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The Potential Of Durian Seed Flour As An Alternative Source Of Carbohydrate For Diabetes Mellitus Sufferers

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Abstract— Durian seed flour is a source of carbohydrates that has the potential to be used to meet the carbohydrate needs of Type 2 Diabetes Mellitus (DMT-2) sufferers, but before it is used to fulfill carbohydrate needs in diabetes sufferers, an in vivo test is needed to identify the glycemic index (GI) of the flour. This study aims to determine the glycemic index of durian seed flour given orally to Sprague Dawley rats. This research was arranged in 2 steps, namely the manufacture of durian seeds flour and the glycemic index test with 5 repetitions with time variations 0; 30; 60; and 120 minutes at 3 days intervals using a glucometer. Rats were grouped into 3 groups each consisting of 2 rats. Flour was suspended in 0.1% sodium carboxymethyl cellulose (Na-CMC) at a dose of 0.5625 g, positive control was 1.125 g of glucose that given in an oral way. Data in the form of test animal blood glucose levels versus time were analyzed into the Area Under Curve (AUC) glucose levels versus AUC. GI calculations were carried out by comparing AUC of durian seed flour to glucose AUC. The results of the research and calculations carried out obtained the GI of durian seed flour of 10.90 with low criteria category. With this GI value, it can be stated that durian seed flour has the potential as a source of carbohydrates for DMT-2 sufferers.

Keywords— Durian seed flour, carbohydrate, glycemic index, diabetes mellitus.

1. INTRODUCTION

Along with the times, the pattern of disease in Indonesia has shifted from infectious diseases and malnutrition to degenerative diseases, one of which is diabetes mellitus [1]. Diabetes mellitus is a chronic disease caused by the inability of the body to produce the hormone insulin or due to ineffective use of insulin production. This is marked by an increase in blood glucose levels [2]. Data from a global study in 2009 showed that the number of diabetes mellitus patients in Indonesia in the age group between 20-79 years in 2010 was estimated at 7 million, this result puts Indonesia in 9th place, while in 2030 it is estimated that the number will increase to 12 million and place Indonesia in 6th place [3]. Estimates of diabetes mellitus sufferers are still higher than COVID-19 in Indonesia for now. COVID-19 is a virus that was discovered at the end of December 2019 in Wuhan, China and has now become a pandemic that is currently hotly discussed by health practitioners [4][5]. COVID-19 and other infectious diseases can be treated using vaccines [6]. Unlike the case with diabetes mellitus, which is handled with a lifestyle and pharmacological approach [7].

One of the efforts to prevent diabetes is by setting the correct consumption pattern and choosing the proper food. How to choose the right food includes eating foods that contain lots

of high fiber content [8]. Functional foods that are suitable for diabetes mellitus sufferers are those that have a low glycemic index (GI) [9]. Knowledge of food GI in DM patients, independently can easily choose foods that can fill you up but do not quickly raise blood glucose levels. Foods with high GI will raise blood sugar levels quickly, while low GI foods raise blood sugar levels slowly. The GI of food is influenced by many factors including fiber content, amylose and amylopectin ratio, starch digestibility, monosaccharide content, fat and protein content, processing methods, and food anti-nutritional substances [10].

One of the foods that contain high fiber content is durian seeds. Durian seeds contain 10.07% moisture, 78.75% carbohydrates, 7.73% protein and 1.09% fat [11]. The high carbohydrate content in durian seeds allows the starch to be present with starch presentation as much as 43.6% for fresh durian seeds and 46.2% for ripe seeds [12]. After physical change into durian seed flour, it turns out that it has a composition, respectively 76.73% carbohydrates, 10.41% protein and 2.12% fat and 10.74% moisture content [13]. In addition, durian seeds also consist of secondary metabolic compounds including flavonoids, alkaloids, triterpenoid steroids, tannins, quinones and saponins [14][15]. These compounds also have functional properties for the body to a certain extent to help prevent degenerative diseases through their antioxidant and antimicrobial properties [16][17]. These data indicate that durian seeds can be used as an alternative to processed food in the form of flour which can add information about nutrition to the community and create a clean environment [18][19].

Based on 2020 statistical data, Central Sulawesi Province produced 25.288,1 tons of durian fruit in 2019 [20]. The increasing durian production is thought to have come from various regions in Central Sulawesi, such as Morowali, Moutong, Parigi, Palu, Poso, Tolitoli and several other areas. The abundance of durian fruit at harvest time will result in an abundance of durian seeds which are not widely used by the community. This untapped solid waste actually contains a lot of added value which can add to the benefits as to the nature of the material and is used for a relatively long time. Therefore, it is important to conduct a study on the proximate of durian seed flour and its potential as a source of carbohydrates for diabetics.

