes, followed by a hedonic test with untrained panelists to measure consumer acceptance. Four formulation trials were conducted, with the final selected formula being BBK4, consisting of a 1:2 ratio of kluwek paste to wheat flour. The hedonic test results indicated that 60% of panelists liked the product in terms of color, 46% in aroma, 53% in taste, 59% in texture, and 57% in overall appearance. These findings suggest that burger buns colored with kluwek paste are acceptable to consumers and have the potential to serve as a safer and more sustainable alternative to synthetic food colorings in bakery products.



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## 1. INTRODUCTION

Bread is a staple food that is widely consumed across the world, classified by the proportion of ingredients used in its formulation. One of the most commonly consumed variants is enriched yeast bread, which includes added sugar, fat, milk, and eggs for a richer flavor and softer texture. Burger buns are a derivative of rich yeast dough and are typically composed of high-protein wheat flour, yeast, sugar, salt, butter, powdered milk, and water (Martínez et al., 2023). Their soft crumb and slightly sweet taste make them suitable for sandwich-based fast foods, especially hamburgers (Green & Smith, 2022).

In 2012, Burger King Japan launched a visually striking "Kuro Burger" with black-colored buns made using bamboo charcoal and squid ink. This trend was quickly adopted by other fast food producers (Time, 2014). However, the use of squid ink has raised health concerns due to its potential to trigger allergic reactions similar to seafood allergies (Brennan, 2012). As a result, there has been increasing interest in replacing synthetic and allergenic food dyes with natural colorants derived from plants, animals, and microbes (Ahsan et al., 2020).

Natural pigments such as anthocyanins, flavonoids, tannins, chlorophylls, and carotenoids are increasingly being explored not only for their coloring capabilities but also for their antioxidant and antimicrobial properties (Lee et al., 2021; Singh & Kaur, 2020). The move toward "clean label" food production, which excludes synthetic additives, has boosted the demand for safer, plant-based coloring agents in bakery products (Chandra & Sharma, 2025).

One promising natural colorant is kluwek (*Pangium edule Reinw*.), a Southeast Asian plant whose seeds are traditionally used in Indonesian cuisine to impart a blackish-brown hue to dishes like rawon and pindang (Warnasih & Hasanah, 2020). Scientific studies have confirmed that kluwek seeds contain high levels of tannins and flavonoids, which contribute to their color and bioactivity (Listyorini et al., 2021). These compounds are relatively stable at neutral pH (6–7) and can withstand moderate heat, making them suitable for use in baking applications (Andarwulan et al., 2024).

Research by Kasim and David (2023) indicated that kluwek extract from different geographical regions consistently contains condensed tannins with potential functional benefits. Furthermore, its natural fermentation process can enhance the extractability and antioxidant activity of phenolic compounds (Andarwulan et al., 2024). In addition to coloring, kluwek has also demonstrated antimicrobial activity against fungi such as Aspergillus flavus (Listyorini et al., 2021), suggesting added value in food preservation.

Therefore, this research aims to explore the formulation of burger buns using kluwek extract as a natural coloring agent and assess its acceptability in terms of sensory attributes. The study aligns with sustainable food processing practices by utilizing local plant resources and contributes to innovations in functional bakery products (Zhang et al., 2024; Martínez et al., 2023).

## 2. METHOD

### 2.1. Research Methods

This study employed an experimental research design, which is used to examine the effect of one or more treatments under controlled conditions. The primary objective of this experiment was to determine the optimal proportion of kluwek used in the formulation of burger buns based on sensory preference indicators, including taste, aroma, texture, and appearance.

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The Quantitative Descriptive Analysis (QDA) was conducted by a panel of expert evaluators consisting of executive chefs, sous chefs, and pastry chefs from the Holiday Inn Bandung Pasteur. Evaluations used a structured 10 cm line scale, where 0 represented the lowest intensity. Sensory attributes assessed included color, aroma, taste, texture, and overall appearance.

