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Comparison of the reduction in blood glucose levels of mice (mus musculus) given boiled water from ginger (zingiber officinale) with metformin

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ABSTRACT

Elevated blood sugar levels that exceed the established normal limits are a typical symptom of diabetes, a metabolic disorder. Traditional medicine is said to have fewer side effects than modern medicine, which has led to its long history of being favored by many people diagnosed with diabetes. People often use ginger as an herbal remedy for hypoglycemia. Ginger can be used as a natural antidiabetic drug due to the antiglycemic effect of its flavonoid content. To determine the comparison of blood glucose levels of mice (Mus musculus) given water decoction of ginger (Zingiber officinale) with metformin. Experimental research with pre and post test randomized controlled group design. There was a decrease in the average blood glucose level of mice (Mus musculus) given water decoction of ginger (Zingiber officinale), from ±185.5 mg/dL to ±136.17 mg/dL, but not as good as metformin, which decreased from ±191 .17 mg/dL to ±108.67 mg/dL. Water decoction of ginger (Zingiber officinale) can reduce fasting blood glucose levels in mice (Mus musculus) although not as well as mice (Mus musculus) given metformin.

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INTRODUCTION

A metabolic disorder characterized by symptoms such as an increase in blood sugar levels beyond normal limits, diabetes is also referred to as "sugar disease". Type 1 diabetes and type 2 diabetes are two classifications of diabetes according to their etiology. Damage to the beta cells of the pancreas, which prevents these cells from producing insulin, results in type 1 diabetes. Insulin resistance or insufficient insulin production by beta cells is the main cause of type 2 diabetes. Exogenous insulin injection is a treatment method used to treat type 2 diabetes. 1. To regulate blood sugar levels, people with type 2 diabetes must commit to a healthy lifestyle that includes regular physical activity and a balanced diabetes diet (Aprilia, 2018).

One of the risk factors for diabetes is being overweight or obese and sweet foods and drinks. However, with these risk factors, many do not realize that they may have diabetes.

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Compared to 2019, the prevalence of diabetes in Indonesia increased by 81.8% in 2021, namely from 10.7 million people (2019) to 19.46 million people (2021) (Magliano, 2010).

Diabetes patients are required to adhere to their prescribed treatment regimen for a long period of time, and possibly for the rest of their lives. Prolonged treatment can cause side effects, including the need for insulin administration. Hyperglycemia and other side effects may occur with long-term use of insulin, which is the primary treatment for type 1 diabetes (Gumantara, 2017).

Patients with type 2 diabetes mellitus often receive metformin, an oral biguanide antihyperglycemic drug, as part of control therapy. Metformin functions to reduce glucose concentrations in the blood. Gastrointestinal disorders, including abdominal pain, diarrhea, nausea and vomiting, are the most common side effects of metformin monotherapy.

Since ancient times, many people have chosen traditional medicine as a treatment option for diabetes because of its purportedly fewer side effects compared to modern medicine. Many plants are thought to lower blood glucose levels in developing countries; however, this is not always proven through clinical or pharmacological studies. Ginger is a plant that is often used by members of the community to lower blood glucose levels. Ginger root is often included in drinks and processed into a spice; Ginger is also a common component in traditional medicines. Ginger is not only easy to obtain but also very functional and cost-effective for society. As a derivative of flavonoids, ginger consists of gingerol, shogaol, paradol, phenol, and zingerone. The pomineal constituents gingerol and shogaol have antitumor, anti-inflammatory and anticancer properties. Apart from lowering blood sugar levels, the flavonoid content in ginger makes it a natural anti-diabetic drug.6–

Using experimental animals in scientific investigations is often done. Mice are one of various species of experimental animals that can be used as research subjects. Mice are smaller in size than other rodents. Because 99 percent of their genes are similar to humans and mice reproduce very quickly, they are very suitable as models of human genetic diseases (Wicaksono, 2015).

