Sensory evaluation of panelists on biscuit products based on sorghum flour and corn bran flour

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Abstract. Biscuits are a popular snack food because taste delicious and varied. However, these biscuits need to be enriched with nutrients through the addition of a combination of sorghum flour and corn bran flour. The purpose of the study was to evaluate the sensory characteristics of the panelists on biscuit products based on sorghum flour and corn bran flour. The data analysis method used statistical tests Analysis of Variance (ANOVA) with a combination of treatments sorghum flour 62% + corn bran flour 38% (P1), sorghum flour 72% + corn bran flour 28% (P2), and sorghum flour 83% + corn bran flour 17% (P3). The variables observed were the sensory characteristics of the panelists including the texture, color, aroma, and taste of the product. Based on the sensory test of the biscuit panelists with a combination of sorghum flour and corn bran flour, it affected the texture, color, aroma, and taste of the resulting biscuit. P3 treatment with a combination of 83% sorghum flour + 17% corn bran flour was the preferred one from all sensory variables including texture, color, aroma, and taste.

1. Introduction
Sorghum is a commodity that is expected to become a new food, so that it can be used for a mixture of other cereals. Sorghum can be used as food ingredients as well as raw materials for feed and food industries such as sugar industry, monosodium glutamate, amino acids, and beverage industry, as well as sorghum flour. [1] stated that sorghum is a potential source of nutraceuticals such as phenolic antioxidants and cholesterol lowering agents. Specifically for sorghum flour, it is obtained from sorghum which are processed through a flouring process. The flouring process aims to facilitate the process of making food products, in the manufacture of various products of cakes, bread, biscuits, and sorghum flour noodles. [2] reported that sorghum flour with a certain level can substitute other flours which can produce sensory-interesting products. Sorghum flour in its use can substitute for wheat flour without reducing the taste, texture, and aroma of the product.

One of the products made from sorghum flour is biscuits. Biscuits are the most popular snack products consumed by almost everyone, because biscuits are ready to eat, have good nutritional quality, available in various forms, and affordable [3]. Biscuits are consumed by all ages, from infants to the elderly with different types. However, the biscuits on the market have an unbalanced nutritional content. Most biscuits have a high carbohydrate and fat content, while the fiber content is relatively low [4]. The main alternative that can be done to add nutritional value to biscuits is by adding dietary fiber from corn bran flour and sorghum flour. [5] Reported that whole sorghum flour can increase more fiber content.

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[6] reported that sorghum biscuit products contain fiber content of 2.56-3.46%. Sorghum flour with a concentration of 60% can increase the fiber content of biscuits, so that food is suitable for diabetics because it can contribute to a longer period of fullness [1].

Corn bran has the advantage that the fiber content is quite high (9.80%), so that material can be used for several nutritional improvement processes such as biscuit products [4]. Therefore, corn bran is expected to enrich biscuit nutrition by combining it with sorghum flour. Several studies related to biscuit products from a combination of several sorghum flours and other flours including research [7] reported that biscuit products with several flour mixtures including sorghum flour and corn flour obtained the highest values of all sensory values of texture, color, aroma and taste. [6] Further reported that biscuits with 60% sorghum flour and 40% soy flour got the best scores for texture, color, appearance and sweetness. The purpose of this study was to evaluate the sensory characteristics of the panelists of biscuit products based on sorghum flour and corn bran flour.

2. Materials and Methods

The research was conducted at Installation center IP2TP Gorontalo Assessment Institute for Agricultural Technology (AIAT) from November to December 2020. The ingredients used in making the biscuits are sorghum flour obtained from polished sorghum flour, corn bran flour from local varieties, sugar, milk powder, salt, baking soda, margarine, vanilla, and eggs.

2.1. Making corn bran flour
Corn bran is washed to remove dirt, then dried in direct sunlight. Then after drying it will go into the process of refining or flouring using a grinder. After that, it was sieved using an 80 mesh sieve. Then the flour is roasted for 20 minutes to reduce the moisture content in the flour production.

2.2. Making polished sorghum flour
The polished sorghum are cleaned using running water, then cleaned, the sorghum are then soaked for 3 hours, after soaking the sorghum then dried using an oven at 105 °C for 100 minutes to reduce the moisture content. After drying, the sorghum is finely ground and then sieved using an 80 mesh sieve to make sorghum flour.

2.3. Process of making biscuits combination of sorghum flour and corn bran flour
Eggs, sugar and margarine are mixed first, then vanilla, milk, salt, and soda are added. After all mixed and smooth, after that add the sorghum flour and bran flour that gradually shifts. After it feels not sticky, the dough is flattened using a wooden roller and then printed using the mold provided. After being printed, then baked using the oven for 50 minutes at a temperature of 100°C

2.4. Research Design
The research design used a one-factor Completely Randomized Design (CRD) with a combination of sorghum flour and corn bran flour consisting of 3 levels including a combination of 62% sorghum flour and 38% corn bran flour (P1), a combination of 72% sorghum flour and 28% corn bran flour (P2), a combination of 83% sorghum flour and 17% corn bran (P3). Data analysis used statistical test Analysis of Variance on SPSS Version 22 software. If there was an effect between treatments, then continued with Duncan's follow-up test at level (α < 0.05).