2. MATERIAL AND METHODS

The materials used in this study were durian seed flour, strip glucometer, one swap, 0.1% sodium carboxymethyl cellulose (Na-CMC), pure glucose, distilled water, and rat (*Rattus norvegicus*).

2.1 Making Durian Seed Flour

Durian seeds were taken in Parigi Moutong, Central Sulawesi, then cleaned of dirt and washed with running water, then separated from the hard skin of the durian seeds and cleaned again of dirt and washed with running water. Flour was made through a blanching. The step was heating the durian seeds in water with a temperature of 80℃-90℃ for 15 minutes. After that, it was drain with a filter cloth and thinly sliced then air dry and oven at 105℃ for 3 hours. Finally, it was blended and sieved with an 80-mesh sieve.

2.2 Animal Test

The test of animals used in this study were white rat (*Rattus norvegicus*) male Sprague Dawley strains aged 2-3 months with a weight of 250 - 300 grams. The first treatment was that the rats were adapted for a week and were given food and drink ad libitum. Then the rats were fasted from food for 10 hours (except water) and the fasting sugar levels were

measured. Then, the rats were grouped into 3 randomly selected groups each consisting of 2 tails. The treatments of each group were Group I: Giving 0.1% Na-CMC, Group II: Giving pure glucose and Group III: Giving durian seed flour. All samples were given food as orally once in 0.1% Na-CMC (suspended). Given a test sample to each group of tested animals according to the treatment of each group. After giving the test sample, the glucose level was measured at 0, 30, 60 and 120 minutes 5 times with a difference of 3 days.

2.3 Blood Glucose Measurement

Blood was taken from the end of the rat's tail by cutting off the tip of the rat slightly using scissors that had been cleaned with one swap. The blood that comes out was then attached to the glucometer strip. The blood glucose level will be measured and appear on the glucometer screen after 10 seconds, expressed in mg/dL.

2.4 Glycemic Index (GI) Determination

Blood glucose levels after giving durian seed flour and glucose at 0, 30, 60 and 120 minutes were depicted on a graph of blood glucose levels versus time. The calculated blood glucose levels of the durian seed flour samples were blood glucose levels of durian seed flour minus the glucose levels given 0.1% Na-CMC. Determination of the GI is carried out using the Trapezoid Method which refers to the Zain procedure [21].

3. RESULTS AND DISCUSSION

Durian seeds (Figure 1) are one part of durian that has not been utilized optimally. Until now, the use of durian seeds has only been used as poultry feed and as superior seeds for the durian itself. However, despite the fact that durian seeds have not yet been utilized, they can be processed into alternative food ingredients such as flour which contains quite high content with a complete composition.

Figure 1. Durian seeds

The results of making durian seed flour from durian seeds local from Parigi Moutong-Central Sulawesi, produces durian seed flour weight and water content can be shown in Table 1.

Table 1. Result of making durian seed fluor

Sample	**Initial weight**	**Wet weight of flour**	**Dry weight of flour**	**Water content of flour**
Durian seed	2 kg	1.023,69 kg	499,45 g	1.08%

The water content of a material indicates the amount of water content in the material. The water content obtained in this study was repeated 3 times, namely 1.119%, 1.340%, and

0.801% respectively, so that an average moisture content was obtained of 1.086%. Basically, food preservation technology is in two alternatives, namely inhibiting enzymes and microbial activity/growth by reducing the temperature to below 0℃ and reducing the water content of food so that it does not provide opportunities for microbial growth/life by drying or evaporating the content. water that is in or on the surface of food, until it reaches certain conditions [22].

Identifying the GI of durian seed flour in vivo was carried out on male Sprague Dawley rat (*Rattus norvegicus*) for 4 weeks. The rat to be used were adapted for 7 days in order to avoid the stress effects of being in a new environment. Before induction was carried out, the rats were fasted for 10 hours so that the conditions of the rat were the same and reduce the effect of food consumed ad libitum on the absorption of the samples given. After fasting, the weight of the rats was weighed first to calculate the dose of administration and the volume of each sample solution. After that, fasting glucose levels were calculated in rat, then induced samples to each group of rats using a Nesco glucometer. There were 3 different samples that were induced to the test animals as describe in 2.2 section. Measurements were carried out in 5 repetitions with an interval of 3 days for 2 hours for each blood glucose measurement, the measurement was carried out for 2 hours because1 the glucose metabolism process occurred in the first 2 hours. The results of measuring glucose levels in rat can be seen in Table 2.

