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Effect of aromatic herbs and roasted coconut flesh on acceptability and perception of mixed porridge (*bubur paddas*)

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ABSTRACT

Bubur pedas or bubor paddas (BP) is porridge from roasted rice granules (R) rich in vegetables with a specific aroma that probably contributed to producing the aroma were roasted coconut flesh granules (C), fresh kesum (Polygonum minus Huds) leaves (K), fresh buas-buas (Premna cordifolia ROXB) leaves (B), and fresh young tumeric (Curcuma longa) leaves (T). This study aimed to find out the effect of aroma-contributing ingredients (B, C, K, and T) and their role in developing specific aromas based on sensory panelists' acceptability and perception. Each aromatic ingredient was prepared in four serial formulations, namely C, K, B, and T, and a sensory test was then conducted using a hedonic rating method with a 9-point hedonic scale by a panel of 100-200 semi-trained panelists. The data were analyzed using a hierarchical analytical process (AHP), principal component analysis (PCA) biplot, multidimensional scaling (MDS) with alternating least squares scaling (ALSCAL) model, and Spearman's correlation. The highest acceptability for each aromatic ingredient's formula was 25 g of the C formula, 16 g of the K formula, 12 g of the B formula, and 12 g of the T formula, respectively. Almost the best formula for each aromatic ingredient's formula showed no correlation or dissimilarity. Among the aromatic ingredients, K and T played a pivotal role in developing the aroma, but only K enhanced the savory. Therefore, K and T were considered compulsory ingredients in generating a unique characteristic for BP in the panellists's perception.

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INTRODUCTION

Porridge is a soft or semi-solid food with a sweet or salty/savory taste prepared by boiling or heating high carbohydrate food (such as oats, rice legumes, wheat, barley, and corn) as a main ingredient with water or milk or coconut milk. Furthermore, savory rice porridge is popular in China, Japan, South Korea, and Southeast Asian countries. It is prepared from rice supplemented with a variety of meat, root crops, vegetables, and herbs, such as chicken, uyang, and carp porridges (Gandhi and Singh 2015); (Li et al. 2020); (Kim and Kang 2023). Indonesia also has different kinds of traditional porridge depending on tribe and location. For example, bubor/bubbor paddas or bubur pedas (BP) from Kalimantan Barat are savory, spicy, and specific flavors of rice porridge. The name of BP is known in some locations in Indonesia, and each location probably has different characteristics caused by different recipes. Therefore, BP characterizations from Kalimantan Barat were needed.

Food can be characterized by sensory tests involving sight, smell, taste, touch, and hearing. Furthermore, the brain responds to different sensory inputs and information from physiologically distinct sensory modes and other factors that contribute to a person's different experiences, processes, and understanding of food (Costell et al. 2010). Interactions among them obtained food perception. Sensory food perception can be used as a tool to describe food quality, diversity in food quality, food acceptability or preferences, and food identity. Food acceptability is measured as liking, expected liking, and wanting of foods.

The sensor specificity contributes to creating an identity that helps to promote the food of the region (Gomis-Bellmunt et al. 2024). For example, the specific flavor of traditional food is used as a characteristic of each culture, while the aroma affects flavor, perception, appetite, and food choice (Murray and Wallace 2011). Furthermore, acquiring knowledge about flavor preferences and taste perception can be employed to acquaint conventional culinary dishes with those originating from diverse cultural backgrounds. Therefore, it is imperative to delineate the essential components that contribute to forming its distinctive aroma. It is crucial to safeguard and uphold the traditional attributes, as well as the social and cultural significance, for the benefit of future generations.

BP has become an iconic food from Kalimantan Barat. Therefore, its authenticity and uniqueness need to be maintained by understanding BP's specific characteristics. Kalimantan Barat BP's specific characteristic compared to the other BP in Indonesia was probably from the unique aroma, which comes from four aromatic ingredients, namely roasted coconut flesh granules (C), fresh buas-buas (Premna cordifolia ROXB) leaves (B), fresh kesum (Polygonum minus Huds) leaves (K), and fresh young tumeric (Curcuma longa) leaves (T). Therefore, each aromatic ingredient was evaluated for its effect on BP characteristics using panelists' acceptability and perception approaches to find out the effect of aroma-contributing ingredients (B, C, K, and T) and their role in developing specific aromas.

