Blood sugar conditions in hyperglycemic mice after given the biscuit from banana skin type Kepok

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Abstract. Hyperglycemia is a condition in which the blood glucose level exceeds reasonable limits. Hyperglycemia is a clinical manifestation of diabetes disorder, a metabolic disorder characterized by resistance to insulin action, inadequate insulin secretion or both. Research has been conducted to determine the blood sugar level of male mice after given the biscuit from Kepok banana skin (Musa paradisiaca L.). The experiment was conducted experimentally with completely randomized design (CRD) design with five treatments, i.e., positive and negative control, the concentration of banana skin flour, i.e., 25%, 50%, and 75%. Each treatment was repeated as many as six tests. Before treatment, the mice were induced with alloxan to create hyperglycemia conditions. The biscuit from banana skins was given for 14 days. The results of research that has been done show that the administration of biscuit from Kepok banana skin could reduce blood sugar levels of mice who have hyperglycemia. Also, after given the biscuit from Kepok banana skin does not affect body weight of hyperglycemic mice. The biscuit from Kepok banana skin on levels 75% can be consumed for people with hyperglycemia to lower blood sugar.

1. Introduction
Diabetes mellitus is a metabolic syndrome which has emerged as one of the most alarming health problems in the present century. Diabetes mellitus is a metabolic disorder of multiple etiology characterized by chronic hyperglycemia and glycosuria with disturbances in carbohydrate, lipid and protein metabolism resulting from defects in insulin secretion, insulin action or both [1]. Chronic hyperglycemia in diabetes starts a cascade of events leading to micro and macrovascular complications which affect many tissues and organs, causing retinopathy, nephropathy, neuropathy, cardiovascular diseases, peripheral vascular diseases [2, 3]. Diabetes is now emerging as one of the main threats to human health in the 21st century, not only in developed countries but also in developing countries [4]. The number of diabetics worldwide by 2025 is projected to reach 300 million people, with the global cost of Mus musculus diabetes treatment reaching the US $1 trillion per year [5]. The increasing number of diabetics causes the need for antidiabetic drugs is increasing.

Musa sapientum Linn. is a herbaceous plant of the Musaceae family is a plant with nutritive, as well as the medicinal value [6]. The banana plant is known for its anti-diabetic properties, and our earlier report revealed that banana flower and pseudostem of Musa sp. cv. elakki bale is beneficial during diabetes in rat models [7]. Previous research shows that banana peel contained large amounts of dopamine and L-dopa, catecholamines with a significant antioxidant activity [8]. Banana peel, an underutilized source of phenolic compounds is considered a good source of antioxidants for foods and functional foods against cancer and heart disease. The peel of the fruit contains various antioxidant
compounds such as gallic acid [9] and dopamine [10]. Based on the results of previous studies, biscuits with the addition of banana peel flour from the type of Kepok have the potential as functional food to maintain health [11].

In Indonesia, bananas are an agricultural commodity that is widely consumed by the community, one of which is banana Kepok (Musa paradisiaca Linn.). It is known that Kepok banana is widely used as an industrial material for the manufacture of food products. Research on the use of Kepok banana peel to reduce blood sugar levels in hyperglycemic mice has never been reported. Therefore, research has been conducted with the aim to measure blood sugar levels of hyperglycemic mice after consuming biscuits with the addition of Kepok banana peel flour.

2. Methods
This study used a completely randomized design (CRD) using 24 mice male Swiss Webster strains. Male mice are induced with alloxan and experience hyperglycemia. Biscuits are made by adding Kepok banana skin flour with levels of 25%, 50%, and 75% [12]. The animal being tested were male mice divided into treatment and control groups. The treatment group, hyperglycemic mice, were given banana skin biscuits. Positive control group, hyperglycemic mice were given banana skin biscuits. A negative control group, normal and not given banana skin biscuits. The study was conducted for two weeks.

Observations were made on blood sugar levels of mice before and after being given biscuits. Blood samples were taken on days 0, 3, 7, 11 and 14 in hyperglycemic mice treated. The animal being tested, their blood was taken after fasting for one night. Blood collection was taken from the caudal vein section by making a wound. Blood was inserted into the measurement strip automatically as much as 0.08 μl for one test. The measurement was continued by reading the scale found on the screen of the AUTOCHECK glucotest tool. The wounded tail part was cleaned with alcohol to prevent infection.

3. Results and Discussion
Based on the results of statistical analysis it can be seen that the administration of Kepok banana skin biscuits gives a significant effect on blood sugar levels of mouse hyperglycemia mice. It can be stated that blood sugar levels before and after the administration of banana skin biscuits decrease significantly. Kepok banana skin biscuits affect reducing blood sugar levels in hyperglycemic male mice (Table 1).

