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Effectiveness of Chinese Ketepeng Infusion on Streptozotocin-Induced Mice

Theopilus Wilhelmus Watuguly✉, Eifan Boyke Pattiasina
Pattimura University, Jalan Ir M Putuhena, Poka Campus, Ambon, Indonesia

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Abstract

Blood sugar is a metabolic disorder disease that occurs due to insufficiency of insulin hormone production or due to insulin insensitivity resulting in typical clinical manifestations in the form of increased glucose levels in the blood (hyperglycemia). This study aims to determine the effect of Chinese ketepeng leaf decoction on blood glucose levels in hyperglycemic mice. This research was carried out in the Zoology laboratory, Faculty of Mathematics and Natural Sciences, Pattimura University, Ambon. This research is an experimental laboratory with a pre and post-test research design with a control group design. This study wanted to prove whether there was an effect of giving Chinese ketepeng leaf decoction to decreasing blood sugar levels in male Balb/C mice using Chinese ketepeng leaf decoction at a dose of 3.64 mg/kg, 7.28 mg/kg, 10.92 mg/kg. The results showed that the usage of Chinese ketepeng leaves (Cassia alata L) can reduce blood sugar levels in mice (Mus musculus). The most effective dose to lower blood sugar levels is a dose of 10.92 mg/kg BW.

Introduction

The primary and safest therapeutic approach since prehistoric times is herbal medicine which has displayed a significant role in primary health care development (Oladeji, Odelade and Oloke, 2020). DM is a group of metabolic disorders characterized by high blood sugar levels over a prolonged period resulting from either destruction or impairment of insulin-secreting pancreatic β cells and insulin action in target tissues (Hossain et al., 2016). Diabetes mellitus (DM), commonly referred to as diabetes, is a group of metabolic disorders in which high blood sugar levels occur over a prolonged period. Typical DM patients exhibit frequent urination, increased thirst, increased hunger, and other symptoms. DM is divided into two main categories: type 1 DM (T1DM), an autoimmune disease associated with insulin deficiency, and type 2 DM (T2DM), which occurs mainly due to ineffective insulin action (Chen et al., 2017).

Diabetes mellitus is a chronic metabolic disease characterized by a deficiency of insulin production, insulin action, or both (Adams and Yakubu, 2020). This chronic condition leads to alterations in the metabolism of carbohydrates, proteins, and lipids and consequently results in hyperglycemia, glucosuria, hyperlipidemia, and atherosclerosis (Baradaran et al., 2013). Diabetes mellitus has grown into a major health risk worldwide. It has been observed to increase with time. The chronic disease has hurt more than 171 million persons globally in 2000, and the frequency is estimated to grow gradually to 366 million by 2030 (Zhu, 2013). DM has also been causing severe organ failure over the years rapidly becoming one of the noncommunicable diseases causing a rapid increase in mortality rates (Koye et al., 2018). The scientific appraisal of the pharmacological activities of herbal plants revealed about 200,000 phytochemicals. These compounds contribute to the apparent medicinal activities displayed by plants and invariably justify the involvement of natural products in the development of novel drugs

✉ Correspondence Address:
Pattimura University, Jalan Ir M Putuhena, Poka Campus, Ambon, Indonesia
Email: twatuguly@gmail.com

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(Svahn, 2015). Several medicinal plants with diverse interesting pharmacophores have been scientifically investigated, and one of these plants is Casisa alata.

Flavonoids and phenol play important roles in the antioxidant activity of plants by absorbing and neutralizing free radicals (Sarkar et al., 2014). According to research and clinical studies, flavonoids have shown their beneficial effects in the prevention, alleviation, and treatment of numerous degenerative and viral diseases, such as cancers, obesity, cardiovascular diseases, diabetes, and other age-related diseases (Dayem et al., 2015; Coelho et al., 2018). In addition, it also acts as an antioxidant to modulate oxidative stresses in the body by neutralizing the effects of reactive oxygen and nitrogen, thereby preventing various diseases.

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Method

This research is an experimental laboratory with a pre and post-test research design with a control group design. This study wanted to prove whether there was an effect of giving Chinese ketepeng leaf decoction to decrease blood sugar levels in Balb/C male mice.