METHODS

Sample Preparation and Serving

The ingredients of BP were 100 g of C: R ratio, 4 g of sliced B, 4 g of sliced K, 4 g of sliced T, 100 g of sweet potato (*Ipomea batatas* L) cubes, 100 g of sliced pakis merah leaves (*Stenochlaena palutris* Lemidi), 100 g of bean sprout (*Phaseolus aureus*), 100 g of sliced water spinach (*Ipomoea aquatica*), 100 g of shredded sweet corn. The seasonings were grouped as dry (3 g of garlic, 1 g of coriander, and 1 g of black pepper) and wet seasonings (4 g of mashed garlic, 5 g of sliced shallot, and 1 g of ground red chilies). The other ingredients were 8 g of sugar, 15 g of salt, 5 ml of vegetable oil (palm oil, Sania brand), and 1,750 ml of water.

The instructions to preparing BP were as follows:

1. The C was prepared by removing the testa from the coconut flesh and then grating. The grated coconut flesh was roasted and homogenized following the R preparation.
2. The R was prepared by washing 100 g of rice (Slyp super brand) with 200 ml of water and drained for 30 minutes, and 100g of drained rice (W1) was roasted at a temperature of ± 50°C for 90 minutes. After cooling down, the roasted rice was weighed (W2), homogenized using the blender (Rinrie national brand), and turned on with press numbers 1 and 2 for 5 s and 2 min. Before turning off the blender, the

speed was decreased to numbers 2 and 1 for 5 s and 0 to obtain roasted rice granules (R).

The percentage of C and R water decrease was calculated as Equation (1).

$$Percentage\ of\ water\ decrease = \left(\frac{W_1 - W_2}{W_1} \times 100\%\right) \quad (1)$$

Remarks,
W1: weigh of the wet sample
W2: weigh of the dry sample

3. The sweet potatoes were peeled skin off and cut into cubes with a size of 1 cm^2, while pakis merah, water spinach, K, B, and T were cleaned with tap water, drained and cut into thin slices
4. The dry seasonings were prepared by roasting approximately 50°C for 7 minutes of 3 g of garlic, 1 g of coriander, and 1 g of black pepper before grinding to a fine consistency
5. The sliced shallots of the wet ingredients were stir-fried with two tablespoons of vegetable oil in a skillet until they appeared to have a fragrant smell. After the crushed garlic, sliced K, sliced T, and sliced B were added, they were stirred for approximately 2 minutes or until the mixture became aromatic
6. In a saucepan, 100 g of each sweet potato cube and shredded sweet corn were introduced to 1,750 ml of boiling water. After 10 minutes, the remaining vegetables were added and stirred for ± 5 min. Subsequently, the dry and wet seasonings were carefully added to the mixture, along with the C: R ratio, bean sprouts, sugar, and salt. The concoction was then cooked for an additional 3 minutes, ensuring all flavors melded harmoniously.

In this study, four formulation steps were executed, and sensory testing was conducted for each formulation. The first step was formulations of C: R ratios, namely 100:0 (C0 formula), 100:5 (C1 formula), 100:10 (C2 formula), 100:25 (C3 formula), and 100:35 (C4 formula). Each ratio of the BP formula, amounting to 100 g, was incorporated, while B, K, and T were added in quantities of 4 grams each (Table 1). In the second step, K formulation was conducted using different amounts of K, namely 0 g (K0 formula), 4 g (K1 formula), 8 g (K2 formula), 12 g (K3 formula), and 16 g (K4). In comparison, the C: R ratio was selected from the best formula of the sensory test and 4 g of each B and T (Table 1). The third step was B formulation using different B amounts, namely 0 g (B0 formula), 4 g (B1 formula), 8 g (B2 formula), 12 g (B3 formula), and 16 g (B4 formula). Furthermore, the C: R ratio and K formulas were selected from the best formula of the first and second sensory tests, while T was 4 g (Table 1). The fourth step was T formulation with different T amounts, namely 0 g (T0 formula), 4 g (T1 formula), 8 g (T2 formula), 12 g (T3 formula), and 16 g (T4 formula). The C: R ratio, K, and B formulas were selected based on the best formula from the first, second, and third sensory tests (Table 1).

