

Potassium, sodium, and proximate analysis of steamed sponge cake from durian seed flour (*Durio Zibethinus*)

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Abstract

Steamed sponge is a conventional cake that enjoys widespread popularity and is highly cherished by the general population. The cake is commonly made using wheat flour. Given the present increase in demand for wheat flour, an alternative option for making steamed cakes is to utilize durian seed flour instead of additional wheat flour. Durian seed flour, which has excellent nutritional value for health, is made from processed durian seeds. This study aims to find out how much potassium and sodium are present in steamed sponge cake based on durian seed flour and to ascertain the quantities of fat, protein, and carbohydrate. Atomic absorption spectrophotometry was used to determine the levels of potassium and sodium in steamed sponge cake. The sodium levels were analyzed at a specific wavelength of 766.5 nm, whilst the potassium levels were analyzed at a distinct wavelength of 589 nm. The proximate analysis involves determining the protein content using the micro-Kjeldahl method, the fat content using the soxhletation method, and the carbohydrate content using the UV-VIS spectrophotometry method at a wavelength of 460 nm. The study found that steamed sponge cake contains approximately 44% carbohydrates, 28% protein, and 23% fat in terms of its nutritional composition. Furthermore, the potassium concentration measured 284 mg per 100 grams, whereas the sodium value was 62 mg per 100 grams.

Keywords: Durian Seed Flour; Potassium; Sodium; Proximate, Sponge Cake

1. Introduction

Indonesia is a tropical country which is rich in various types of fruits and has an important role in the processing industry. Durian (*Durio Zibethinus*) is a fruit that is very popular with Indonesian people because it has a distinctive taste and aroma, so it has high economic value. This fruit is more popularly called King of Fruits which belongs to the Bombacaceae family [1]. They are also found in central Sulawesi. Central Sulawesi has abundant natural wealth, one of which is durian fruit. In this study, the durian seeds used were local durian fruit originating from Bancea Village, Poso Regency, Central Sulawesi. Durian fruit consists of three parts: the skin, the flesh, and the seeds. The part of the durian fruit that is usually consumed is the flesh. Even though the percentage of the weight of the fruit flesh is low, only 20–35%. This means that the weight of the durian skin is around 60–75% and the durian seed is 5–15% [2]. In general, durian skins and seeds have not been utilized optimally; a small portion is only used as animal feed, and most of it is simply thrown away so that it becomes waste that can pollute the environment [3]. Durian seeds become waste that is not utilized, which contains lots of good nutrition for the body. Durian seeds contain carbohydrates, protein, fat, and minerals such as potassium (K), and sodium (Na) [4]. The nutrition contained in durian seeds allows them to be used as a food raw material in the form of flour.

Durian seed flour contains 76.73% carbohydrates and 10.41% protein. Durian seed flour has a protein content that is not inferior when compared to other flours, such as wheat flour (8.9%), rice flour (7%), and corn flour (9.2%) [5]. Durian seed flour also contains quite a few minerals. The mineral content found in durian seed flour is potassium at

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9117.86 ppm, and sodium at 18.07 ppm [6]. The amount of nutritional content contained in durian seed flour makes it suitable as the main ingredient. The nutrients contained in durian seed flour deserve to be substituted with other flours as basic ingredients for food products such as bread, cakes, biscuits, sponge cakes, and others.

Various ways to increase people's nutritional intake are by making healthy snacks or meals from durian seed flour, one of which is by making steamed cakes. Steamed sponge is a snack that is loved by all people, both children and adults. It has a sweet taste, a soft texture, and various shapes that make it popular with the public. Steamed sponge is usually made from wheat flour. Currently, the need for wheat flour in Indonesia is increasing. To meet domestic demand, Indonesia needs to import wheat flour in large quantities 11.17 million metric tons in 2021 [7]. The number is high enough to meet the food needs of the population; therefore, it is necessary to develop steamed cakes made from flour other than wheat flour, namely by utilizing durian seed flour.