In determining the variables of this study, there are two variables, that is: 1) Independent variable: Chinese ketepeng leaf steeping at a dose of 3.64 mg/kg, 7.28 mg/kg, 10.92 mg/kg; 2) Dependent variable: Sugar level in male Balb/C mice (Mus musculus) induced by streptozotocin.

Dosage determination is based on the assumption of herbal therapy in humans weighing 50 kg (Syariefa 2011). Using Laurence and Bacharach's (1964) conversion formula, the dose conversion factor from humans (70 kg) to mice (20 g) is 0.0026, so the dose to be given to mice is 70/50 x 0.0026 x 10% = 0. 0364 %. So based on the above results, the dose of Chinese ketepeng leaf boiled water used in mice is 3.64 mg/g BB. In this study, three dose levels were made, with the conversion results from humans and mice (Mus musculus) as follows: 1) 70/50 x 0,0026 x 10% = 3,64 mg/g BB; 2) 70/50 x 0,0026 x 20% = 7,28 mg/g BB; 3) 70/50 x 0,0026 x 30% = 10,92 mg/g BB. After obtaining data from measuring blood sugar levels, the data was analyzed using One Way ANOVA with a significance level of 95% to find out more about the level of difference between groups, the Duncan test was carried out. In the above analysis, homogeneity and normality tests were carried out.

Results and Discussion

After analyzing the normality test, homogeneity test, Anova test, and Duncan test, the results of the normality test for the average blood sugar level show that there is no deviation from the normality of the blood sugar level data at a significant level ($\alpha > 0.05$). Test results for blood sugar levels in mice (Mus musculus) Balb/C induced by streptozotocin after being given Chinese ketepeng (Cassia alata L) boiled water showed that there was a decrease in blood sugar levels. The test results can be seen in Table 1.

Table 1. Average ± SD Blood Sugar Levels after administration of Chinese ketepeng (Cassia alata L) boiled water in Mice (Mus musculus)

Treatment	Mean ± SD Blood Sugar Level (mg/dL)
Control (-)	105,6667±12,0138[a]
Control (+)	174,33±17,61628 [c]
Dosage 3.64 mg/kgBW	128,33±5,85947[b]
Dosage 7.28 mg/kgBW	118,33±1,52753[b]
Dosage 10.92 mg/kgBW	104,6667±27,86823[a]

Source: Primary Data, 2022,

In the positive control there was a difference between the treatment dose of 3.64 mg/kg, dose of 7.28 mg/kg, and dose of 10.92 mg/kg, while the treatment dose of 3.64 mg/kg had no difference with a dose of 7.28 mg/kg. This is due to the results of the average blood sugar levels and the Standard Deviation in the Duncan test in the treatment group with a dose of 3.64 mg/kgBW and the treatment group with a dose of 7.28 mg/kgBW showed no difference. Table 1 shows the average blood sugar level in the negative group, the average blood sugar level is 105.6667 mg/dl. This value is used as a reference to see the difference in each treatment because the negative control was not treated. In the positive control, the average blood sugar level was 174.33 mg/dl. This value is greater than the negative control. In the positive group, mice (Mus musculus) were induced by streptozotocin so that it could cause a high average blood sugar level.

At a dose of 3.64 mg/kg, the average blood sugar level was 128.33 mg/dl. When compared with the positive control, the average value of blood sugar levels is still high. At a dose of 7.28 mg/kgBW, the average blood sugar level was 118.33 mg/dl and experienced a significant decrease when compared to the positive control and at a dose of 3.64 mg/kgBW. The results of blood sugar levels at a dose of 10.92 mg/kgBW is a dose that has an average value of blood sugar levels of 104.6667mg/dl which indicates that at a dose of 10.92mg/kgBW, it can inhibit glucose transport in the blood and stimulate insulin secretion in pancreatic beta cells a significant decrease in blood sugar levels when compared to the negative control group which is in normal condition (no treatment).