Table 1 The formulation of BP aromatic ingredients

Formula	100 g of each C: R ratio added into BP		K	B	T
	C, g	R, g			
C: R ratio formulas with different C: R ratio					
C0	0	100	4	4	4
C1	5	100	4	4	4
C2	10	100	4	4	4
C3	25	100	4	4	4
C4	35	100	4	4	4
Different K formulas					
K0	25	100	0	4	4
K1	25	100	4	4	4
K2	25	100	8	4	4
K3	25	100	16	4	4
K4	25	100	20	4	4
Different B formulas					
B0	25	100	16	0	4
B1	25	100	16	4	4
B2	25	100	16	8	4
B3	25	100	16	12	4
B4	25	100	16	16	4
Different T formulas					
T0	25	100	16	12	0
T1	25	100	16	12	4
T2	25	100	16	12	8
T3	25	100	16	12	12
T4	25	100	16	12	16

Sensory Test

The sensory test was conducted based on the hedonic rating method using a nine-point rating scale (1-dislike extremely, 2-dislike very much, 3-dislike moderately, 4-dislike slightly, 5-neither like nor dislike, 6-like slightly, 7-like moderately, 8-like very much, and 9-like extremely. Panelists were selected randomly based on their availability for the evaluation, interest in participating in the research, and normal perception abilities. The

panelists came from the Pontianak communities aged 17 to 50 years and numbered 102-202 panelists. All panelists were confirmed unable to communicate during the test. Before the test, the panelists were trained to fill in the questionnaire. Each sample was prepared in a small container filled with 25-30 g of BP provided with a spoon and drinking water and served to each panelist. Each panelist was instructed to clean their palate using drinking water before and after tasting each BP formula. Subsequently, they were asked to complete the questionnaire about the taste (salt, savory), aroma, texture, and appearance of each formula. They also were requested to rank the following criteria: appearance, taste, aroma, and texture. For the panelists' familiarity, they were also asked to fill out the questionnaire about the frequency of consuming BP in a year, which was grouped into four categories: never (0%), seldom (1-3), sometimes (4-6), and often (more than 7).

Statistical Analysis

The panelist's familiarity was calculated based on mode value and percentile score. The data value was divided into four frequency distributions, i.e., never (0), seldom (1-3), sometimes (4-6), and often (7-9). The sensory data were analyzed using the analytical hierarchy process (AHP) to determine the acceptability rank, principal component analysis (PCA) biplot to determine a correlation among criteria or formulas, and multidimensional scaling (MDS) with alternating least squares scaling (ALSCAL) model to determine a similarity among criteria or formulas (Young et al. 1978). The correlation between T or K and the aroma and taste was determined using Spearman's correlation, while the significance of differences calculated using Tukey's Honest Significant Difference (HSD) test. The AHP was calculated using Microsoft Excel 2016, and panelists' consistency in their choice was calculated by the consistency ratio (CR) as Equation (2) – (4).

$$CR = \frac{CI}{RI} \quad (2)$$

$$CI = \frac{\lambda_{max} - n}{n - 2} \quad (3)$$

$$RI = \frac{\overline{\lambda}_{max} - n}{\lambda_{max} - n} \quad (4)$$

Remarks,
CI = Consistency index
λ_{max} = A consistency index (eigenvalue maximum)
RI = The average value of CI for random matrices using the Saaty scale

The PCA biplot and MDS were performed by IBM SPSS 26 version on the correlation matrix. The data were extracted using factor 2 and then rotated with the direct oblimin method to facilitate interpretation of the results.

The MDS with ALSCAL mode was analyzed and created from Euclidean distance data (Young et al. 1978). The ordinal level of measurement, individual difference Euclidean distance, and matrix conditionality were selected for the MDS characteristic. Additionally, the goodness of fit to a nonmetric hypothesis was calculated based on the Kruskal stress test and the R-squared (RSQ) value (RSQ value of close to 100%) (Kruskal 1964). Lower S-stress or higher RSQ values indicated better goodness of fit (Kruskal 1964).

RESULTS AND DISCUSSION

Panelists' familiarity with the BP sensory test

The panelist's familiarity is important in the sensory test, particularly to assess food characteristics and acceptability or perception. The panelists who are familiar with the food are likely to exhibit higher levels of acceptability and perception (Jeong and Lee 2021); (Gotow et al. 2018); (Gotow et al. 2021). For example, Japanese panelists tend to demonstrate a higher acceptance of yokan than Germans, mainly because yokan is more familiar to the former group (Gotow et al. 2018). Therefore, the panelists involved in the BP sensory test are determined by their familiarity with BP.

