Physicochemical and sensory characteristics of bread made from composite flour mocaf, flour and starch from orange sweet potato and breadfruit

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Abstract The high demand for wheat flour in Indonesia made us to continue to develop the use of flour made from local food ingredients. We studied bread from orange sweet potato flour and starch, breadfruit flour and starch, and mocaf. This study using a nonfactorial complete randomized design, bread made from breadfruit flour, mocaf⁷, breadfruit starch, orange sweet potato starch, orange sweet potato flour, namely (P): 60: 20: 10: 10: 0, 50: 20: 10: 10: 10, 40: 20: 10: 10: 0, 30: 20: 10: 10: 10, 20: 20: 10: 10: 20, 10: 20: 10: 10: 30, 0: 20: 10: 10: 40. The best treatment for making bread was P6 (10: 20: 10: 10: 50).

1. Introduction
Wheat flour is one of the primary ingredients in the manufacture of food processing, one of which is for making bread. Bread can not only be a substitute menu for breakfast, but can also be used as a menu for lunch or dinner. Compared to 100 g of white rice or wet noodles, 100 g of bread provides more energy, carbohydrates, protein, calcium, phosphorus, and iron [1]. The high demand for wheat flour in Indonesia has resulted in an increase in the import value of wheat seeds so that it is necessary to continue to develop the use of flour made from local food ingredients such as orange sweet potato, breadfruit, and cassava. Sweet potato is a superfood that is in the first position in nutrition between vegetables [2]. We can develop sweet potato for food consumption [3]. In addition to orange sweet potatoes, breadfruit, and cassava, the use of several local raw materials can also reduce consumption of wheat flour such as jackfruit seeds [4], processing durian seed flour, which has good nutritional value [5], and saga seed flour, which is a source of vegetable protein [6]. The physicochemical properties of bread with different ratios of flour will be tested and obtained a composite bread with the best treatment.

2. Materials and methods
We purchased sweet potato from the traditional market in Medan, breadfruit was purchased from Setia Budi, Medan, and mocaf was purchased from Inovasi Bakery in Medan. Bread making is done by mixing the composite flour.
This research was made with seven comparisons of a mixture of breadfruit flour, mocaf, breadfruit starch, starch from orange sweet potato, and flour from orange sweet potato. The seven comparative treatments, namely:

- \( P_1 = 60 : 20 : 10 : 10 : 0 \)
- \( P_2 = 50 : 20 : 10 : 10 : 10 \)
- \( P_3 = 40 : 20 : 10 : 10 : 20 \)
- \( P_4 = 30 : 20 : 10 : 10 : 30 \)
- \( P_5 = 20 : 20 : 10 : 10 : 40 \)
- \( P_6 = 10 : 20 : 10 : 10 : 50 \)
- \( P_7 = 0 : 20 : 10 : 10 : 60 \)
- \( P_8 = 100\% \) wheat flour

Each treatment was made in 3 replications, so that the total sample size was 24 samples.

The value of the colour index (°Hue) was calculated according to Hutchings [7]. Specific volume by using seed displacement test [8]. Analysis of ash content was carried out using the Ash method [9], fat and protein content were carried out using AOAC method [10], crude fibre content was carried out using the Crude Fibre method [11]. The sensory properties were evaluated by using 70 inexperienced individuals.

3. Results and discussion

3.1. The colour index (°Hue)

The colour index of the resulting composite bread is in the range 54-90 °Hue, which indicates a yellow red colour. The colour index of the resulting composite bread is influenced by the type of composite flour (mocaf, orange sweet potato flour and starch, breadfruit flour and starch) used comes from different varieties so that it has different colours. Other than that, the addition of eggs and sugar and the baking process in making bread. The presence of sugar facilitates the Maillard reaction to take place more intensively. Caramelization of sugars and Maillard browning of reducing proteins and sugars cause browning of the surface layers of bread [12]

![Figure 1. Correlation between orange sweet potato flour, breadfruit flour, orange sweet potato starch, breadfruit starch, and mocaf with the value °Hue of bread.](image)

Comparison of breadfruit flour (BF), mocaf (M), breadfruit starch (BS), orange sweet potato starch (OS), and orange sweet potato flour (OF):