2.5. Observation Parameters
The parameters tested in this study were sensory which included texture, color, aroma, and taste. The test method uses a hedonic or preference scale involving 25 semi-trained panelists. The number of hedonic numbers used includes 5 = Like extremely, 4 = Like, 3 = Slightly like, 2 = Dislike, and 1 = Dislike extremely.
3. Results and Discussion

3.1. Texture

Figure 1 shows that the characteristics of the panelists' sensory evaluation of the biscuit texture with a combination of 83% sorghum flour and 17% corn bran flour (P3) the highest mean 3.84 which is included in the criteria of liking, or 64% of panelists choosing to like as in Figure 2. Meanwhile, the other two treatments, P1 and P2, were quite similar, with a lower percentage of sensory values, namely 50%. The results of the analysis of the texture of the biscuits showed that the combination of sorghum flour and corn bran had a significant effect with a significance p value < 0.05 (Table 1). The low sensory value of the panelists on the texture was due to the texture of the biscuits produced from the treatment (P1) which had a hard texture. In treatment (P2) the resulting texture is slightly crunchy, while in treatment (P3) the resulting texture is more crunchy. The difference in texture of the three treatments was caused by the concentration of sorghum flour used. The increase in crispiness is thought to be due to the absence of gluten [8]. Lack of gluten content makes viscoelastic tissue around the dough which can cause the texture of sorghum biscuits to be better [9]. In addition, the crunchy texture is a function of the amount of water bound to the carbohydrate matrix [10], [11]. The texture of biscuits is influenced by flour particles which can cause between protein and starch which results in varying hardness, where water absorption will occur during cooking resulting in starch gelatinization and protein denaturation. The texture of sorghum biscuits is also influenced by the presence of sugar in the biscuit formulation dough [12].

![Texture](image)

**Figure 1.** Biscuit texture with a combination of 62% sorghum flour + 38% corn bran flour (P1), 72% sorghum flour + 28% corn bran flour (P2), 83% sorghum flour + 17% corn bran flour (P3)

**Table 1.** Effect of different treatments on various sensory characteristics of biscuit products based on sorghum flour and corn bran flour

| Treatment | Texture | Color   | Aroma   | Taste   |
|-----------|---------|---------|---------|---------|
| P1        | 3.52ab  | 4.00a   | 3.72ab  | 3.56a   |
| P2        | 3.20a   | 3.60a   | 3.56a   | 3.32a   |
| P3        | 3.84b   | 3.52a   | 4.08b   | 4.08b   |

Notes :
- P1 = Combination of 62% sorghum flour + 38% corn bran flour
- P2 = Combination of 72% sorghum flour + 28% corn bran flour
- P3 = Combination of 83% sorghum flour + 17% corn bran flour
3.2. Color

Color is the characteristic of food products that most attracts consumers' attention, and becomes an impression indicator to be liked or not. Figure 3 shows that the results of the panelists’ assessment were 4.0 or equal to likes, in the combination treatment of 83% sorghum flour with 17% corn bran flour (P1). The same thing in Figure 4 shows that treatment P3 has the highest percentage of sensory values at 68%, and is followed by treatments P2 and P1 at 38% and 44%, respectively. The high percentage of panelists' sensory values for biscuit products in P3 treatment was caused by the basic color of sorghum, which is brownish yellow, thus adding to the panelists' attractiveness for the color impression displayed (Figure 5). In addition, the low sensory value of the panelists for P1 and P2 treatments was due to the increasing concentration of corn bran flour. [7] reported that the color of biscuits from sorghum flour was lighter than other flours. The color of the biscuits is also thought to be influenced by the ash content of sorghum flour. The ash content component of sorghum flour is about 1.32% [13], the ash content of sorghum biscuit products is about 2.20-2.80% [6]. [14] reported that the color of sorghum biscuits was influenced by the ash content with a brightness value of 34.4%, meaning that the whiteness was low. Meanwhile, the results of the analysis showed that biscuits with a combination of sorghum flour and bran flour did not have a significant effect on the resulting color with a p value>0.05 (Table 1). The ineffectiveness of the combination of sorghum flour and corn bran flour is more due to the basic color components of the flour and the carbohydrate content in it which can accelerate the browning reaction during cooking. The color of the biscuits is caused by the Maillard reaction which produces a brown polymer which can contribute to the surface coloring of the biscuits [15-16]. The presence of protein contribution from sorghum flour is thought to be the trigger for the Maillard reaction [8]. This reaction also occurs due to the addition of corn bran, which causes the color of the biscuits to become more dull brown [4].
Figure 3. Biscuit color with a combination of 62% sorghum flour + 38% corn bran flour (P1), 72% sorghum flour + 28% corn bran flour (P2), 83% sorghum flour + 17% corn bran flour (P3)