The frequency of the familiarity questionnaire was chosen based on Kalimantan Barat people's eating BP habits. BP is usually served on special occasions, such as family or community gatherings, the ritual of the dagger bathing, welcoming Ramadhan, every Haul (commemoration of the death of the deceased king) on Ramadhan, meeting the kings of all Kalimantan Barat and welcoming guests from other countries or kingdoms. Based on this habit, the highest average of people consuming BP was decided more than seven times a year, then divided into 4 categories.

The familiarity toward BP calculated using percentile showed that the panelists' familiarity for

each formula fell on the third quartile or were categorized as "sometimes" (Table 2). From these results, most panelists were familiar with BP, which distinguished specific aromas and perceptions of the BP sensory test. The number of panelists used in this study was more than 50 to reduce the bias.

Table 2 Panelists' familiarity with the BP

Formula	Mode value	Percentile score	Panelists
C: R ratio	5.72	5.72 or the third quartile	202
K	5.98	5.43 or the third quartile	202
B	0.92	4.98 or the third quartile	84
T	3.33	5.33 or the third quartile	200

All panelists were also asked their opinions on how to rank the BP criteria (appearance, taste, aroma, and texture) that the AHP needed to calculate BP sensory data to obtain acceptability. The result showed most of the panelists prioritized the appearance criteria followed by the aroma, taste, and texture, regardless of the specific formulation (Figure 1). The first and second priorities were consistently awarded to the appearance and aroma criteria for B, C, and K formulations, except for the C: R ratio (Figure 1).

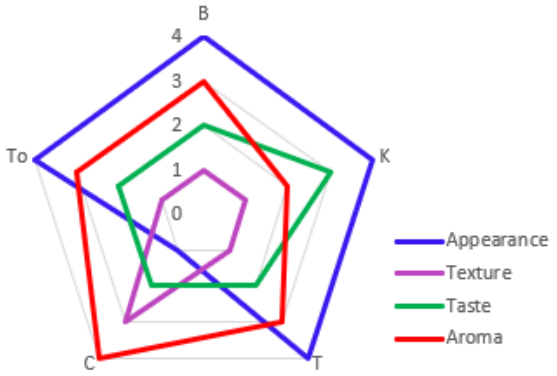

Figure 1 Profiles of criteria priorities are based on the panelists' opinions for each BP formula. B. fresh buas-buas leaves formula; C. C: R ratio formula; K. fresh kesum leaves formula; T. fresh young turmeric leaves formula.

Sensory acceptability of the C: R ratio formula

The grated coconut flesh and rice were roasted to decrease the water and gain the light golden and dry grated coconut flesh and rice. In addition, the water decrease of dry grated coconut flesh and rice was 55.57% ± 0.27 and 11.91% ± 0.94, respectively. The roasted grated coconut flesh and the roasted rice were homogenized to obtain C and R). For BP, C and R were mixed with various C: R ratios and exhibited different golden brown intensities (Figure 2). The higher the C added in the C: R ratio, the darker the golden brown color (Figure 2E).

Figure 2 Various C: R ratio. A. 0:100; B. 5: 100; C. 10:100; D. 25: 100; E. 35:100.

Table 3 Sensory acceptability of different C: R ratios formula

Sample	100 g of the ratio R and C	Criteria score of			Subcriteria taste score of			Overall score
		Appearance	Texture	Aroma	Taste	Salt	Savoury	
C0	100:0	0.1948	0.1975	0.1978	0.2010	0.2009	0.2014	0.1978
C1	100:5	0.1913	0.1933	0.1908	0.1936	0.1913	0.1925	0.1923
C2	100:10	0.2008	0.2063	0.1927	0.1975	0.1974	0.1938	0.1993
C3	100:25	0.2119	0.2033	0.2134	0.2042	0.2069	0.2071	0.2082
C4	100:35	0.2012	0.1996	0.2053	0.2037	0.2035	0.2052	0.2025
Dominant Criteria		0.2442	0.2533	0.2540	0.2484	0.3178	0.3452	
CR = 1%								

n=202 panelists, with a range aged 15-50 years

Table 4 Sensory acceptability of different K formula

Sample	K, g	Criteria score of				Subcriteria taste score of		Overall score
		Appearance	Texture	Aroma	Taste	Salt	Savoury	
K0	0	0.1794	0.1683	0.1602	0.1706	0.1617	0.1579	0.1708
K1	4	0.2156	0.1903	0.1656	0.1790	0.1644	0.1652	0.1910
K2	8	0.1662	0.1952	0.1954	0.2022	0.1790	0.1900	0.1870
K3	16	0.2004	0.2417	0.2645	0.2447	0.2834	0.2745	0.2333
K4	20	0.2385	0.2045	0.2144	0.2034	0.2115	0.2123	0.2180
Dominant Criteria		0.3402	0.2183	0.2193	0.2222	0.2573	0.2248	
CR =0.53%								