Durian seeds have a high starch content compared to sweet potatoes or cassava. The starch content in durian seed flour is very high, namely around 42.1% compared to sweet potato's 27.9% or cassava's 34.7%, so it has the potential to be an alternative food substitute. Starch produced from durian seeds is classified in the form of natural starch, namely starch, which is a carbohydrate from the photosynthesis of a particular plant and is stored in certain parts as a food reserve and has not undergone chemical changes or been chemically or physically processed. Apart from containing a lot of starch, durian seeds have a lot of nutritional content. Durian seeds, when viewed from their chemical composition, have potential as a source of nutrition. They contain 9.79% protein, 30% carbohydrates, 0.27% calcium, and phosphorus. 0.9%. From the explanation above, it can be concluded that durian seeds can be used as a good substitute for additional ingredients for making bread or sponge cake. This high carbohydrate and protein content is expected to produce good-quality steamed cakes. Apart from the high carbohydrate and protein content, durian seeds also do not contain gluten, so they can be used as an alternative to flour to make various gluten-free preparations [8].

In this study, steamed sponge cake will be made with durian seed flour as the basic ingredient. The use of this flour is expected to reduce the use of wheat flour and produce steamed cakes that are high in nutrition, especially potassium and sodium content. Potassium and sodium are mineral pairs that work together to maintain fluid, electrolyte, and acid-base balance, so these two minerals affect blood pressure regulation. Excess sodium intake will cause an increase in the composition of sodium in the extracellular fluid, which results in an increase in blood volume, which causes hypertension. Meanwhile, potassium itself is said to be able to lower blood pressure because it has a function as a diuretic, which can increase fluid and sodium expenditure [9]. It is necessary to know the content of potassium and sodium in steamed sponge cakes made from durian seed flour. Also, in this case the proximate analysis is also carried out.

2. Material and methods

This research is a laboratory experiment conducted to determine the content of potassium, sodium, carbohydrates, proteins, and fats in steamed sponge products. The atomic absorption spectrophotometer (AAS) was used for potassium and sodium analysis. Determination of carbohydrate content using the UV-Vis spectrophotometry method, protein content using the Micro-Kjeldahl method, and fat content using the soxhletation method. The materials used in this study were samples of steamed cakes made from durian seed flour for all analysis.

2.1. Manufacture of Durian Seed Flour

First, the durian seeds are sorted and then cleaned under running water until they are clean. Then, the durian seeds are peeled off the outer skin so that only the durian seed remains and then washed using running water. Then the durian seeds are boiled in water at a temperature of 80–90°C for 15 minutes. Then drain using a filter cloth, cool for 30 minutes, then slice the durian seeds thinly and wash again in running water until the mucus is reduced. Then the durian seeds are dried by airing them. Then put them in the oven at a temperature of 110°C for 3 hours. Then chill for 30 minutes, then puree the durian seeds using a blender and sift the durian seeds using a sieve [10].

2.2. Making Steamed Sponge Cake with Durian Seed Flour

First, measure the raw materials and other ingredients according to the predetermined formulation, then beat 1 egg, 115 grams of sugar, and ½ tsp sp using a mixer until the dough expands and has thick traces. Add 100 mL of soda water then add durian seed flour and corn starch in the ratio (50%:50%) then add ½ tsp vanilla flavor then stir the mixture until well blended. After that, the mixture is put into the mold and then steamed for 15-20 minutes. Then remove and let the steamed sponge cake made from durian seed flour and cooked corn starch rest. After that, the steamed sponge cake is ready to be tested for carbohydrate, protein and fat content.

2.3. Determination of Potassium and sodium

Potassium and sodium content were tested using an atomic absorption spectrophotometer. The working procedure begins with carefully weighing a sample of 20 grams and then placing it in a porcelain cup. Then put it in the oven at 105°C for 3–4 hours. Then the ashing process is carried out by inserting the sample into the furnace for the ashing process at 450°C for 6 hours. Perfect ash is usually marked by a sample that has turned into white ash. The sample of steamed sponge ash obtained was added to 5 ml of 5 M HNO₃ solution and added to 20 ml of distilled water. After that, it was filtered using filter paper in a 100 ml volumetric flask. Then the filtrate obtained was diluted with distilled water in a 100-ml volumetric flask until it reached the boundary mark and then homogenized. Furthermore, the content of potassium and sodium was determined using AAS. The content of potassium was measured at a wavelength of 766.5 nm, and sodium was measured at a wavelength of 589 nm. Then the standard solution data obtained is made into a linear regression equation. Furthermore, the levels of potassium and sodium in the samples were determined based on the linear regression equation.

