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Case Study: Effect of Soybean Infusion on Blood Glucose Levels on Wistar-strain Rats Loaded with Glucose

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Authors' contributions

This research was conducted in collaboration between the both authors. Author FPB designed the research, performed statistical analyzes, wrote protocols and wrote the first draft of the manuscript. Authors FPB and IS authors administered the research analysis and administered the literature search. The authors FPB and SI read and approved the final manuscript

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Case Study

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ABSTRACT

Background and Objective: The increase in diabetes in Indonesia is largely due to poor food patterns and ingredients. Soybeans as a traditional Indonesian food contain good food ingredients and are believed by the public to prevent damage to pancreatic cells and to maintain the balance of the insulin hormone so as to reduce glucose levels in the blood. This study aims to determine the effect of soy infusion on blood glucose levels (Study on Wistar-strain rats loaded with glucose).
Methods: This study is a True Experiment with using a pretest and posttest design with control group design. The research subjects used in this study were 3 months old male Wistar rats with glucose load intervention 1.35 mg with a concentration of 25%, 50%, 100% for 30 minutes, 60 minutes and 120 minutes.

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Results: showed that there were significant differences between groups, p value <0.05. The effectiveness of reducing glucose levels in test animals based on the regression test showed that the best treatment with intervention dose glucose load was 50%, with trend / time of observation y = -1.3251 + 150.3.
Conclusion: This study concluded that the effect of soybean infusion had an effect on decreasing blood glucose levels of the tested animals.

Keywords: Diabetes Mellitus; soybean, soybean infusion; blood glucose levels; blood sugar reduction trend.

1. INTRODUCTION

Diabetes Mellitus is a metabolic disease caused by several factors, including genetic, immunological, environmental and lifestyle [1]. This disease is characterized by hyperglycemia, a condition that is closely intertwined with damage to large blood vessels (macrovascular) and small blood vessels (microvascular), which results in failure, damage or impaired organ function [2]. Microvascular changes are believed to be exist when the blood glucose level of a person with diabetes exceeds 126 mg / Dl [3], while macrovascular abnormalities did not appear until a few years later. Microvascular changes affect the eyes and kidneys causing retinopathy and nephropathy. Macrovascular disorders mainly affect the cardiovascular system and atherosclerosism [4]. The prevalence of atherosclerosis in Indonesia currently reaches 8.3 / 1000 population [5].

The use of natural ingredients as alternative therapies is very helpful for the treatment of diabetes mellitus sufferers, especially the ingredients that are easily available in the environment [6]. One of the best and most accessible types of therapy for sufferers diabetes mellitus is the use of soy foods [7].

Soybeans have many chemical constituents including lecithin which can be used as an alternative herbal remedy to lower blood sugar (diabetic) [8]. Lecithin is believed to prevent damage in pancreatic cells, and Lecithin is believed to prevent damage to pancreatic cells and is able to maintain the balance of the insulin hormone so that it can reduce glucose levels in the blood [9]. therefore consumption of soy protein can prevent the risk of cardiovascular disease including lowering blood triglycerides, total LDL cholesterol levels [10]. increases High Density Lipoprotein *(* HDL cholesterol) and High Density Lipoprotein *(* HDL cholesterol) /Low Density Lipoprotein (LDL) ratio [11].

Experimental research using genistein soybean intervention in experimental animals (mice) is a type of research before it is applied to humans or primates that must be tested on experimental animals. Mice (wistar strain mice) are experimental animals that are widely used in the study of metabolic disorders (diabetes) and cardiovascular disorders. This is because mice have a physiological system similar to humans, available in large quantities, economical prices, and varying strains [12]. Experimental research on soybean genistein in experimental animals (rats) showed a decrease in blood sugar levels, prevent diabetes mellitus and prevent nephropathy. Genistein can cure some symptoms of diseases that accompany diabetes complications. Likewise, the content of soy isoflavones can suppress lipid peroxidation and act as antioxidants in the liver and kidneys of diabetic rats. Genistein isoflavones play a role in pancreatic beta-cell function by stimulating regeneration in pancreatic beta-cell proliferation. With the regeneration of pancreatic beta cells, insulin production will increase which can reduce blood sugar levels in diabetics [13]. Research shows a decrease in blood sugar levels, prevent diabetes mellitus and prevent nephropathy. Genistein can cure several symptoms of diseases that accompany complications of diabetes. Likewise, soy isoflavones can suppress lipid peroxidation and act as antioxidants in the liver and kidneys of diabetic rats. Genistein isoflavones play a role in pancreatic beta cell function by stimulating regeneration in pancreatic beta cell proliferation. With the regeneration of pancreatic beta cells, insulin production will increase which can reduce blood sugar levels in diabetics [14]. Research on diabetic rats decreased plasma insulin levels, liver glycogen levels and decreased glucokinase enzyme activity after soy intervention [15].