n=202 panelists, with a range of 15-50 years

During roasting, the grated coconut flesh and rice also produced a specific aroma. The roasted coconut flesh produced a uniquely strong, sweet, nut-like aroma, probably obtained from six pyrazines, two furans, and two pyrroles (Saittagaroon et al. 1984). Roasted rice obtained a sweet taste and aroma reported on BRS Sertaneja, BRS Primavera, and IRGA 417 rice varieties (Garcia et al. 2012).

Formulation of BP with different C: R ratios was used to evaluate the role of C based on the sensory test. In this formulation, C varied while R was constant. Variations in the mass of coconut added to the kesum leaves have a fluctuating effect on all the criteria as the aroma and taste scores of BP without C (C0) were higher than BP with C, i.e., C1 and C2 while the other (C2 and C3) was higher from C0 (Table 3). The proper C added into BP could increase all criteria scores. For example, C3 was awarded with the highest all criteria, subcriteria scores, and the overall score. Therefore, C3 was awarded as the highest acceptability or the best formula. The CR was less than 10%, which means that the panelists were consistent in answering the questionnaire in this sensory test (Table 3).

Sensory acceptability of the K formula

Kesum leaves have a specific aroma and can be applied as a food additive in most Southeast Asia cuisines, such as Singapore, Indonesia, Malaysia, Vietnam, and Thailand. The chemical components of kesum essential oil are one ester, one furan, five alcohols, nine aldehydes, and 32 hydrocarbons (Yaacob 1987); (Baharum et al. 2010). The specific flavor is probably from the terpene groups (Baharum et al. 2010). Kesum leaf extract showed various biological activities such as antioxidant, antimicrobial, anti-tumor, and anti-dandruff (Vikram et al. 2014); (Baharum et al. 2010); (Christapher et al. 2015). Decoction of kesum leaves can be used for digestive disorders (Christapher et al. 2015).

Panelists' acceptability of various K formulas in BP was assessed through sensory tests. The results showed increased texture, aroma, and taste (salt, savory) criteria scores from the K0 to K3 formulas while decreasing for the K4 formula. Adding K with a certain weight in the BP formula could increase the BP aroma, taste, and texture scores. Furthermore, the appearance criteria value for each formula fluctuated (Table 4). The highest and lowest K formulas based on all the criteria were K3 and K0 (without kesum leaves), respectively. The best acceptability was awarded for the K3 formula based on the overall priority score.

The retronasal aroma can affect the flavor of foods or drinks, particularly with the sense of taste (Landis et al. 2005). The sensory test in this study for the aroma of each formula was performed as a retronasal aroma using the familiar panelists, which could give a higher BP taste score compared to the unfamiliar panelists.

The herb (Oreganum vulgare) added to the beef hamburger is reported to increase taste and aroma (Carvalho et al. 2018). The K aroma derived from essential oil seemed to be responsible for the increase or decrease in them. Essential oil from rosemary and thyme extracts with certain concentrations can increase or decrease pork meatballs and hamburger acceptability (Szymandera-Buszka et al. 2020)

Sensory acceptability of formula B

Buas-buas leaves were also eaten as fresh or cooked vegetables by the community in Sumatera

Utara and Kalimantan Barat. The leaves can also be used as folk medicine, such as for catching a cold, and are reported to have anti-hyperglycemic activity, anti-tumor, chemotherapy agents, and inhibiting the growth of vascular endothelial protease inhibitors and immunostimulants (Restuati 2014); (Restuati et al. 2016).

The effect of B added to BP was evaluated by a sensory test and analyzed using AHP. The results showed that all criteria scores fluctuated, but adding the proper amount of B obtained the highest of all criteria scores except the aroma score such as B3 (Table 5). The highest overall score fell on B3. Therefore, B3 was the best formula BP added B and showed the best acceptability based on the panelists' choice of all criteria except the aroma (Table 5). The panelists in this sensory test were consistent with their choices due to the CR value of less than 10% (Table 5).