2.4. Determination of Carbohydrate

In carbohydrate analysis Using a UV-VIS Spectrophotometer. The steps for weighing 1 gram of sample in a 250mL beaker. Add 10 mL of distilled water and stir until mixed. Then 13 mL of hydrochloric acid was added. Subsequently, added 100 mL of distilled water again and covered the beaker with aluminum foil. Then stirred for 20 minutes using a magnet. After that, filtered into a 250-mL measuring flask and diluted to the mark. Then make standard glucose solutions with concentrations of 20, 40, 60, 80, and 90 ppm. Next, take 1 mL of each solution into a test tube. Then add 5% phenol, as much as 1 mL, and shake. Subsequently, add as much as 5 mL of concentrated sulfuric acid and immerse it in water, then let it stand for 10 minutes. Measure the absorbance at a wavelength of 490 nm. Then make a standard curve. Repeat the same treatment by replacing the standard glucose solution with the sample [11]. Carbohydrate level levels can be calculated by:

$$\% \text{ Glucose} = \frac{G}{W} \times 100\%$$

G = Glucose level (g)

W = Sample weight (g)

2.5. Determination of Protein

In the protein analysis, the stages carried out in the analysis of protein content using the Micro-Kjeldahl method are:

1. Destruction Step

Weigh 1 gram of sample, put it into a 100-mL Kjeldahl flask, and then pipette 10 mL of concentrated sulfuric acid. Then the Kjeldahl flask is heated, starting with a small temperature. After a while, little by little, the temperature rises so that the temperature rises. Destruction was stopped when the solution turned greenish-clear.

2. Distillation Step

The results of the digestion obtained were then cooled, after which they were diluted with distilled water up to 100 ml. After being homogeneous and cold, pipette as much as 5 ml and put it in the distillation flask. Add 10 mL of a 30% sodium hydroxide solution through the inner wall of the distillation flask until a layer form under the acid solution. The distillate flask is installed and connected to the condenser. Then the tip of the condenser is immersed in the reservoir liquid. Steam from the boiling liquid will flow through the condenser to the holding tank. The Erlenmeyer container is filled with 10 ml of 0.1 N hydrochloric acid solution, which has been dripped with methyl red indicator. Check the distillation results with litmus paper; if the results are no longer alkaline, the distillation is stopped.

3. Titration Step

After the distillation process, the next step is titration. The distillation results were collected in an Erlenmeyer containing 0.1 N hydrochloric acid, and 5 drops of methyl red indicator were added and immediately titrated using a 0.1 N sodium hydroxide solution. The end point of the titration is marked with a pink to yellow colour [11] Protein content can be calculated by:

$$\% \text{ N content} = \frac{tb-ts \times N \text{ HCl} \times 14,008 \times 100\%}{\text{mg sample}} \times 100$$

$$\% \text{ Protein content} = \%N \times 6,25$$

ts = sample titration volume (mL)

tb = blanko titration volume (mL)

2.6. Determination of Fat

In the fat analysis, the first step is to put the round-bottom flask into the oven at 110°C for 1 hour. After that, it was cooled in a desiccator and weighed. Then, weigh as much as 2 grams of sample, then wrap it with cotton and filter paper. Enter the sample into the Soxhlet extraction tool, install the condenser above it, and place the flask under the Soxhlet tool. Fill enough n-hexane solvent into the flask. Carry out the reflux process until the solvent drops back to gray and the result is clear. Then, heat the flask until the solvent boils and evaporates up to the sample wrapped in filter paper until it turns gray and the solvent in the flask is reduced. Heat the flask containing the extracted fat in the oven at 110°C, then cool it in a desiccator, then weigh it until the weight remains constant [11]. Fat content can be calculated by:

$$\% \text{ Fat content} = \frac{\text{Weight of final flask} - \text{Weight of initial}}{\text{Weight of dry sample}} \times 100\%$$

3. Results and discussion

Data obtained from research regarding the potassium and sodium content in steamed sponge cake products made from durian seed flour using atomic absorption spectrophotometer (AAS) can be seen in Table 1.

