Acceptance of Sweet Bread with Black Rice Flour as a Substitute Ingredient

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Abstract: This research aims to assess the organoleptic quality of sweet bread substituted with black rice. Methodology: Black rice replaces wheat flour as the main ingredient in this study. It employs a qualitative research design with an experimental approach involving 20 panelists. Indicators studied include the quality of the bread's crust, focusing on color, aroma, texture, and taste, with seven indicators for each. Results indicate that sweet bread substituted with black rice exhibits a darker color, a more fragrant aroma, less softness, a superior taste, and increased preference levels. The most favored formula consists of a 50% black rice and 50% wheat blend, achieving an overall acceptance rate of 94.45%. Conclusion: The acceptance of black rice as a substitute for bread suggests that as the proportion of black rice flour increases, panelists are more likely to accept the bread produced.

1 Background

Rice (Oryza sativa L.) is one of the main components of people's countries. Valued as one of the world's most important nutritious staple food among cereals, it is considered either directly as human food or indirectly. Rice is a rich source of carbohydrates. Although it contains protein and fat, rice is also a source of B complex vitamins such as niacin, riboflavin and thiamine. The carbohydrates in rice mainly consist of amylose and amylopectin. Rice grains contain 12% water, 75-80% starch, and only 7% protein with complete amino acids. Due to its higher concentration of lysine (~4%), it is highly digestible, up to 93%. Additionally, rice contains minerals such as calcium (Ca), magnesium (Mg) and phosphorus (P), copper (Cu), iron (Fe), manganese (Mn) and zinc (Zn) [1-7].

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Black rice (*Zizania aquatica*) is a type of rice that contains anthocyanin pigments, high levels of nutritious chemicals, and amino acids. It offers numerous health benefits, including natural antioxidants, anti-inflammatory properties, lipid oxidation reduction, blood sugar level regulation, and anti-cancer effects. Black rice is particularly rich in phytochemicals, anthocyanin color, protein, and vitamins, making it well-regarded for its antioxidant capacity, which is essential for memory improvement and immune system support [5-10].

Despite its high health benefits, black rice is still under consumed due to several properties that hinder its consumption compared to white rice. One issue is its hard texture and taste when prepared as rice. Additionally, the aroma of black rice is often described as unpleasant, reminiscent of sacks, suggesting prolonged storage [15-17]. The organoleptic qualities of black rice, however, are noteworthy, with its taste being described as very tasty, its texture as soft, its color as dark black, and its aroma as aromatic [11-14].

Anticipating a decrease in the organoleptic quality of black rice due to prolonged storage, and aiming to enhance its public consumption, one potential solution is to incorporate it into bread products as a substitute for wheat flour. Bread was selected for this research due to its widespread popularity and the increasing acceptance of innovative bread products across various demographics [15-18].

Moreover, bread was chosen as the focus of this study because of its significant consumption in Indonesia. Additionally, research is underway to explore the utilization of local ingredients as substitutes for wheat flour, aiming to reduce imports and enhance the functional properties of bread products. The inclusion of black rice fiber and anthocyanin pigment in this research is particularly significant, given their functional attributes, which necessitate further exploration to maximize their utility [19-22].

Bread is a beloved snack enjoyed by many. It is typically made from wheat flour, water, and yeast, and crafted through kneading, fermentation (rising), and baking processes in an oven. Originally considered a delicacy for the upper middle class, bread has evolved into a staple in the diets of busy urban dwellers, serving as a convenient option for breakfast, snacks, and fast food. According to the 2020 food consumption statistics from the Ministry of Agriculture, white bread sees a weekly consumption rate of 0.340%, while sweet bread stands at 1.129%. Annually, these figures increase to 17.73% for white bread and 58.87% for sweet bread. Comparatively, these rates surpass the consumption of other foods such as white rice (15.08%) and green bean porridge (6.63%) [23-25]. Given this context, research in this area holds significant importance, particularly in the realm of health product innovation, which plays a crucial role in enhancing public health, aligning with the priorities outlined in the national research master plan, specifically in the areas of food and health. Moreover, it resonates with the strategic plan of Makassar State University, aiming to foster an entrepreneurial mindset within the academic community through the tertiary education tridharma program [26–27]. The primary objective of this research is to explore the acceptance of sweet bread with black rice as substitute ingredient.