As an indication of the hypoglycemic properties of red ginger extract, Abdulrazaq et al. conducted research showing its efficacy as a blood glucose lowerer. In this study, three treatment groups were given red ginger extract with different concentrations. Red ginger extract at doses of 100 mg/kgBW, 300 mg/kgBW, and 500 mg/kgBW were evaluated. An investigation into the potential of ginger as an antioxidant and antihyperglycemic agent for type 2 diabetes was carried out by Singh et al. Diabetic patients were given boiled water containing ginger in a study conducted by Suharto et al. in 2019. The results of this study show that diabetes patients can experience a decrease in blood glucose levels through the use of ginger therapy (Amin, 2018).

The author's motivation to conduct research regarding the comparison of reducing blood glucose levels between (Mus musculus) given boiled ginger water (Zingiber officinale) and metformin started from this idea.

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METHOD

Experimental research using a randomized controlled group design with pre- and post-tests is the methodology used in this research.

RESULTS AND DISCUSSION

Univariate analysis

The following is an overview of the results of research on reducing blood sugar levels in mice (Mus Muculus). The characteristics of the research data will be described by the mean value and standard deviation.

Table 1. Mean decrease in fasting blood sugar levels in mice

Group	*Pre test*	*Post test*
	Mean ± SD	Mean ± SD
Negative control (normal)	107 ± 13,27	101,33 ± 8,07
Positive control (diabetes)	183 ± 20,97	173,33 ± 11,48
Ginger boiled water *(Zingiber officinale)*	185,5 ± 36,42	136,17 ± 12,45
Metformin	191,17 ± 22,58	108,67 ± 49,25

In table 1, we can see that there was a decrease in fasting blood sugar levels before and after treatment. The most significant reduction in blood sugar levels occurred in the group given metformin, namely from ±191.17 mg/dL to ±108.67 mg/dL, followed by the group given boiled ginger water (Zingiber officinale), namely from ±185.5 mg/dL to ±136.17 mg/dL. The positive control group also experienced a decrease, namely from ±183 mg/dL to ±173.33 mg/dL, as did the negative control group, namely from ±107 mg/dL to ±101.33 mg/dL.

Bivariate Analysis

Comparability test

The comparability test is to compare the average fasting blood sugar levels of mice in the control and treatment groups. The analysis that will be used is the One Way ANOVA test. As for interpretation, if the p value is <0.05 then there is a significant difference in the mean data between the groups, but if the p value is >0.05 then there is no significant difference in the mean data between the groups.

Table 2. Comparability test of the control group and ginger boiled water (Zingiber officinale) using One Way ANOVA analysis

Group	*p*	Information
Negative control (normal) Positive control (diabetes) Ginger boiled water *(Zingiber officinale)*	0,00	Significant differences

Based on table 2, the value obtained is p < 0.05, which means there is a significant difference between the average fasting blood sugar levels of mice in the control group and the group given boiled ginger water (Zingiber officinale).

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Table 3. Comparability test of control and metformin groups using One Way ANOVA analysis

Group	*p*	Information
Negative control (normal) Positive control (diabetes) Metformin	0,00	Significant differences

Based on table 3, the value of p < 0.05 is obtained, which means there is a significant difference between the mean fasting blood sugar levels of mice in the control group and the group given metformin.

Comparisons were also made between the group that received metformin and the group that received boiled ginger water (Zingiber officinale) regarding the reduction in fasting blood sugar levels. Further LSD testing was carried out for this purpose. Regarding the results, statistically significant differences in group mean values can be identified when the p value is less than 0.05. A lack of significance in the average data between groups is indicated by a p value greater than 0.05.

Table 4. Comparability test of groups given boiled ginger water (Zingiber officinale) and those given metformin analyzed using One Way ANOVA then LSD further test

Group	*p*	Information
Ginger boiled water *(Zingiber officinale)* Metformin	0,001	Significant differences

Based on table 4, the p value <0.05 is obtained, which means there is a significant difference in the mean data between the group given ginger boiled water (Zingiber officinale) and the group given metformin.

Discussion

In this experiment, mice were given merformin and boiled ginger (Zingiber officinale). Mice were given boiled ginger water (Zingiber officinale) in group III, metformin in group IV, and group I as negative control, and group II as positive control group. Every day at 13.00 WITA for seven days, treatment is given. Temporary blood sugar levels in mice are determined by glucometer readings.