Table 1 Data of Potassium and Sodium Contents in Sample

Sample	Treatment	Dry Weight Sample (g)	Absorbance	Content (Mg/100g)
Sponge cake for Potassium analysis	1	20.006	0.1686	279.1
	2	20.018	0.1746	288.9
	3	20.011	0.1717	283.1
		Average		284.0
Sponge cake for Sodium analysis	1	20.006	0,0978	64.4
	2	20.018	0.0901	58.8
	3	20.011	0.0939	61.5
		Average		6.6

Measurement of mineral concentrations such as potassium and sodium metals can be carried out using the atomic absorption spectrophotometry method. Potassium levels were analysed at a wavelength of 766.5 nm and sodium levels were analysed at a wavelength of 589 nm. The advantages of this method compared to other spectrophotometric methods are that it has high sensitivity, is fast, is specific for the specified element, and can be used to determine very small concentrations in samples [12]. Analysis of the content of potassium and sodium using AAS was carried out for sample preparation by dry digestion, where the ash sample of steamed sponge cake made from durian seed flour obtained from the ashing process was dissolved in 5 mL of 5M HNO₃. The addition of 5M HNO₃ aims to dissolve the metals present in the sample because HNO₃ is a universal metal solvent and can stabilize the metals to be analysed [13].

Based on the analysis and calculation results (Table 1), it was found that the potassium content was 284 mg/100g. These results are in accordance with research conducted by Fahira found that durian seed flour contains many minerals, one of which is potassium with an average content of 612.606 mg/100g [14]. The daily requirement for potassium for adults is estimated at 3900–5300 mg/day [15]. The potassium content, which is quite high in steamed cakes of durian seed flour as a snack, is enough to meet the body's needs for potassium. Potassium is an intracellular ion and one of the macro minerals that plays a role in regulating body fluid balance. As much as 95% of potassium is in the intracellular fluid. Potassium is a mineral that is beneficial to the body and functions to regulate blood pressure and sterilize carbon dioxide in the blood. Potassium also functions to protect electrolyte fluid balance and balance acids and bases [16]. Potassium deficiency can occur because most of it is lost through the digestive tract or kidneys, which can cause loss of appetite, lethargy, paralysis, delirium, and constipation. The heart will pound and reduce its ability to pump blood. Conversely, excess potassium can cause hyperkalaemia, which can lead to heart failure and death [17].

It also was found that the sodium content in sample was 61.6 mg/100g. These results are in accordance with the research of Efendi et al who found that durian seed flour contains sodium of 18.07 ppm [18]. The average daily nutritional adequacy figure for sodium for adults is 1300–1700 mg per day [15]. By consuming steamed cakes of durian seed flour, which contain high amounts of sodium, as a snack, it is enough to meet the body's need for sodium. Sodium in the body is in the inter-cellular fluid (extracellular), which functions by regulating the osmotic pressure of the fluid. When sodium is deficient, osmotic pressure decreases and extracellular fluid enters the cell, so the volume of extracellular fluid decreases. The physical effect is a drop in blood pressure. Conversely, if sodium intake is excessive, there will be an increase in extracellular fluid volume because of increased osmotic pressure, which causes extracellular fluid to leave the cell. Physically, blood pressure rises [19]. Carbohydrate content was obtained by using UV-Vis while the data is presented in Table 2.

Table 2 Carbohydrate content in steamed sponge cakes of durian seed flour

Treatment	Results
1	43.7037%
2	44.074 %
3	44.2529 %
Average	44.0102 %

Carbohydrates are natural products that have many important functions for living things. Carbohydrates in flour consist of carbohydrates in the form of simple sugars, pentoses, dextrans, cellulose, and starch. Most carbohydrates, especially monosaccharide and disaccharide classes such as glucose, fructose, galactose, and lactose, have reducing properties. The reducing properties of carbohydrates are due to the presence of a free aldehyde or ketone group and a free OH group. Carbohydrates play a major role in preparing food products in general and are one of the macronutrients needed by the body. The functional properties of carbohydrates, which are important in food processing, make their presence a component that needs to be considered and analyses [20].