Burger bun formulations that passed the QDA test proceeded to a hedonic test, which was carried out by 30 untrained consumer panelists. These participants were randomly selected members of the general public in the Sukagalih area of Bandung, aged between 18 and 60 years. The testing period—including both QDA and hedonic evaluation—was conducted between June and August 2023, and all product testing took place in the Pastry Laboratory of the Culinary Education Study Program at Universitas Pendidikan Indonesia.

### 2.2. Materials and Tools

The main ingredients used in the burger bun formulations included high-protein wheat flour, instant yeast, sugar, bread improver, salt, butter, milk powder, eggs, water, kluwek paste, kluwek soaking water, and sesame seeds.

Tools used in this research were categorized into three groups:

- Preparation tools: digital scales, measuring spoons, measuring cups
- Processing tools: stove, pans, stand mixer, baking sheet, and oven
- Serving tools: duplex boxes (15 × 5 × 5 cm)

**Tabel 1.** Burger Bun Formulations with Kluwek

| Material Name | BBK1 | BBK2 | BBK3 | BBK4 |
|---|---|---|---|---|
| High protein wheat flour | 150g | 150g | 150g | 150g |
| Sugar | 12g | 12g | 12g | 12g |
| Instant yeast | 3g | 3g | 3g | 3g |
| Egg | 8g | 8g | 8g | 8g |
| Kluwek soaking water | 82g | | | |
| Kluwek pasta | | 35g | 50g | 75g |
| Water | | 65g | 38g | 24g |
| Milk powder | 9g | 9g | 9g | 9g |
| Bread improver | ¼ tsp | ¼ tsp | ¼ tsp | ¼ tsp |
| Salt | 3g | 3g | 3g | 3g |
| Butter | 7g | 7g | 7g | 7g |

### 2.3. Burger Bun Preparation Procedure

The ingredient compositions used to develop the burger bun formulas are presented in Table 1. The complete process flow for making kluwek burger buns is illustrated in Figure 1.

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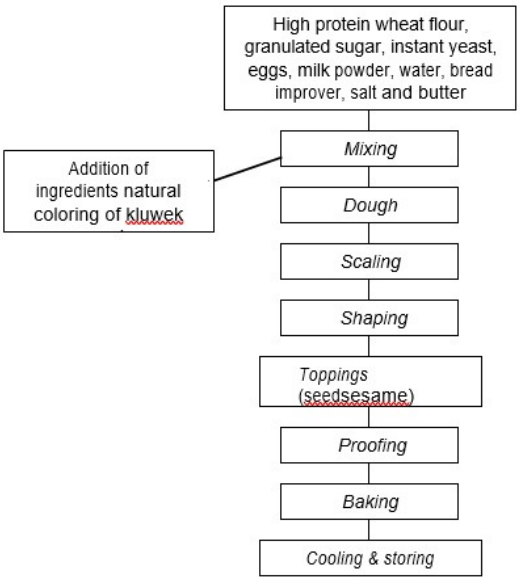


**Figure 1.** The flow of making bun kluwek burgers

### 2.4. Data Analysis

Descriptive analysis was employed for data interpretation in this study. The QDA method utilized a 10 cm line scale to quantify the intensity of sensory characteristics. Panelists' ratings were measured using a ruler, and the resulting data were processed using Microsoft Excel 2016. Results were visualized using spider web (radar) graphs, which illustrate the sensory profile of each formulation.

For the hedonic (acceptability) test, consumer panelists provided preference scores for five sensory parameters: color, texture, aroma, taste, and overall appearance. A 4-point Likert scale was used for scoring, where:

4 = Like very much
3 = Like
2 = Neutral
1 = Dislike

The hedonic data were also tabulated and analyzed to determine the most preferred formulation.

## 3. RESULT AND DISCUSSION

### 3.1. Quantitative Descriptive Analysis (QDA) Results

The Quantitative Descriptive Analysis (QDA) was conducted three times with a panel of three expert evaluators, comprising an executive chef, a sous chef, and a pastry chef from the Holiday Inn Bandung Pasteur. Initial trials (BBK1 and BBK2) were refined based on feedback from both the panelists and academic supervisors. Subsequent evaluations focused on the third and fourth formulations (BBK3 and BBK4), alongside a reference product (BB1) and a mini burger variant (BBKW). Sensory attributes assessed included color, texture, aroma, flavor, and overall appearance, using a 10 cm unstructured line scale, as recommended by Stone et al. (2020).

