

Nutritional and Antioxidant Analysis of Cookies Made From Sorghum Flour

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ABSTRACT

One type of snack that is highly favored by the public is *desert*. Replacing wheat flour with food that can be produced in Indonesia, such as sorghum, can reduce wheat imports. It is expected that sorghum flour will increase the benefits and nutritional value of *cookie* products. Wheat flour is one of the main ingredients for making *cookies*. Sorghum has almost the same nutritional content as wheat flour, therefore sorghum can be used as a substitute for wheat flour in food raw materials. The purpose of this study was to determine the nutritional content and antioxidants found in *cookies* made from sorghum flour. Carbohydrate, protein, and fat values as well as antioxidant activity values for the replaced sorghum flour cookies were measured by gravimetric and titrimetric methods. The results met the standards of SNI No.2973-2011 for carbohydrate, fat, and protein tests.

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1. INTRODUCTION

Indonesia has great potential in non-rice carbohydrate sources such as sago, corn, cassava and sorghum. Sorghum is one of these non-rice carbohydrate sources that has great potential to be utilized more optimally. Food diversification using local food ingredients such as sorghum can help overcome the limitations and risks associated with dependence on rice or other cereals (5). Sorghum (*Sorghum bicolor L.*) is a cereal and is also a source of nutritional compounds that contain bioactives for food. Sorghum is also included in the cereal group of plants.

Kingdom : Plantae
Family : Poaceae
Genus : Sorghum
Species : *Sorghum bicolor L. (Moench)*

Sorghum contains a variety of benefits, including being high in fiber, low in gluten, and rich in nutrients such as iron, phosphorus, and magnesium. In addition, sorghum can also withstand extreme environmental conditions such as drought, so it can be a good alternative for agriculture in areas prone to extreme weather.

Sorghum with a content similar to wheat, has the potential to replace wheat in the raw material for making a staple product. The ability to be processed in the form of flour makes it a flexible raw material and can be developed to be used as various types of processed food for public consumption (5).

Table 1. Nutrient content of sorghum and other cereals (per 100g)

| Commodities | Fat (%) | Protein(%) | Carbohydrate (%) |
|-------------|---------|------------|------------------|
| Sorghum | 3,1 | 10,4 | 70,7 |
| Rice | 2,7 | 7,9 | 76,0 |
| Corn | 4,6 | 9,2 | 73,0 |
| Wheat | 2,0 | 11,6 | 71,0 |
| Jawawut | 1,5 | 7,7 | 72,6 |

Source: Directorate of Nutrition, Ministry of Health (1992)

Sorghum contains antioxidant activity, such as phenolic compounds like flavonoids, phenolic acids, and tannins. This content provides additional health benefits, helping to protect the body from free radicals.

The preparation of sorghum flour is similar to other cereals and the process of making rice flour. In general, the process involves a series of steps such as milling of sorghum seeds into flour, separation of the skin or fibers, sifting, and further refining if required (10).

The steps may vary slightly depending on the technology and equipment used in the flour production process. However, the basic principle remains the same, which is to convert sorghum seeds into flour ready for use in various food products.

2. METHOD

The articles included relevant research journals that have been published nationally over the past five years with high priority. This review utilized online sources such as Google Scholar, Science Direct, and other scientific journal providers.

2.1 Nutrient analysis includes carbohydrate, fat and protein content. The tests used in nutrient content analysis include carbohydrate, fat and protein content

2.1.1 Carbohydrate content test

Carbohydrate content of the difference method. Performed using 100% minus the sum of the results of the other four test components such as moisture, ash, protein, and fat content.

2.1.2 Protein content test

Analysis of protein content with the Kjeldahl Method deconstructs proteins and organic matter in the sample using sulfuric acid to which a catalyst is added. The result is neutralized first using an alkaline solution and then distilled.

2.1.3 Fat content test

Fat content using the soxlet extraction method. Fat content analysis was carried out for 30 minutes at 105°C until constant weight.

2.2 Antioxidant analysis was tested by the:

2.2.1 DPPH

According to Malik et al. (2017), the DPPH method is a reduction-oxidation reaction in which DPPH is a synthetic free radical that can be dissolved using polar compounds such as ethanol and methanol. Antioxidant compounds can react with DPPH by obtaining electron pairs from hydrogen atoms.