Sensory acceptability of the T formula

Turmeric, an indigenous plant from Asia and Northern Australia, is known as a food preservative and aromatic agent in most communities compared to K and B. The leaves are also beneficial for human health, such as antiseptic, anticarcinogenic, digestion, antimicrobials, and antioxidant properties (Yanti et al. 2021). The turmeric leaves contain oil components that are different in each location. However, some components are α-phellandrene (major component), α-terpinolene, 1,8-cineole, p-cymene, and 2-β pinene (Yanti et al. 2021); (Sindhu et al. 2011) but the turmeric-like aroma is from ar-tumerone and β-tumerone (Hasegawa et al. 2015).

In the sensory test, the weighted importance of each criterion from high to low score based on the panelists' choice was appearance, aroma, taste, and texture. The aroma, taste, and texture scores increased from T0 to T3 formulas but decreased for T4. This trend differed for the texture score, which increased from T0 to T2 formulas and decreased from T3 to T4. These results showed that T affected the aroma and taste. T is categorized as an herb that contains essential oil. Most herbs and essential oils can improve flavor, either taste or aroma, with a certain amount. For example, Oreganum vulgare added to the beef hamburger is reported to increase taste and aroma (Carvalho et al. 2018). The highest and lowest overall priority score was awarded for T3 and T0 (Table 6). Therefore, the best acceptability was awarded for T3 based on the highest overall priority scores.

Table 5 Sensory acceptability of formula B with varied B

Sample	B, g	Criteria score of				Subcriteria taste score of		Overall priority score
		Appearance	Texture	Aroma	Taste	Salt	Savoury	
B0	0	0.1997	0.1998	0.2138	0.1812	0.1844	0.1909	0.1990
B1	4	0.1911	0.2019	0.1930	0.1782	0.1790	0.1881	0.1906
B2	8	0.1787	0.1985	0.1895	0.1665	0.1649	0.1797	0.1820
B3	12	0.2269	0.2041	0.2034	0.2594	0.2663	0.2331	0.2246
B4	16	0.2036	0.1958	0.2003	0.2146	0.2053	0.2081	0.2039
Dominant Criteria		0.3599	0.1791	0.2360	0.2250	0.2642	0.3396	
CR=0.95 %								

n=84, with a range aged 15-50 years

Table 6 Sensory acceptability of T formula with varied T

Sample	T, g	Criteria score of				Subcriteria taste score of		Overall score
		Appearance	Texture	Aroma	Taste	Salt	Savoury	
T0	0	0.1791	0.1829	0.1753	0.2213	0.1722	0.1952	0.1887
T1	4	0.1955	0.1834	0.1823	0.2438	0.1732	0.2052	0.2004
T2	8	0.2255	0.2344	0.2129	0.2783	0.2476	0.2434	0.2364
T3	12	0.2308	0.2055	0.2382	0.2763	0.2038	0.1802	0.2375
T4	16	0.1690	0.1938	0.1914	0.2361	0.2032	0.1952	0.1960
Dominant Criteria		0.2799	0.2273	0.2622	0.2306	0.3836	0.3288	
CR=0.491%								