In the positive control group, the average fasting blood sugar level of mice decreased from ±183 mg/dL to ±173.33 mg/dL, even though this group was given nothing other than food and drink every day. This can occur due to the regeneration and neogenesis of pancreatic β cells so that the mice's fasting blood sugar levels slowly decrease. These results are in accordance with Chougale's research entitled optimizing the dose of alloxan is very important to induce diabetes that is stable for a long time. In this study it was said that a dose of 140 mg/kgBB alloxan only caused diabetes while in mice, their blood sugar would return to normal within 10 days (Stevany).

In the group given boiled ginger water, the average fasting blood sugar level of mice decreased from ±185.5 mg/dL to ±136.17 mg/dL. This reduction in blood sugar levels in mice supports previous research by Al-amin, Yanto and Nurul Mahmudati. Ginger's ability

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to lower blood sugar levels is because ginger contains flavonoids, saponins and tannins which are known as antidiabetic compounds (Yanti, 2019).

Regenerating cells in the islets of Langerhans, flavonoids have antidiabetic properties. Insulin resistance can be overcome by flavonoid compounds; Therefore, diabetes mellitus caused by insulin deficiency or injury to the insulin receptor is positively influenced by the presence of flavonoids (Setiadi, 2020).

As a result of their glucagon-lowering properties, saponins may increase glucose utilization in diabetics, consequently reducing their blood glucose levels. Additionally, it was observed that certain saponins induce insulin secretion from the islets of Langerhans located in the pancreas of rodents (Simatupang, 2019). In addition to its hypoglycemic effect, tannin stimulates glycogenesis. In addition, tannins function as chelators that can block the epithelial membrane of the small intestine, thereby inhibiting the absorption of food fluids and, as a result, limiting sugar consumption and preventing excessive increases in blood sugar.13

Diabetic mice treated with metformin showed substantial reductions in blood glucose levels, according to a study by Yanti, Pertiwi, and Mona R. Alshathly. Mice treated with metformin showed a mean reduction in fasting blood glucose levels of ± 108.67 mg/dL compared to ± 191.17 mg/dL observed in the control group, as identified by the study (Sopianti, 2019).

Instead of increasing plasma insulin levels, metformin improves insulin sensitivity through increasing peripheral glucose uptake. Although it can also be given to normal weight individuals, metformin is the drug of choice for overweight diabetics who have failed on a strict diet. In cases of diabetes unresponsive to sulfonylurea treatment, metformin is also administered. Its effectiveness depends on the presence of endogenous insulin in pancreatic islet cells, thus requiring partial function (Saedi, 2019).

Statistical evaluation is also used to examine research findings. Way ANOVA analysis was used to assess comparisons. This analysis showed that there was a statistically significant difference in the average fasting blood sugar levels of mice in the control group compared to the group given boiled ginger water (Zingiber officinale). Similarly, a comparison between the control group and the metformin-treated group also yielded a p value of less than 0.00, indicating that there was a substantial difference between the two groups. Additional analysis was carried out to compare the mean values of the groups given metformin and ginger (Zingiber officinale) boiled water. These findings indicate a statistically significant difference between the two groups, as indicated by a p value of less than 0.001.

Metabolic side effects of metformin include nausea, diarrhea, bloating, vomiting, chills, migraines and hypoglycemia, according to research by Sopianti et al. entitled Description of Side Effects of Metformin in Type II Diabetes Mellitus Patients (Gumantara, 2017). Many conditions, including stomach ache, nausea, regurgitation, cough, rheumatism, high blood pressure, and diabetes, are often treated with the herbal plant ginger (Zingiber officinale). Apart from being easy to obtain and safe for consumption by pregnant women, ginger also has no side effects and is increasing its popularity in society (Saedi, 2019).

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CONCLUSIONS

Based on research that has been carried out, it was found that there was a significant difference between the average reduction in blood glucose levels of mice (Mus musculus) given boiled ginger water (Zingiber officinale) and metformin. It is hoped that further research will be carried out to compare different concentrations in ginger (Zingiber officinale) boiled water. Apart from that, it is also recommended that research be carried out to test the toxicity of boiled ginger water (Zingiber officinale).

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