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**Table 2**. Average QDA Scores for Burger Bun Variants

| Component | BB1 | BBK3 | BBK4 | BBKW |
|---|---|---|---|---|
| **Color** | 4.3 | 7.3 | 8.8 | 8.5 |
| **Texture** | 6 | 7.9 | 8.3 | 7.9 |
| **Aroma** | 4.9 | 6 | 8.3 | 7.1 |
| **Flavor** | 4.9 | 7 | 6,7 | 7.1 |
| **Overall appearance** | 7.7 | 7.9 | 8.9 | 8.2 |

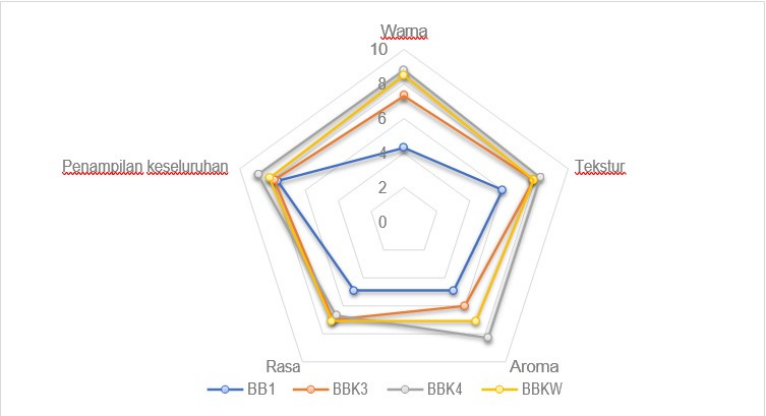


**Figure 2.** Average QDA Scores for Burger Bun Variants

The data indicate that BBK4 achieved the highest scores in color, aroma, and overall appearance, suggesting a favorable impact of increased kluwek paste concentration. These findings align with previous studies highlighting the efficacy of natural colorants in enhancing sensory attributes (Martínez et al., 2023).

### 3.2. Hedonic Test Results

A hedonic test was conducted on August 14–15, 2023, involving 30 untrained consumer panelists aged 18–60 from the Sukagalih area of Bandung. Participants evaluated the burger bun variants using a 4-point Likert scale: 4 = like very much, 3 = like, 2 = neutral, and 1 = dislike. The sensory attributes assessed were color, aroma, flavor, texture, and overall appearance.

#### 3.2.1. Color

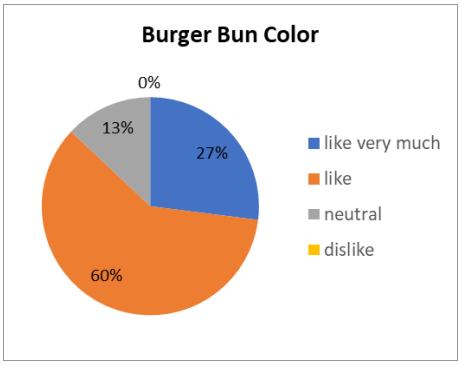


**Figure 3.** Hedonic Test Results of Burger Buns Color Components

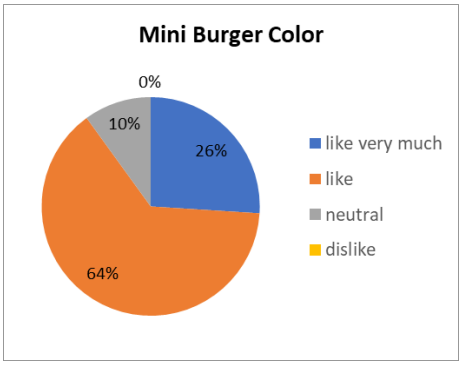


**Figure 4.** Hedonic Test Results of Mini Burger Color Components

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From the diagram, it can be seen that, for the Burger Bun, 27% of panelists (n=7) rated the color as "like very much," 60% (n=17) as "like," and 13% (n=4) as "neutral," with no panelists expressing dislike. Similarly, the mini burger variant received 26% (n=7) "like very much," 64% (n=20) "like," and 10% (n=3) "neutral" responses, also with no negative feedback.