3. RESULT AND DISCUSSION

Table 2. Nutrient content analysis results

| Parameters | Content (%) | SNI No. 2973-2011 | Description | Source |
|---------------|-------------|-------------------|-------------|---------------|
| Carbohydrates | 49,9 | - | Fulfill | Sondang, 2022 |
| Carbohydrates | 77,4 | - | Fulfill | An-Nida, 2023 |
| Protein | 5,69 | Minimum 5 | Fulfill | Sondang, 2022 |
| Protein | 5,97 | Minimum 5 | Fulfill | An-Nida, 2023 |
| Fat | 25,2 | Minimum 9.5 | Fulfill | Sondang, 2022 |
| Fat | 13,87 | Minimum 9.5 | Fulfill | An-Nida, 2023 |

According to Suarni (2001), starch that depends on sorghum flour of 80.42% compared to wheat flour of 78.74% causes higher carbohydrate levels in cookies made from sorghum flour. The analysis method used also has an impact on cookies. The results of the carbohydrate test for cookies made from sorghum flour are 49.9%, these results are in accordance with SNI 012891- 1992. From the results of the analysis of carbohydrate content in sorghum flour cookies, there was a decrease. This decrease in carbohydrate content occurs because the main element in carbohydrates comes from plants, the drying stage of sorghum can affect the macronutrient content contained in sorghum (7).

Sorghum has the least protein digestibility when cooked and raw when compared to wheat and rice proteins (4). The protein content of sorghum flour cookies has met SNI 2973-2011 which has a minimum protein content requirement of 5%. The decrease in protein nutrient content is due to the baking process carried out. High temperatures can make kinetic energy increase and make protein constituent molecules that are initially slow to become faster and can destroy the constituent bonds in proteins, this is the cause of the decrease in protein content in sorghum flour cookies (2).

The fat content of sorghum flour cookies is quite high. Fat content in products that have been mixed with margarine, egg yolks and other raw materials. Has an increase in fat content in food due to the presence of margarine and egg yolk in the process (6).

Table 3 Comparison of Antioxidant Content Analysis

| Antioxidant Test Method | Flour | IC50 | Description |
|-------------------------|---------|-----------------------|------------------------|
| DPPH | Sorghum | 123 μ Mol TE/g | Chiremba et al. (2009) |
| DPPH | Wheat | 15 μ Mol TE/g | Chiremba et al. (2009) |
| DPPH | Sorghum | 104.48 μ Mol TE/g | Hudayana. (2010) |

The antioxidant activity test should be carried out to ensure that products made from sorghum contain antioxidant activity capable of binding free radicals, as indicated by the IC50 value. A lower IC50 value in the analysis indicates higher antioxidant activity in the sample. Since sorghum flour, which is used to make cookies, has a medium antioxidant activity value. Sorghum as an antioxidant has an influence on the amount of polyphenols it contains and also has antioxidant activity. Phenol compounds contained in sorghum can inhibit free radicals by increasing protons that form stable free radicals. The data in **Table 3** shows that cookies with sorghum content have high antioxidant activity compared to cookies with wheat content. This high antioxidant activity is thought to come from the higher antioxidant content in sorghum flour, especially tannin and anthocyanin compounds.

Tannins and anthocyanins are types of polyphenolic compounds found in many foods, including sorghum. Both of these compounds have been known to have powerful antioxidant properties, protecting the body from damage caused by free radicals. Due to these antioxidant properties, consumption of foods rich in these compounds can help reduce the cause of several symptoms including those of heart disease, cancer and others. This also shows the potential of using sorghum flour as an alternative raw material in food manufacturing, especially for products that want to increase their antioxidant content.

4. CONCLUSION

The nutritional content in the carbohydrate, protein and fat tests has a considerable difference due to the different cookie ingredients. The antioxidant content of wheat flour and sorghum is different because the flavonoid content in sorghum seeds is relatively high, making anthocyanins and their derivatives potential antioxidants. From the data obtained, although the levels are different, they have met the quality of SNI No. 2973-2011.

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