n=200, with a range aged 12-50 years

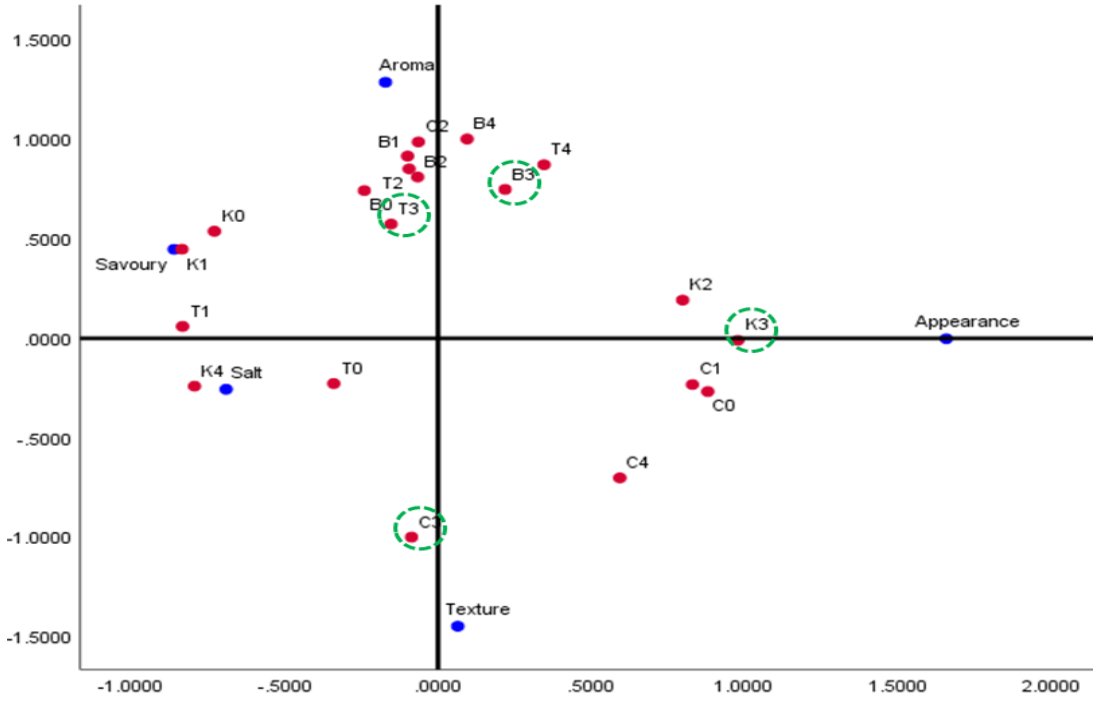

Figure 3 Variability and correlation of the criteria and formula BP based on PCA biplot analysis. Blue dots. Sensory attributes: Red dots. BP Formula was calculated from appearance, texture, aroma, and taste attributes; The correlation was measured as an angle between two variables; The variability was measured as a vector. The green dashed circle line showed the best formula for each variation.

Panelists' perception of BP

The panelists' perception of each formula was mapped by PCA biplot and MDS. PCA biplot mapping was based on the correlation among the formulas to reflect the total criteria of appearance, texture, aroma, and taste (salt and savory). PCA played a role in measuring BP variance in each BP formula based on the sensory tests. The results of all the formulas explained 50.02% and 26.11% of the total variance on principal components 1 and 2 (Figure 3). The variable criteria showed no correlation except between the savory and salt criteria. Some formulas showed a positive correlation based on the angle, such as K0 and K1, K0 and K4; K1 and K4, K2 and K3, but a negative correlation for K0, K1, K4 and K2, K3. Amongs B0, B1, B2, B3, and B4 showed a positive correlation among them and also among T0, T1, T2, T3, and T4. C2 showed no correlation with C0, C1, C2, and C4. Among the best formula, B3 showed a positive correlation to T3 and a weak correlation with K3 and C3. The angle greater than or equal to 90 ° or 270° between the two variables indicates a weak correlation. An angle of 0° or 180 ° reflects a correlation value of 1 or -1.

Meanwhile, the angle of 90° showed no correlation between the two characteristics, and shorter vectors have less variability. Similarly, the variables in the graph were positioned close to each other, and different products were far apart. K3, B4, C2, and C3 showed the longest vectors, indicating the highest variability. The appearance presented the highest variability; some criteria showed no correlation based on the angle. However, almost the best formula for each aromatic ingredient's formula showed no correlation.

The MDS technique can measure panelists' acceptance and perception of products (Oraman et al. 2011). The technique with the ALSCAL method mapped similarity and dissimilarity among the formulas. The analyzed formulas obtained good goodness of fit based on Kruskal stress test and RSQ values of 2.5% and 99.85%, respectively. The similarity group falls on the C: R ratio and B formulas, including each in their formulas due to short rank distances (Figure 4). All the best formulas for each aromatic ingredient's formula showed dissimilarity with K3 and T3 or B3, which showed the longest rank

distance. T3 and K seem to affect the panelists' perception of BP.

Effects of K and T on the BP aroma and taste

The interactions among the texture, appearance, aroma, and test can give positive and negative correlations (Gotow et al. 2018). Among the four aromatic ingredients evaluated by the sensory test, only K and T affected BP aroma and taste (savory and salt). The sensory test for aroma was conducted by retronasal olfaction. It is because retronasal aroma decouples the noticeability and intensity of a given taste quality (Gotow et al. 2018). Moreover, K and T aromas were more intense than C: R ratio and B aromas. Therefore, both K and T can probably enhance the perceived intensity of BP taste. The retronasal aroma of yokan, a traditional Japanese food, significantly increased with the taste (Gotow et al. 2013). Familiarity with food and its retronasal aroma affect the noticeability and intensity of a taste (Gotow et al. 2018). The strength of the correlation between BP aroma and taste (specifically salt or savory taste) for the K and T formulas was evaluated using Spearman's correlation coefficient. The correlation between the aroma and the savory increased significantly ($p < 0.05$) with the addition of K, mainly from the K1 to K3 formula, but decreased significantly for the K4 formula ($p < 0.05$) (Table 7). The aroma and salt of the K formula and the aroma and taste (savory and salt) of the T formula showed almost or no correlation. However, only K aroma can improve the intensity of BP savory, particularly for the K3 formula, due to the highest Spearman's correlation compared to the other K formula (Table 7). These results showed that K played a role in enhancing BP savory. Therefore, K became an important characteristic of the panelists' perception.