These findings indicate a positive consumer response to the natural coloration imparted by kluwek in burger buns. The use of natural colorants like kluwek aligns with current consumer preferences for clean-label products and natural ingredients. Studies have shown that natural food colorants are generally well-accepted by consumers and can enhance the perceived healthiness and appeal of food products (Weiss et al., 2023). Moreover, the sensory appeal of natural colorants can influence consumer purchasing decisions, especially when the color is associated with traditional or culturally significant foods (Su et al., 2022).

In the context of bakery products, incorporating natural colorants like kluwek not only meets the demand for natural ingredients but also adds unique visual appeal, potentially differentiating the product in the market. The positive reception of the kluwek-colored burger buns suggests that such innovations can be successfully introduced to consumers seeking both novelty and naturalness in their food choices.

### 3.2.2. Aroma

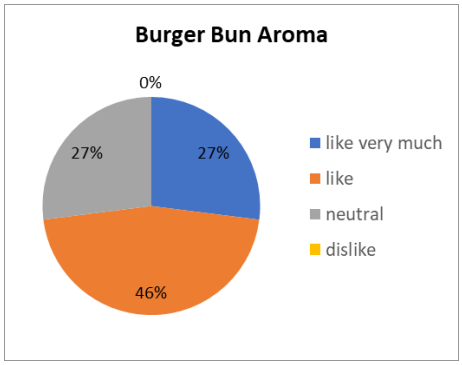


**Figure 5.** Hedonic Test Results of Burger Bun Aroma Components

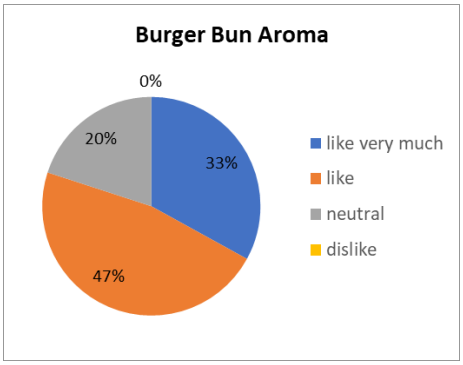


**Figure 6.** Hedonic Test Results of Mini Burger Aroma Components

The diagram in Figure 5 indicates that the Burger Bun, 24% of panelists (n=8) rated the aroma as "like very much," 52% (n=14) as "like," and 23% (n=8) as "neutral," with no panelists expressing dislike. Similarly, the mini burger variant received 33% (n=10) "like very much," 47% (n=11) "like," and 20% (n=6) "neutral" responses, also with no negative feedback.

These findings indicate a positive consumer response to the aroma imparted by kluwek in burger buns. The use of natural ingredients like kluwek aligns with current consumer preferences for clean-label products and natural ingredients. Studies have shown that natural food additives are generally well-accepted by consumers and can enhance the perceived healthiness and appeal of food products (Jeesan & Seo, 2020). Moreover, the sensory appeal of natural additives can influence consumer purchasing decisions, especially when the aroma is associated with traditional or culturally significant foods (Su et al., 2022).

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In the context of bakery products, incorporating natural ingredients like kluwek not only meets the demand for natural ingredients but also adds unique sensory appeal, potentially differentiating the product in the market. The positive reception of the kluwek-infused burger buns suggests that such innovations can be successfully introduced to consumers seeking both novelty and naturalness in their food choices.