Figure 4. Percentage of panelists hedonic value on biscuit color with a combination of 62% sorghum flour + 38% corn bran flour (P1), 72% sorghum flour + 28% corn bran flour (P2), 83% sorghum flour + 17% corn bran flour (P3)

Figure 5. Biscuit product with a combination of 62% sorghum flour + 38% corn bran flour (P1), 72% sorghum flour + 28% corn bran flour (P2), 83% sorghum flour + 17% corn bran flour (P3)
3.3. Aroma

The aroma of biscuits produced from the three treatments as shown in Figure 6 is equivalent to liking. However, for the combination treatment of 83% sorghum flour with 17% corn bran flour (P3), the highest panelist sensory value was 60% (Figure 7). While the results of the analysis of the biscuit aroma, it was found that the combination of sorghum flour and corn bran had a significant effect with a significance p value <0.05 (Table 1). Corn bran flour contributes to the aroma of biscuits, although in the use of flour it is dominated by sorghum flour. [17] reported that the percentage of substitution of corn flour to wheat will affect the aroma of the product. [18] reported that the use of large amounts of corn bran flour will increase the aroma of corn in biscuit products. In addition, the aroma is influenced by several raw materials used in the manufacture of cookies, including fat, milk, and eggs [10].

![Aroma](image)

**Figure 6.** Biscuit aroma with a combination of 62% sorghum flour + 38% corn bran flour (P1), 72% sorghum flour + 28% corn bran flour (P2), 83% sorghum flour + 17% corn bran flour (P3)

![Aroma](image)

**Figure 7.** Percentage of panelists hedonic value on biscuit aroma with a combination of 62% sorghum flour + 38% corn bran flour (P1), 72% sorghum flour + 28% corn bran flour (P2), 83% sorghum flour + 17% corn bran flour (P3)
3.4. Taste
Taste is a determinant of whether a product is accepted or not by consumers. Figure 8 shows that the percentage of sensory value of 4.08 is equivalent to like for the treatment of 83% sorghum flour and 17% corn bran flour (P3). This is also reinforced by the panelists' sensory percentage on the taste of the biscuits in Figure 9, that the panelists' highest assessment was in the P3 treatment with the percentage of panelists' like and like extremely 52% -32% sensory values, respectively. The increase in the percentage of panelists' sensory values for this treatment was caused by the dominant use of sorghum flour, so that it could eliminate the basic taste of corn bran flour which could affect the taste of biscuits, as in P1 treatment with the addition of corn bran flour. This can reduce the sensory value of the panelists. Meanwhile, the low value of sensory taste by the panelists was thought to be caused by the effect of non-enzymatic reactions, namely the browning reaction resulting from the reaction between amino acids and free sugars which caused a little bitterness [8]; [19]. [20] reported that the more corn bran flour was added, the more corn tasted, and vice versa, the less corn bran flour was used, the less corn tasted. The results of the analysis showed that biscuits treated with a combination of sorghum flour and corn bran flour had an effect on the taste of the biscuits with a significance p value<0.05 (Table 1). This is due to the addition of a low concentration of corn bran flour, so it does not dominate the taste of the biscuits. In addition, the high concentration of sorghum flour cannot affect the taste because sorghum flour does not have a normal flour taste or taste, so that the combination of the two flours has an effect on the sensory panelists by assessing like.

![Figure 8](image_url)

**Figure 8.** Biscuit taste with a combination of 62% sorghum flour + 38% corn bran flour (P1), 72% sorghum flour + 28% corn bran flour (P2), 83% sorghum flour + 17% corn bran flour (P3)
Figure 9. Percentage of panelists' hedonic value on biscuit taste with a combination of 62% sorghum flour + 38% corn bran flour (P1), 72% sorghum flour + 28% corn bran flour (P2), 83% sorghum flour + 17% corn bran flour (P3)

4. Conclusion
Based on the results of the panelists' sensory evaluation of biscuit products with the basic ingredients of a combination of sorghum flour and corn bran flour, it was found that the P3 treatment with 83% sorghum flour + 17% corn bran flour was the most preferred of all the panelists' sensory characteristics variables including texture, aroma, color and taste. Therefore, biscuits with the basic ingredients of a combination of sorghum flour and corn bran flour can potentially be used as a nutritious and delicious dry food additive.

Acknowledgments
The author would like to thank Hasyim Dj. Moko and Santty Fuji Pomalingo as Engineering Technicians who have assisted in the research process.

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