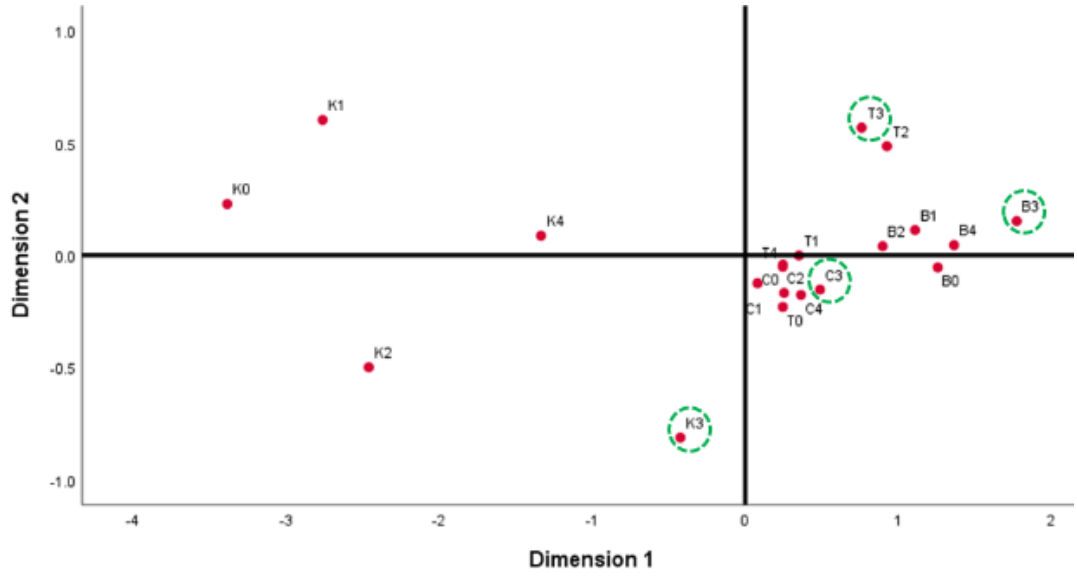

Figure 4 MSDS Alscal of BP formula. The green dashed circle line showed the best formula for each variation.

Table 7 The correlation between aroma and taste on BP with varied C and K

Formula	Aroma and Savoury		Aroma and Salt		Formula	Aroma and Savoury		Aroma and Salt	
	Correlation Value	P-value (p<0.05)	Correlation Value	P-value (p<0.05)		Correlation Value	P-value (p<0.05)	Correlation Value	P-value (p<0.05)
K1	0.2827	0.0000	-0.0029	0.9676	T1	0.0234	0.7427	-0.1200	0.1159
K2	0.4099	0.0000	0.0271	0.7036	T2	0.0779	0.2729	0.0237	0.7573
K3	0.7171	0.0000	0.0043	0.9514	T3	0.1045	0.1409	-0.1643	0.0312
K4	0.4377	0.0000	0.0126	0.8596	T4	0.2307	0.0010	-0.034	0.6549

CONCLUSION

The effects of the four aromatic ingredients added to the BP were prepared by serial formulation and evaluated by sensory test. The optimal aromatic ingredients incorporated into the BP formula based on the best acceptability of each formulation was a ratio of 100 g of roasted rice granules to 25 g of coconut flesh granules, along with 16 g of fresh kesum leaves, 12 g of fresh buas-buas leaves, and 12 g of fresh young turmeric leaves. Among the aromatic ingredients evaluated, fresh kesum and young turmeric leaves played a pivotal role in developing the BP aroma, but only fresh kesum leaves enhanced BP savory. Fresh kesum and young turmeric leaves were considered compulsory ingredients in generating a specific characteristic for BP perception. Further investigation of preservation of compulsory ingredients (the fresh kesum and young turmeric leaves) will be carried out in order to BP can be made anytime and everywhere.

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