The carbohydrate content in the steamed sponge cake samples was analysed using UV-Vis spectrophotometry. In this study, carbohydrates were recorded or measured from the average yield with three treatments, namely 44.0102% in the 50% formulation. This shows that the carbohydrate content in durian seed flour is quite high (Table 2).

Steamed sponge cakes of durian seed flour have quite high levels of dietary fiber, including carbohydrates (47.3118%), fat (32.49%), and protein (12.25%), where high dietary fiber affects the low glycemic index of a food. Foods that have a low glycemic index are optimal for controlling blood glucose. Based on research conducted by [11], it states that durian seed flour can be recommended for people with diabetes mellitus because it has high dietary fiber and low GI values. The glucose sample has a glycemic index value of 100, while the durian seed flour sample has a glycemic index value of 10.90.

Based on the results obtained in the table of carbohydrate content research results, this indicates that durian seed flour has a high carbohydrate fiber content and a low glycemic index value. Based on previous studies, durian seed flour has high dietary fiber, a low glycemic index, and is recommended for DMT-2 with a carbohydrate content of 48.50%. So, the results of this study are not much different.

Protein content was obtained by using Micro-Kjeldahl and the data is presented in Table 3.

Table 3 Protein content in steamed sponge cakes of durian seed flour

Treatment	Results
1	17.5%
2	24.5 %
3	28 %
Average	23.33 %

The protein content in the steamed sponge samples was analyzed using the Kjeldahl method for quantitative determination of protein content. In this study, the carbohydrate content was slightly higher than the protein. In this study, the protein content recorded or measured from the average results with three treatments was 23.33% in the 50% formulation (Table 3). This shows that the carbohydrate content in durian seed flour is quite high.

The content of sponge which has high protein is suitable for consumption, especially children. Moreover, sticks are a snack that most of those who like are children. Protein functions to build and maintain body tissue cells. Children with less protein intake will experience slower growth than children with sufficient protein intake. Based on the research conducted [21] states that the steamed cakes produced can contribute protein intake which can be given to school children as additional food, especially children who are stunted/short. Where is the result of his research, the chemical quality recapitulation of steamed sponge cake with the addition of durian seed flour in 50 gr of durian seed flour steamed cake sample contains 43.75 gr of protein.

Fat content was obtained by using the Soxhlet method while the data is presented in Table 4.

Table 4 Fat content in steamed sponge cakes of durian seed flour

Treatment	Results
1	23.01%
2	23.025 %
3	23.055 %
Average	23.03 %

The fat content in the steamed sponge cake samples was analyzed using a quantitative determination of protein content using the Soxhlet method. In this study, the protein content was slightly higher than the fat content. In this study, the fat content recorded or measured from the average results with three treatments was 23.03% in the 50% formulation. This shows the fat content in durian seed flour is lower. Based on research [11]) the fat content in durian seed flour was 31.35%. The results showed that the fat content of durian seed flour and steamed sponge products made from durian seed flour was not much different.

From the explanation that has been given, the best cake product made from durian seed flour, namely the formulation of 50% durian seed flour with three treatments, is highly recommended for diabetics as a source of nutrition. Based on previous studies, durian seed flour has high dietary fiber, a low glycemic index, and is recommended for DMT-2 with a carbohydrate content of 48.50%. So, the results of this study are not much different [11].

4. Conclusion

Based on research conducted on the potassium and sodium content of steamed sponge products made from durian seed flour, it can be concluded that contains 468.4 mg/100g potassium and 60.6 mg/100g sodium. The carbohydrate content of steamed cakes of durian seed flour was 44.0102%, and the protein content of steamed cakes of durian seed flour was 23.33%. And the fat content in the durian seed flour steamed cake is 23.03%.

Compliance with ethical standards

Disclosure of conflict of interest

No Conflict of interest to be disclosed.

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