Based on these data, this study aims to determine the effect of soybean infusion on blood glucose levels on an invivo experimental scale.

2. MATERIALS AND METHODS

This research is a true experiment research with a pretest-postest research design with Control Group Design. This research was conducted at the Biology Laboratory of the Faculty of Mathematics and Natural Sciences, Semarang University-Indonesia. The animal work was done using 24 male Wistar strain rats with a bodyweight of 150-250 gm. The sample was divided into 4 groups, each of which consisted of 6 rats. All test animals were treated with glucose monohydrate as much as 1.35 mg / rat.

Sampling was done by random sampling. The inclusion criteria used were male rats, in normal health and physical condition, active in motion, able to eat and drink normally, no injuries with a bodyweight of 15 grams-250 grams. The independent variable in this study was soybean infusion with a dose of 25%, 50%, and 100% with an ordinal scale. The dependent variable was blood glucose levels in rats as measured by glucometer with a duration of 30, 60, and 120 minutes with a ratio scale. Group, I was the control group which was given glucose monohydrate only 1.35 g / mouse, then group II was the treatment group which was given loading glucose plus soybean infusion at a dose of 25% (0.9 ml/gm body weight of rats), Group III was given loading glucose plus soy infusion. 50% dose (1.8 ml/gm body weight) and Group IV was given glucose loading plus soybean infusion at a dose of 100% (3.6 ml/gm body weight). Before the study, all rats were adapted to their environment in the Biology Laboratory for 7 days and then fasted for 16 hours. Blood glucose levels before (pretest) and after (postest) treatment with a duration of 30 minutes, 60 minutes, and 120 minutes were measured.

The data obtained from the study were analyzed by univariate and bivariate analysis. The univariate analysis stage was carried out to describe the data for each variable using a frequency distribution table, average value, minimum and maximum blood glucose levels. Bivariate analysis was used to test the normality and homogeneity of the data from each variable. Linear regression analysis to determine the rate of glucose reduction in each treatment.

3. RESULTS AND DISCUSSION

Based on the results of observations, the following research data were obtained:

The results of blood glucose levels in this study showed that the average blood glucose levels in the group receiving soy infusion treatment were lower than the group that did not receive soy infusion (control group). The decrease in average blood glucose levels was caused by the effect of soybean infusion at doses of 25%, 50% and 100% with a linear trend as follows:

1) Trend without treatment $y = 3.1362 x + 281.71$
   Trend of glucose levels in test animals shows an increase in glucose levels (+)
2) Trend with soybean infusion treatment (25%) $y = - 0.9401 x + 201.54$
   Trend of glucose levels in test animals shows a decrease in glucose levels (-)
3) Trend with soybean infusion treatment (50%) $y = - 1.3251 x + 150.3$
   Trend of glucose levels in test animals shows a decrease in glucose levels (-)
4) Trend with soybean infusion treatment (100%) $y = - 1.161 x + 150.3$
   Trend of glucose levels in test animals shows a decrease in glucose levels (-)

All treatments had a negative tendency; this shows that treatment with soy infusion reduced blood sugar levels in experimental animals. The highest trend in soybean infusion treatment was 50% $y = - 1.3251 x + 150.3$.

Excessive soybean infusion interventions can trigger allergic reactions (anaphylactic) and malabsorption [16]. Soy lecithin may not be suitable for everyone and can have side effects if it is used excessively. Soybean intake is recognized as safe by the Food and Drug Administration when given in reasonable quantities.

The decrease in blood glucose levels in test animals was caused by the nutritional content of soybeans, including the content of lecithin, arginine, and fiber. Lecithin contains unsaturated fatty acids which function to treat excessive fat buildup in blood vessels [17]. Lecithin has the ability to keep pancreatic cells from being damaged by oxidation and regenerate damaged cells [18]. The presence of arginine in soybeans also plays a role in maintaining the balance of the insulin hormone. Arginine acid is very useful because it is able to maintain the balance of the insulin hormone [19]. The presence of arginine in soybeans also plays a role in maintaining the balance of the insulin hormone. Arginine is a substrate for the production of Nitric Oxcide,

which plays an important role in maintaining vasodilation of blood vessels [20]. Soybeans also contain lots of fiber (0.1 mg / 100 grams of soybeans) which serves to slow down glucose absorption and increase the thickness of the intestinal contents, so that it can indirectly reduce the diffusion rate of the intestinal mucosa surface so that blood sugar levels decrease slowly and the need for insulin is also reduced [21].