### 3.2.3. Flavor

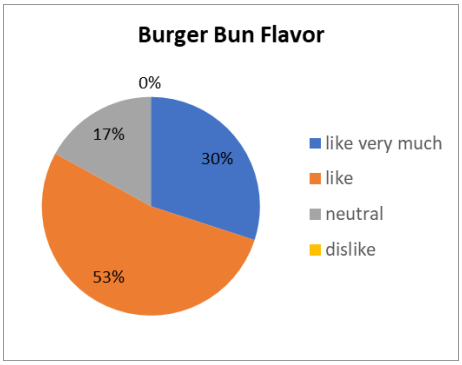


**Figure 7.** Hedonic Test Results of Burger Bun Taste Components

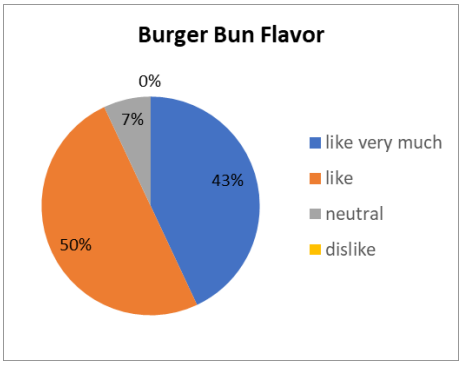


**Figure 8.** Hedonic Test Results of Mini Burger Taste Components

As depicted in Figure 7, 30% of the panelists (n = 10) reported that they "liked very much" the taste of the Burger Bun, while 53% (n = 16) expressed that they "liked" it. A smaller proportion, 17% (n = 5), gave a neutral response, and no panelists indicated any dislike. In Figure 8, representing the mini burger variant, 43% of panelists (n = 13) responded with "liked very much," 50% (n = 15) with "liked," and 7% (n = 2) with "neutral," again with no negative feedback.

These findings suggest that the addition of kluwek as a natural flavoring and coloring agent positively influenced taste perception. Natural plant-based additives such as kluwek have been recognized for their ability to contribute unique flavor profiles and enhance sensory complexity in food products (Yousefi et al., 2021; Zhang et al., 2023). Additionally, consumer trends increasingly favor natural flavor enhancers that align with health and sustainability concerns (Chaudhary & Kumar, 2022).

In the context of bakery products, the earthy and mildly fermented profile of kluwek may add a depth of flavor that appeals to culturally attuned consumers, while also promoting novelty in the marketplace (Farrag et al., 2022). The consistent positive reception of the kluwek-based burger buns supports the potential for incorporating indigenous plant-based ingredients into modern food innovations.

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### 3.2.4. Texture

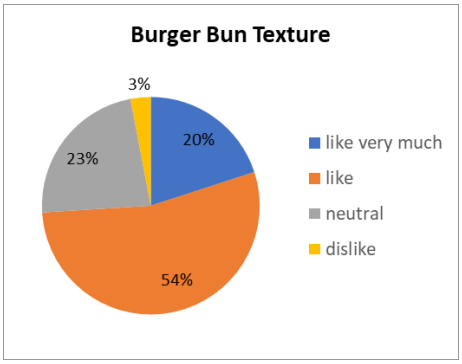


**Figure 9.** Hedonic Test Results of Burger Bun Texture Components

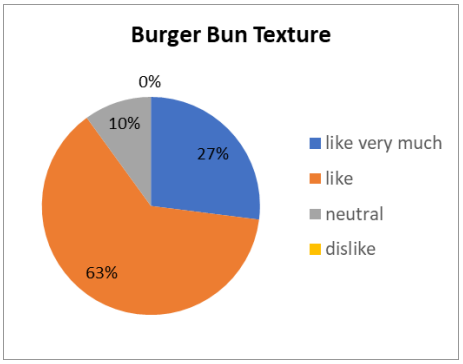


**Figure 10.** Hedonic Test Results of Mini Burger Texture Components

As shown in Figure 9, 23% of the panelists (n = 6) stated that they "liked very much" the texture of the Burger Bun, while 54% (n = 16) reported that they "liked" it. Meanwhile, 20% (n = 7) gave a neutral response, and 3% (n = 1) expressed dislike. For the mini burger variant (Figure 10), 27% of the panelists (n = 8) reported "liked very much," 63% (n = 19) reported "liked," and 10% (n = 3) reported "neutral," with no respondents indicating dislike.

These results suggest that the texture of both burger variants was well-received, particularly in the mini burger version, which had a slightly higher percentage of positive responses. Texture is a critical factor in consumer satisfaction and significantly influences the overall acceptability of bakery products (Suri et al., 2020). The presence of kluwek paste may have contributed to a softer and more moist crumb structure due to its fat-like consistency and fibrous content, which has been shown in previous studies to positively impact dough rheology and final product mouthfeel (Jin et al., 2021; Tsatsaragkou et al., 2022).