Diabetes Mellitus is a condition that causes glucose levels in the blood to increase or a condition in which there is a chronic disorder characterized by hyperglycemia (increased blood glucose) and specifically involves the metabolism of carbohydrates (glucose) in the body. The results of this study indicate that the average blood sugar level in mice (Mus musculus) induced by streptozotocin after being given Chinese ketepeng (Cassia alata L) boiled water at a dose of 10.92 mg/kgBW contains flavonoids, saponins, and tannins which can lower blood glucose levels. with high doses so that blood sugar levels decreased, the average blood sugar level was 104.67 mg/dL with a standard deviation of 9.074 when compared to the group of mice (Mus musculus) which were induced by streptozotocin after being treated with Chinese ketepeng stew at a dose of 3.64 mg/kkBW and dose of 7.28 mg/kgBW.

The decrease in blood sugar levels in mice (Mus musculus) induced by streptozotocin after being given Chinese ketepeng (Cassia alata L) boiled water at a dose of 10.92 mg/kgBW was lower. high so that the ability to inhibit α-glucosidase. The results showed that there was a decrease in blood sugar levels in mice (Mus musculus) induced by streptozotocin which was given ketepeng cina (Cassia alata L) boiled water at a dose of 10.92 mg/kgBW, 3.64 mg/kgBW and a dose of 7.28 mg/ kgBW so that it can be said that the decrease in blood sugar levels was in line with the increase in the dose of ketepeng cina (Cassia alata L) cooking water. According to the assumptions of researchers, the content of flavonoids, saponins, and tannins in Chinese ketepeng leaves (Cassia alata L) is thought to play a significant role in reducing blood sugar levels. Flavonoids, saponins, and tannins in Chinese ketepeng (Cassia alata L) can overcome the effect of streptozotocin on the pancreas. Flavonoids, terpenoids, saponins, and tannins give antioxidant activities, which can capture free radicals produced by the oxidation reaction of alloxan and reduce oxidative stress (Ghorbani, 2017).

The chemical structure of the flavonoids is based on the presence of a 15-carbon skeleton consisting of two benzene rings (A and B rings) connected by a heterocyclic pyran ring (ring C). Flavonoids can be classified into various classes, such as flavanones, flavonols, flavones, and others, based on the molecular substitution patterns of their carbon skeletons (Kumar and Pandey, 2013). Flavonoids are widely present in plants, and more than 5,000 natural flavonoid compounds have been reported. These natural compounds exhibit high pharmacological activity. These compounds possess many biological activities, such as antioxidant, antitumor, anti-cardiocerebrovascular disease, and anti-inflammatory activities. A large number of studies have shown that flavonoids have significant antidiabetic effects, effectively reducing blood sugar levels, inhibiting α-glucosidase, and protecting the pancreas (Salib, Michael and Eskande, 2013; Zheng et al., 2013) and high levels of flavonoids in the diet could reduce the incidence of diabetes (Van Dam, Naidoo and Landberg, 2013; Jacques et al., 2013) Flavonoids in the process of regeneration of pancreatic beta cells by against free radicals (Ghorbani, 2017).

Saponins also work to inhibit ROS by forming chelates with metals that cause free radicals non-enzymatically. This happens because saponins which have many -OH chains play a role in increasing antioxidant activity and the formation of free radicals. Enzymatically, saponins induce antioxidant catalysts and superoxide dismutase (SOD), which in diabetic rats the amount decreases or is very small. (Elekofehinti et al., 2013). Saponins have antidiabetic activity by working to modulate calcium in pancreatic β-cells and slightly inhibit adrenaline and calcium channel blockers so that they can restore atrophic β-pancreatic cells and increase endogenous insulin production and increase hepatic glycogen and reduce the possibility of hyperinsulinemia. In addition, saponins also work to inhibit ROS and reduce levels of hyperglycemia by restoring insulin response and sensitivity, increasing insulin levels in plasma, inducing insulin secretion in the pancreas, inhibiting disaccharide enzymes, increasing glycogen synthesis, reducing gluconeogenesis, inhibiting glucosidase, inhibiting mRNA glycogen phosphorylase and glucose 6 phosphatase, increases Glut4 expression (Elekofehinti et al., 2013; Konri, Samaddar and Ramaiah, 2014).

Conclusion

Based on the research results obtained, it can be concluded that: The usage of Chinese ketepeng leaves (Cassia alata L) can reduce blood sugar levels in mice (Mus musculus). The most effective dose to lower blood sugar levels is a dose of 10.92 mg/kg BW.

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