Soybean extract can reduce blood sugar levels because it has components with a hypoglycemic effect [22]. Soy components that can cause hypoglycemic effects are lecithin, protein, isoflavones, and genistein [23]. The protein content of soybeans is known to be rich in the amino acids such as arginine and glycine. These two amino acids are components of the insulin hormone secreted by the pancreas gland. Therefore, the higher the protein intake from soy milk, the secretion of the insulin hormone into the body's tissues will increase. Other soy components that have hypoglycemic effect are isoflavones and genistein. Isoflavones are phytoestrogens in soy, which have a structure similar to estrogen. Isoflavones can act as estrogens that bind to estrogen receptors in pancreatic beta cells. The presence of estrogen receptors on pancreatic beta cells will cause insulin release [24]. Genistein and daidzein in soy can inhibit glucose absorption into the lumen of the small intestine, thereby reducing hyperglycemia [25].

Table 1. Average blood glucose levels (mg / dL)

Group	Average		
	30 minutes	60 minutes	120 minutes
I control	283.5	325.8	324.8
II 25 %	211.1	195.8	175.6
III 50 %	152.0	137.6	122.6
IV 100 %	114.1	101.0	90.3

Table 2. ANOVA test results of blood glucose levels

Variable	F	P-value	Ket
Glucose levels at 30 minutes	40.508	0.000	There were differences in the
Glucose levels at 60 minutes	96.545	0.000	average blood glucose levels
Glucose levels at 120 minutes	132.47	0.000	between groups

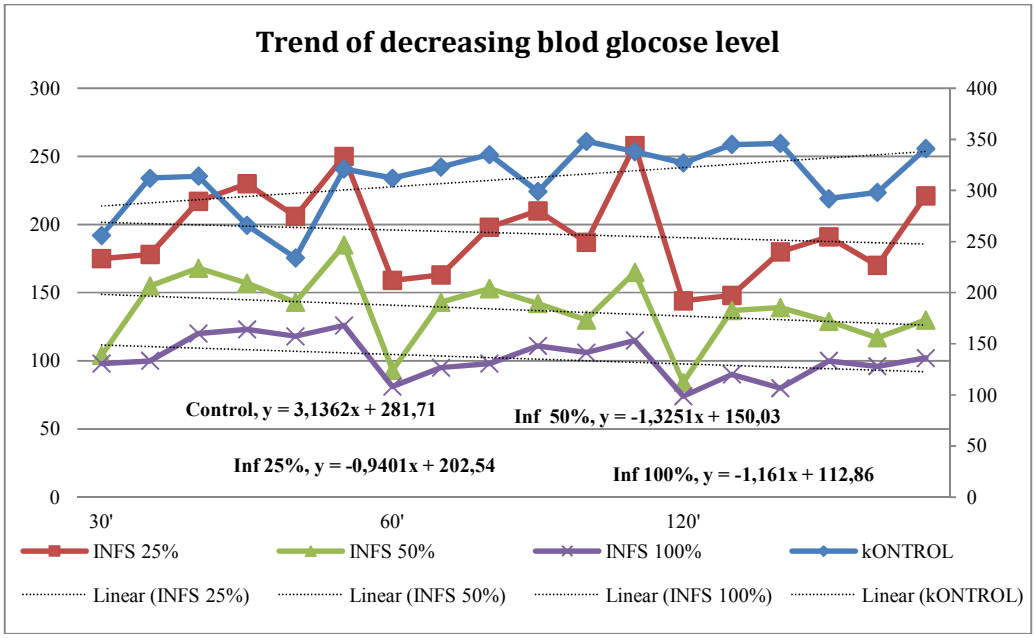

Fig. 1. Trend of average blood glucose levels (mg / dL) in test animals

4. CONCLUSION

Based on the results of the study, it was concluded that the best soybean infusion treatment that could reduce blood glucose in Wistar strain Animal Test rats was 50% infusion treatment, with a decrease tendency based on linear equations, is $y = - 1.3251 x + 150.3$

ETHICAL APPROVAL

Animal Ethic committee approval has been taken to carry out this study.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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