## 2 Research methods

### 2.1 Type of research and research location

This type of research is descriptive quantitative with experimental methods. The research was conducted gradually. The first stage was the formulation process of making sweet bread with black rice as a substitution ingredient. The second stage was the second stage of the hedonic quality test process to obtain the best quality information from sweet bread with black rice as a substitution ingredient. The third stage was the hedonic test process to obtain information on preferred bread. The location of this research was at the Culinary Laboratory,
Faculty of Engineering, Universitas Negeri Makassar for the formulation process, quality testing, and hedonic testing of sweet bread with black rice as a substitution ingredient.

2.2 Tools and materials

The tools utilized in the preparation of black rice substitute bread include ingredient scales, dough combs, spoons, grinders, ovens, 80-mesh sieves, measuring cups, and filter paper. Meanwhile, the ingredients consist of black rice, rice flour, wheat, sugar, eggs, and several additional components.

2.3 Research stages

Before conducting the research, several steps need to be taken to facilitate its implementation. The first step is the preparation of the substitution ingredient, which is black rice. Black rice is used in the form of flour for making cakes. Using flour simplifies the innovation of various types of desired cakes. The second step involves formulation using a substitution system, which replaces one of the main ingredients in the product with the research material. The main ingredients in the study are wheat flour/rice. The substitution used in this study refers to Widodo's research on biscuit production, which includes 5%, 10%, 15%, 20%, 25%, and 30% red rice flour [28-30]. The third step is the product evaluation process by panelists, involving individuals who act as panelists to assess the traditional cake products produced. Panelist requirements include being healthy and not currently sick, especially regarding the four senses: sight, smell, touch, and taste, as these senses play a role in providing evaluations. In addition to these health requirements, panelists are expected to have experience in food and beverage evaluation.

2.4 Data collection methods

The data collection method in this research begins with formulation and extends to hedonic testing or acceptance of black rice substitute bread using photo and video documentation. The characteristics of the results encompass beautiful fresh color, a fragrant aroma, a soft texture, and a delicious taste, evaluated overall using a 7-point scoresheet. Furthermore, acceptance is assessed using an 11-point scoresheet ranging from like to dislike [28-29].

2.5 Data analysis techniques

The data analysis technique used for the formulation process up to product acceptance employs descriptive analysis. Bread quality characteristics are assessed using averages, difference tests, and further difference tests. Acceptance data is analyzed through frequency analysis [30].

3 Results and discussion

3.1 Results

3.1.1 Black rice flour process

The process of making black rice substitute bread begins by preparing all the main ingredients in the form of black rice flour. The setup process can be described as follo
The process of making black rice flour begins with the process of cleaning from dirt, soaking, draining, grinding and sieving/screening. The finished and sieved rice flour is ready to be used as the main ingredient in making bread. The criteria for good flour are that it is smooth, fragrant, does not form lumps, is free from dirt, has a color that matches the material being floured.

3.1.2 Formulation
The second stage is that the formulation in this research uses a substitution system, namely by replacing one of the main ingredients in the product with the research ingredient. The main ingredient in the research is wheat flour/rice. The substitutions used in this research refer to Widodo's research on making biscuits, namely 5%, 10%, 15%, 20%, 25%, and 30% brown rice flour [28-29]. The bread formulation can be seen in Table 1.

**Table 1.** Formulation of black rice substitution bread

<table>
<thead>
<tr>
<th>Ingredient (g)</th>
<th>Basic</th>
<th>F0</th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>F4</th>
<th>F5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>0/100</td>
<td>10/90</td>
<td>20/80</td>
<td>25/75</td>
<td>30/70</td>
<td>40/60</td>
</tr>
<tr>
<td>Black rice</td>
<td>0</td>
<td>4,9</td>
<td>9,7</td>
<td>12,2</td>
<td>14,6</td>
<td>19,5</td>
<td></td>
</tr>
<tr>
<td>Flour</td>
<td>1000</td>
<td>48,7</td>
<td>43,8</td>
<td>39,0</td>
<td>36,5</td>
<td>34,1</td>
<td>29,2</td>
</tr>
<tr>
<td>Sugar</td>
<td>200</td>
<td>9,7</td>
<td>9,7</td>
<td>9,7</td>
<td>9,7</td>
<td>9,7</td>
<td>9,7</td>
</tr>
<tr>
<td>Yeast</td>
<td>20</td>
<td>1,0</td>
<td>1,0</td>
<td>1,0</td>
<td>1,0</td>
<td>1,0</td>
<td>1,0</td>
</tr>
<tr>
<td>Softener</td>
<td>15</td>
<td>0,7</td>
<td>0,7</td>
<td>0,7</td>
<td>0,7</td>
<td>0,7</td>
<td>0,7</td>
</tr>
<tr>
<td>Egg yolk</td>
<td>68</td>
<td>3,3</td>
<td>3,3</td>
<td>3,3</td>
<td>3,3</td>
<td>3,3</td>
<td>3,3</td>
</tr>
</tbody>
</table>
### 3.1.3 Quality of bread substitute for black rice