- \( P_1 = 60 \text{ BF}: 20 \text{ M}: 10 \text{ BS}: 10 \text{ OS}: 0 \text{ OF} \)
- \( P_5 = 20 \text{ BF}: 20 \text{ M}: 10 \text{ BS}: 10 \text{ OS}: 40 \text{ OF} \)
- \( P_2 = 50 \text{ BF}: 20 \text{ M}: 10 \text{ BS}: 10 \text{ OS}: 10 \text{ OF} \)
- \( P_6 = 10 \text{ BF}: 20 \text{ M}: 10 \text{ BS}: 10 \text{ OS}: 50 \text{ OF} \)
- \( P_3 = 40 \text{ BF}: 20 \text{ M}: 10 \text{ BS}: 10 \text{ OS}: 20 \text{ OF} \)
- \( P_7 = 0 \text{ BF}: 20 \text{ M}: 10 \text{ BS}: 10 \text{ OS}: 60 \text{ OF} \)
- \( P_4 = 30 \text{ BF}: 20 \text{ M}: 10 \text{ BS}: 10 \text{ OS}: 30 \text{ OF} \)
- \( P_8 = 100\% \) wheat flour
3.2. Specific volume
The highest specific volume was obtained on P₈ made from 100% wheat flour, which was 2.91 mL/g and the lowest specific volume was obtained on P₁ which was 1.38 mL/g. The addition of non-wheat flour, which are gluten-free flour can decrease the volume of bread, thereby decreasing its specific volume [13,14]. Gluten functions as a gas trap resulting from fermentation and separates the gas by forming a protective layer into foam so made the dough was expands and firm [15]. Other than that, the addition of breadfruit flour is proportional to the amount of fibre which can reduce the volume of bread, because fibre can decrease the ability of the dough to trap air [16].

![Figure 2. Correlation between orange sweet potato flour, breadfruit flour, orange sweet potato starch, breadfruit starch, and mocaf with specific volume of bread.](image)

3.3. Ash content
The ash content in the resulting composite bread shows the mineral content. Figure 3 shows that treatment P₄ has the highest ash content and treatment P₈ has the lowest ash content. The size of the bread is influenced by the raw materials of breadfruit flour and orange sweet potato flour which have ash content of 2.15% and 1.89% due to the soaking of sodium metabisulfite in the pretreatment of making flour. The concentration of sodium metabisulfite used can increase the ash content in food ingredients because there is a mineral content of Na and S so that the mineral content in the material increases [17]. The ash of a material reflected the mineral. Minerals can be two kinds of salt, namely organic salt and inorganic salt [18].

![Figure 3. Correlation ratio between orange sweet potato flour, breadfruit flour, orange sweet potato starch, breadfruit starch, and mocaf with bread ash content.](image)

3.4. Fat content
The results show that the high fat content is due to the use of other raw materials that contain fat, such as shortening, egg yolk and milk full cream high amounts of. The highest bread fat content was at P₁ with a value of 10.16%. This is in accordance with the results of research on raw materials, where the fat content of breadfruit flour is 0.82%.
3.5. Protein content

P₈ has the highest protein content, namely 9.04% while P₁ has the lowest protein content, namely 5.37%. Figure 5 shows the greater the proportion of orange sweet potato flour in the composite flour, made the bread had higher protein concentration, so the addition will increase the protein content in the bread produced.

3.6. Crude fibre content

P₁ has the highest crude fibre content, namely 3.14%, while the P₇ has the lowest crude fibre content of 2.44%. The increase in crude fibre content occurs was caused of the amount of crude fibre of raw materials, breadfruit flour has a higher fibre content than other flours so that its addition will increase the crude fibre in the bread produced [19]. High levels of fibre in food have a good impact on
digestion. The decrease in crude fibre in the product is due to the heating process in making bread and the processing time is also one of the factors that causes a decrease in fibre content [20].

3.7. The sensory properties of composite breads

Table 1. The effect of comparison of orange sweet potato flour, breadfruit flour, orange sweet potato starch, breadfruit starch, and mocaf on the sensory characteristics of bread.

| Treatment | Colour   | Aroma    | Taste    | Texture   | Overall Acceptance |
|-----------|----------|----------|----------|-----------|--------------------|
| P1        | 5.02±0.29bb | 4.95±0.25bb | 4.94±0.21bb | 4.90±0.21bb | 5.05±0.27bb |
| P2        | 4.95±0.20bb | 4.99±0.23bb | 4.90±0.29bb | 4.95±0.20bb | 5.07±0.23bb |
| P3        | 5.03±0.16bb | 5.09±0.21bb | 5.04±0.22bb | 4.98±0.27bb | 5.04±0.25bb |
| P4        | 5.04±0.15bb | 5.04±0.14bb | 5.04±0.20bb | 5.06±0.15bb | 5.08±0.15bb |
| P5        | 5.12±0.17bb | 4.09±0.23bb | 5.10±0.28bb | 5.16±0.30bb | 5.10±0.29bb |
| P6        | 5.16±0.20bb | 5.25±0.26bb | 5.23±0.29bb | 5.14±0.12bb | 5.21±0.24bb |
| P7        | 5.09±0.22bb | 5.13±0.10bb | 5.04±0.29bb | 5.31±0.29bb | 5.33±0.29bb |
| P8        | 6.30±0.17AA | 6.00±0.07AA | 6.15±0.14AA | 6.17±0.19AA | 6.21±0.24AA |

From Table 1, the sensory properties of composite breads indicated that P6 (breadfruit flour, mocaf, breadfruit starch, orange sweet potato starch, orange sweet potato flour (10: 20: 10: 10: 50) was more accepted by the panellists than other composite breads.

4. Conclusions

Bread made from breadfruit flour, mocaf, breadfruit starch, orange sweet potato starch, orange sweet potato flour (10:20: 10: 50) is more acceptable to consumers.

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