Table 2. Glucose levels of rats (Rattus norvegicus)

Sample		**Glucose level (mg/dL)**			
		0 minutes	**30 minutes**	**60 minutes**	**120 minutes**
NAMC	1	105,4	111,8	104,6	102,0
	2	92,0	95,2	93,2	85,6
	Average	98,7	103,5	98,9	93,8
Glucose	1	100,6	102,8	98,6	100,6
	2	108,6	117,8	104,4	102,8
	Average	104,6	110,3	101,5	101,7
Flour	1	95,6	100.0	92,0	88,0
	2	101,6	112,8	106,6	97,4
	Average	98,6	106,4	99,3	92,7

The data analysis used was the Trapezoid Method by comparing the value of the Area Under Curve (AUC) of glucose with the durian seed flour that had been previously obtained, then multiplied by 100 as follow the Zain procedure [21], [23]. The GI can be calculated using the formula below.

$$_{(1-0)} = \sum \frac{+}{2} x) \quad (1)$$

$$_{(2-1)} = \sum(\ ^{+} x) \text{ and so on until } n \quad (2)$$

$$= _{(1-0)} + _{(2-1)} + \quad (3)$$

a and b = two parallel sides, namely blood glucose levels between two measurement periods (mg / dL).

t = height, which is the distance between the measurement periods of blood glucose levels (hours).

To obtain the GI value of durian seed flour is to compare the Area Under Curve (AUC) 0-2 durian seed flour with (AUC) 0-2 glucose as can see in formula below.

$$= \frac{x}{100} \qquad (4)$$

After getting the GI value, then the GI was categorized, if the GI value <55 is a low category, a GI value of 55-69 is a moderate category, and a GI value> 70 is a high category.

Based on the glucose response for each sample, the value was determined to reflect the total increase in blood glucose levels after giving the sample. Where the glucose sample of durian seed flour was reduced by glucose levels of Na-CMC to determine blood glucose levels of durian seed flour and calculated glucose. The results obtained for the AUC calculation were for the glucose sample the total AUC value was 10.78 and for the durian seed flour sample the total AUC value was 1.175. The Figure 2 is the curve of the increase in blood glucose levels of the test animals.

Based on the GI value obtained, the category of durian seed flour was determined. The results of the GI of durian seed flour can be seen in Table 3.

Based on the Table 3, it can be seen the value of changes in blood glucose from test animals compared to pure glucose, where the value of durian seed flour is a low GI value. This is because durian seed flour has a high enough content of food fiber and high dietary fiber affects the low GI of a food ingredient. Food that has a low GI value is optimal in controlling blood glucose in diabetes mellitus sufferers because it does not cause an increase in blood glucose levels so that it can suppress insulin resistance. Food carbohydrates that are low GI will be broken down and absorbed so that they release glucose into the blood slowly. Thus, it is associated with a reduced incidence of diabetes mellitus. Besides, the lower carbohydrate diet resulted in less using of medication for diabetes mellitus sufferers [24].

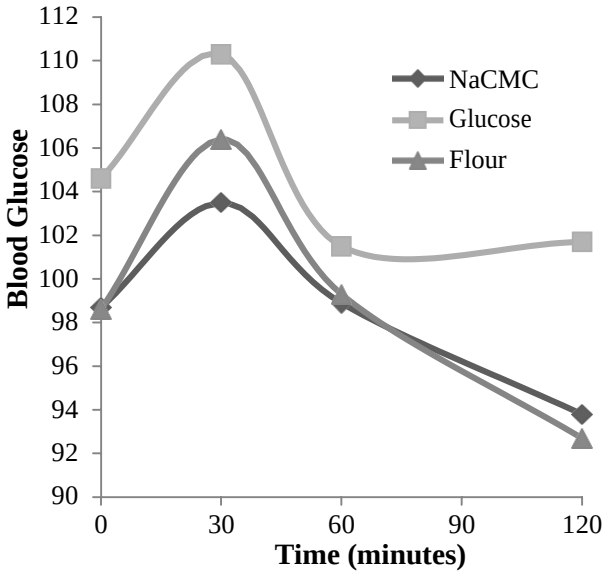

Figure 2. Curve of increase in blood glucose levels of test animals

Table 3. Glycemic Index value

Sample	Glycemic Index value	Category
Glucose	100	High
Durian seed flour	10.90	Low

4. CONCLUSION

Based on the results obtained in this study, it can be concluded that durian seed flour from Parigi Moutong has the potential to be a source of carbohydrates that can be consumed by diabetes mellitus sufferers with the criteria for a low glycemic index of 10.90.

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