The next stage is the quality testing stage or hedonic quality testing. Hedonic quality testing is a stage carried out to determine the quality of the bread produced through formulation in the second stage. At this stage the tests carried out include: (1) color with 7 scales starting from very dark to very not dark; (2) aroma with a 7 scale starting from very odorless to very fragrant; (3) texture on a scale of 7 starting from very hard to very not hard; (4) taste on a scale of 7 ranging from very unpleasant to very good; and (5) overall with a scale of 7 starting from very bad to very good.

This third stage will involve other people acting as panelists who provide assessments regarding the traditional cake products that have been produced. The requirements for panelists include: being healthy and not sick, especially with regard to the 4 five senses, eyes, nose, touch and taste. Because these four senses play a role in providing judgment. Apart from these health requirements, panelists are expected to frequently carry out/be involved in food and beverage assessments. Bread quality data can be seen in Table 2.

#### Table 2. Average data and differences in organoleptic test results for the quality of bread substituted for black rice

<table>
<thead>
<tr>
<th>Formula</th>
<th>Color</th>
<th>Aroma</th>
<th>Texture</th>
<th>Flavor</th>
<th>Overall</th>
<th>Favorite</th>
</tr>
</thead>
<tbody>
<tr>
<td>F0</td>
<td>(4,17±0,619)^d</td>
<td>(3,33±1,08)^a</td>
<td>(2,28±0,58)^b</td>
<td>(5,28±0,75)^b</td>
<td>3,88±0,40)^a</td>
<td>(5,28±0,58)^a</td>
</tr>
<tr>
<td>F1</td>
<td>(3,17±0,619)^c</td>
<td>(4,33±1,09)^b</td>
<td>(3,28±0,58)^b</td>
<td>(5,11±0,90)^ab</td>
<td>4,21±0,56)^b</td>
<td>(6,28±0,58)^b</td>
</tr>
<tr>
<td>F2</td>
<td>(2,17±0,619)^ab</td>
<td>(5,22±0,94)^c</td>
<td>(4,28±0,58)^c</td>
<td>(5,00±0,77)^c</td>
<td>4,54±0,37)^b</td>
<td>(7,28±0,58)^c</td>
</tr>
<tr>
<td>F3</td>
<td>(5,50±0,51)^e</td>
<td>(5,28±0,58)^b</td>
<td>(2,89±0,76)^b</td>
<td>(5,00±0,77)^b</td>
<td>4,47±0,47)^b</td>
<td>(7,28±0,58)^c</td>
</tr>
<tr>
<td>F4</td>
<td>(2,56±0,71)^b</td>
<td>(4,39±0,61)^b</td>
<td>(5,28±0,75)^d</td>
<td>(4,50±0,92)^a</td>
<td>4,52±0,45)^b</td>
<td>(7,06±0,54)^c</td>
</tr>
<tr>
<td>F5</td>
<td>(2,22±0,55)^ab</td>
<td>(4,28±0,752)^b</td>
<td>(4,28±0,58)^c</td>
<td>(5,00±1,03)^c</td>
<td>4,36±0,52)^b</td>
<td>(7,17±0,71)^c</td>
</tr>
<tr>
<td>F6</td>
<td>(1,83±0,79)^a</td>
<td>(4,22±1,00)^b</td>
<td>(5,22±1,00)^d</td>
<td>(4,83±0,79)^ab</td>
<td>4,53±0,7)^b</td>
<td>(7,50±0,79)^c</td>
</tr>
</tbody>
</table>

| p.Value | 0,000** | 0,000** | 0,000** | 0,001** | 0,001** | 0,000** |

** : Showing the data is very different p<0,01
abcd : Subscript letters indicate different data positions

Information:

- getting darker
- getting more fragrant
- getting louder
- getting worse
- Better
- More and more like it

Based on Table 2, it shows that the quality test results of bread substituted for black rice flour show that with the addition of brown rice flour, the color of the bread produced is darker, the aroma is more fragrant, but the texture of the bread is harder/crumbler, the taste is better and it turns out to be more liked. and the best formula of the 6 bread formulas produced was
formula F6 with the substitution of 50% black rice flour (24.5 g) and 50% wheat flour (24.5 g) per 100 g of weight of the most preferred ingredients.