![Figure 1. Average Blood Sugar Levels of Mice after Consuming Biscuits with The Addition of Kepok Banana Skin.](image)

The results of the analysis of mice blood sugar levels after two weeks of giving the banana skin biscuits showed that there was a decrease in blood sugar levels in all groups. The higher addition of
banana skin flour (75% dose) has been able to reduce high blood sugar levels. These results indicate that the skin of Kepok banana has the potential to reduce blood sugar levels in hyperglycemic mice. The results of this study are by the research of previous researchers which states that bananas can be used to reduce blood glucose levels [13]. The compounds responsible for decreasing blood glucose levels are flavonoids, tannins, triterpenoids, and steroids [14]. Flavonoids can prevent irregular metabolism of glucose, fat and protein. Flavonoid glycosides are also capable of acting as hydroxyl binders, thus preventing diabetogenic action. Tannin can reduce absorption of food nutrients including glucose in the small intestine, consequently inhibit sugar intake and the rate of increase in blood glucose is not too high and has hypoglycemic activity by increasing glycogenesis [15]. Kepok banana can reduce the blood glucose of mice which are burdened with glucose because they contain flavonoids and tannins [16].

A significant reduction in the treatment group was estimated due to the presence of flavonoids and their derivatives. Flavonoids 5, 7, 3', 5'-tetrahydroxy-3-4-flavon-diol are flavonoid derivatives which can be used as hypoglycemic agents (lowering blood sugar levels). Flavonoid derivatives such as quercetin are also known to have hypoglycemic effects [17]. This is because flavonoid compounds can suppress cell death (apoptosis) in beta cells without changing the cell cycle (proliferation) of beta cells in the pancreas. Besides that, flavonoid compounds can also stabilize free radicals that can cause damage to the pancreas by donating one hydrogen atom [18]. Flavonoid compounds can reduce blood glucose levels (hypoglycemia). Previous research has shown that Geroho banana skin can reduce glucose levels in mice because they contain flavonoids [19].

Banana skin has antioxidant activity. The types of antioxidant compounds that can be isolated from banana skins are flavonoid [20]. Banana skins contain higher antioxidant activity compared to the flesh. Useful antioxidants can reduce oxidative damage in diabetics so they can control blood glucose levels and prevent complications [21]. Saponins can provide a hypoglycemic effect because they can regenerate the pancreas which causes an increase in the number of pancreatic β cells and Langerhans islands so that insulin secretion will increase. Increased insulin secretion will help decrease blood glucose levels [22]. Tannin is one of the antioxidants that has health benefits, can be as cardio-protective, anti-inflammatory, anti-carcinogenic and antimutagenic. Protective effects related to their capacity to: (a) act as free radical scavengers; (b) activate antioxidant enzymes. Tannin can increase glucose uptake through the mediator of the insulin signaling pathway, by activating PI3K (Phosphoinositide 3-Kinase), p38 MAPK (Mitogen-Activated Protein Kinase) and GLUT-4 translocation [21]. Tannin also acts as an anti-hyperglycemic agent in diabetic mice. Therefore, a decrease in blood sugar levels in mice given banana skin biscuits can be due to the tannin content of banana skins which acts as an anti-hyperglycemic agent in diabetic mice. Increased doses are generally proportional to increasing the effect given, but the results obtained that the administration of Kepok banana skin biscuits showed a statistically significant difference in decreasing blood sugar levels. Kepok banana skin flour with a percentage of 50% and 75% can provide hypoglycemic effects (antidiabetic) on hyperglycemic mice.

Based on the results of statistical tests obtained a comparison of data before and after treatment (Table 2), where kepok banana skin biscuits cannot affect the weight of mice except at 25%. Furthermore, the results of weighing the weight of mice after giving banana skin biscuits at different levels showed that the higher the banana skin biscuits, the lower the weight of the mice. This condition is caused by biscuits with banana skins containing dietary fiber which can slow down the digestive process. This explanation is consistent with the opinion that fiber can also cause changes in intestinal motility, has a high viscosity for macronutrient absorption, one of which is fat absorbed more slowly, can increase insulin sensitivity, and reduce energy intake [26].
The weight loss of hyperglycemic male mice was thought to be due to the crude fiber content in the banana skin. The fiber content of flour biscuits with the addition of a banana skin was higher than the Indonesia National Standard maximum of 0.5%. Fiber content biscuits with the addition of flour banana skin 25%, 50%, 75% respectively were 1.92%, 2.47%, and 3.13%. This is presumably because the influence of the fiber content of flour banana skin was high [11]. Kepok the banana skins in the oven containing 14.04% crude fiber and dry drying of 16.14% [12]. The high fiber content of flour biscuits with the addition of the potential banana skins to become functional foods.

The crude fiber that comes from the feed after being consumed will bind bile acids upon arrival in the gastrointestinal tract, thus causing bile function to help the fat absorption be inhibited. Furthermore, bile acids that have been linked by crude fiber will be removed from the body in the form of feces resulting in a decreased abdominal fat deposition [23]. Abdominal fat tends to decrease along with the tendency of increasing crude fiber [24]. The results of other studies showed similar results, namely by using chicken test animals, in which chickens that consumed rations with higher crude fiber had lower abdominal fat content than the ration had lower crude fiber [25]. In this study, Kepok banana skin biscuits contain high crude fiber, which could be reduced visceral fat formation.

4. Conclusion
Based on the research that has been done can be concluded that the giving of the Kepok banana skin biscuits (*Musa paradisiaca* Linn.) affects decreasing blood sugar level of male mice (*Mus musculus*) hyperglycemia. The most substantial percentage of banana skin flour added was 50% and 75%. Also, giving banana kepok banana flour biscuit does not affect body weight of hyperglycemic mice. The banana skin flour can be used as a raw material for biscuit snacks for diabetics to lower blood sugar levels.

5. References
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