Moreover, consumer preference for natural and locally sourced ingredients aligns with the use of kluwek in traditional and contemporary food formulations (Barretto et al., 2021). The incorporation of such indigenous plant materials into bakery products may not only enhance texture but also improve consumer perception of authenticity and naturalness (Mohan et al., 2023).

### 3.2.5. Overall Appearance

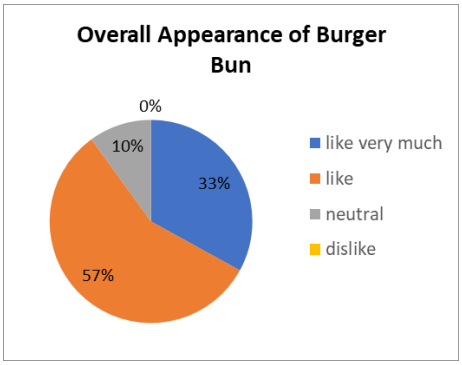


**Figure 11.** Burger Buns Hedonic Test Results for Overall Appearance Components

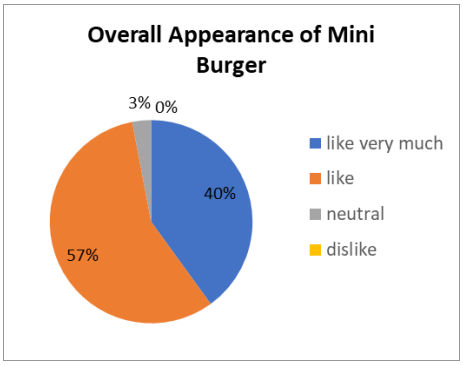


**Figure 12.** Mini Burger Hedonic Test Results for Overall Appearance Components

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As illustrated in Figure 11, 33% of the panelists (n = 10) indicated that they "liked very much" the overall appearance of the Burger Bun. A further 57% (n = 17) stated that they "liked" it, while 10% (n = 3) gave a neutral response. No participants expressed any negative perception. For the mini burger version (Figure 12), 40% of panelists (n = 12) rated the appearance as "liked very much," 57% (n = 17) as "liked," and 3% (n = 1) as "neutral," with zero negative responses.

These results suggest that both products were positively received in terms of visual appeal, with the mini burger slightly outperforming the full-size version. Overall appearance plays a critical role in the initial consumer acceptance of food products, as it is the first sensory attribute encountered and often shapes expectations of flavor, freshness, and quality (Deliza et al., 2021; Chaya et al., 2020).

In this study, the natural brown-black coloration from kluwek contributed to a unique and culturally resonant appearance, which may have enhanced the product's attractiveness. Visual distinctiveness derived from natural ingredients has been shown to improve the marketability of baked goods, particularly when the appearance aligns with consumer trends favoring clean-label and ethnically inspired foods (Ndomo et al., 2022; Rodríguez et al., 2021).

Hence, the positive evaluation of appearance suggests strong consumer acceptance of naturally colored burger buns using kluwek as a key ingredient, reinforcing its potential for broader food applications.

## 4. CONCLUSION

The research resulted in a Kluwek Seed Bun Burger formulation using a 1:2 ratio of kluwek seed paste to wheat flour, which produced the desired natural color. The high concentration of paste required a reduction in water content to achieve optimal dough consistency. Based on QDA testing, the BBK4 product received favorable evaluations from expert panelists and was established as the standard formula. Further hedonic testing involving consumer panelists demonstrated that the BBK4 product consistently fell into the "like" category across all five sensory attributes: color, aroma, taste, texture, and overall appearance. The mini burger version (BBKW) received similar ratings, with "really like" responses specifically for taste and overall appearance. Overall, the findings indicate that both the BBK4 and BBKW products were positively received, and the use of kluwek as a natural colorant and flavoring agent in burger buns is both acceptable to consumers and promising for wider application in bakery innovations.

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