3.1.4 Acceptance of black rice substitute bread

This next stage is related to assessing preferences. This hedonic (liking) assessment. The conditions for implementing this fourth stage are the same as the third stage. The only difference is the assessment indicator with 11 acceptance scales ranging from very unaccepted to very accepted.

<table>
<thead>
<tr>
<th>Table 3. Acceptance of black rice substitute bread</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Formulas</strong></td>
</tr>
<tr>
<td>F0</td>
</tr>
<tr>
<td>F1</td>
</tr>
<tr>
<td>F2</td>
</tr>
<tr>
<td>F3</td>
</tr>
<tr>
<td>F4</td>
</tr>
<tr>
<td>F5</td>
</tr>
</tbody>
</table>

Based on Table 3, acceptance of bread substituted for black rice, data shows that the formula accepted is the F6 formula with black rice and wheat substituted by the same weight, namely 50% (24.5 g) with an acceptance rate of 17 panelists (94.45%).

3.2 Discussion

3.2.1 The process of making black rice substitute bread

The process of making black rice substitute bread has the aim of increasing the nutritional value and selling value of the bread produced. The making process is not much different from other bread making processes. The more the amount of additional bread ingredients produced, the more it will affect the color, aroma, texture and taste. If the additional ingredients have a dark color, the resulting product will also be darker, as well as other qualities, the aroma will be more fragrant, the texture of the resulting bread will be more brittle/hard, the taste of the bread will become unpleasant as the additional ingredients increase. So that acceptance is decreasing, this is in accordance with the opinions of several researchers below [30-36 ].

The baking process will also affect the quality and color of the bread produced, which is why using the right temperature and stable heat will produce bread that is uniform in color and doneness. For this reason, using a bread baking temperature of 180°C for 20 minutes can produce good bread. this is in line with opinion [37-40].

3.2.2 Quality of black rice substitute bread

The quality of good bread is influenced by the ingredients, processing equipment, processing process so that the quality of the bread in the form of color, aroma, texture and taste can be more optimal. The quality of the bread produced will affect the acceptance of the bread itself, good quality will result in good acceptance and vice versa.

Color: sweet bread produced by adding black rice flour produces a darker color of sweet bread, this is because the additional ingredients used are ingredients that are characterized by a dark color. So the more additional ingredients, the darker the resulting candy. Apart from
that, the main ingredient in sweet bread (sugar) when heated will turn brown due to caramelization [41-45].

Aroma: Sensory quality test: the aroma of the resulting sweet bread is more fragrant (sharp), especially as a result of the increase in the addition of black rice, so the panelists like it more. This shows that the panelists like the aroma of black rice [28], [42], [46-47].

Texture: The sensory quality test for the texture of sweet bread with the addition of black rice shows that the increase in the addition of additional ingredients indicates that it is harder/not softer. This is because the additional ingredients have the property of brown rice which contains less gluten than wheat flour, so the more brown rice you add, the less soft it is. The level of softness of bread is greatly influenced by the presence of margarine, eggs and gluten and caramelization of sugar [48-53].

Taste: Taste sensory quality tests show that increasing the black rice ingredient means it becomes less delicious. This is because the additional ingredients have unpleasant properties and are close to the taste of black sticky rice. This makes the resulting sweet bread even less delicious and the panelists show that their assessment of the sensory quality of the sweet bread taste is increasingly bad [32-34], [46], [54-57].

3.2.3 Acceptance of black rice substitute bread.

Likes: The liking test shows that an increase in the flour of black rice shows that it is more liked, this is due to the quality of the sweet bread which is getting darker, the color is similar to chocolate even though there is no added chocolate, the aroma is more fragrant, the texture is more fragile, the taste is getting worse. The increase in liking is due to the increasingly delicious taste. The level of panelist liking is generally caused by the panelist's pleasant taste [32-34], [43], [45-47], [54-59].

4 Conclusion

Based on the research objectives and referring to the research results, it can be concluded as follows: The acceptance of black rice substitute bread shows that the more black rice flour increases, the more the panelists will accept the bread produced.

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References

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42. D. Rahadian et al., Food Hydrocoll., 100, 105377, (2020).