Harnessing Ashitaba Extract: A Promising Solution for Regulating Blood Glucose in High Glucose Diet Mice

ABSTRACT

A metabolic condition known as diabetes mellitus (DM) is defined by high blood sugar levels brought on by impaired insulin quality, production, or both. Diet remains the first line of sustained effort to attain the anticipated goal blood glucose levels in order to slow the progression of illness. The purpose of this investigation is to ascertain how ashitaba extract affects blood glucose reduction. Healthy mice over 1 month old, weighing 30–40 grams, were the study's population. A total of 30 mice were included in the sample. The One Way Anova statistical test was utilized for data analysis in this study. The outcomes demonstrated that administering Ashitaba extracts to hyperglycemic mice decreased blood glucose levels, as evidenced by a sig value of 0.004 (sig $\alpha < 0.05$).

Keywords: Blood Glucose Levels, High Glucose Diet, Ashitaba Extract, Mice

INTRODUCTION

The influence of globalization, which brought about the Western way of life, has changed Indonesian society's eating habits and way of life, particularly in large cities. Foods heavy in calories, fat, and cholesterol are very popular. People who work and have little time to make nutritious food start prioritizing fast food, which is quick and convenient. Today, another major issue is the lack of time, knowledge, and motivation in exercising.

This situation has an impact on the increase of a person's blood glucose levels, known as hyperglycemia. According to American Diabetes Association [3], normal capillary blood glucose levels during fasting should not exceed 120 mg/dl, and 2 hours after eating, should be less than 200 mg/dl. High blood sugar levels in the long term can cause various health problems such as nerve, kidney, and eye damage. Therefore, it is very important to maintain blood sugar levels within the normal range to prevent diabetes complications [1], [9].

A metabolic condition known as diabetes mellitus (DM) is defined by elevated blood glucose levels brought on by impaired insulin quality, production, or both. Diabetes (and diabetics) are becoming more and more common. It is well recognized that diabetes mellitus has a number of consequences, including microangiopathy and macroangiopathy, and that blood glucose control has a direct impact on the development of these diseases. Dietary planning, physical activity, medication therapy, education, and blood sugar monitoring are the five fundamental pillars of DM management [15]. Diet is still the first line of ongoing attempts to meet the anticipated blood glucose target, even if insulin and oral hypoglycemic medications have been developed as medical therapies to manage blood glucose levels [10].

According to the International Diabetes Federation (IDF) [5], in 2020 there were approximately 463 million people worldwide living with diabetes mellitus. This number is projected to increase to around 700 million people by 2045.

According to data from the Ministry of Health of the Republic of Indonesia (2021), 10.3 million Indonesians, or roughly 6.1% of the country's total population, were estimated to have diabetes mellitus in 2020. According to the same prediction, Indonesia's population of people with diabetes mellitus is anticipated to grow even more, reaching 16.7 million by 2045. It becomes difficult for Indonesia's healthcare system to maintain its current level of excellence in its efforts to prevent and cure diabetes mellitus as a result.

The Indonesian nation has long been familiar with and used medicinal plants as one of the efforts to overcome its health problems. Many types of plants in nature can be utilized or have been utilized by the community, both as food and medicinal ingredients (Made Oka et al., 2012). Indonesia has a rich biodiversity, including various types of medicinal plants that have been used for centuries in traditional medicine. Many of these plants are easily accessible and can be found in various regions of Indonesia. The diversity of medicinal plants in Indonesia has resulted in traditional healing practices that are still used by many people today.

One of the most well-known medicinal plants in Indonesia is the Jamu plant. Jamu is a traditional herbal medicine made from various plants and spices and has been used for centuries to treat various health conditions. Some of the most commonly used plants in Jamu include ginger, turmeric, and galangal [16].

Other often used medicinal plants in Indonesia include katuk leaves, which are thought to assist nursing women produce more breast milk, and soursop leaves, which have been shown to have anti-cancer qualities [4].

The richness of Indonesia's medicinal plants has also fueled the growth of the herbal sector, with numerous businesses creating a range of herbal supplements and goods for both domestic and global markets [17].

The Ashitaba plant (Angelica keiskei) is one of Japan's native medicinal plants known as the "Treasure" and "King of Vegetables" that is not widely known in Indonesia. According to

Japanese history, Ashitaba is a useful plant for longevity and was once sought after by the first emperor of China from the Chin Dynasty. During the Edo period, Ashitaba was also known as "Longevity Herbal Medicine." Due to its strong vitality, new young leaves will sprout tomorrow (tomorrow's leaf) if the leaves are picked today. Ashitaba is also known as the "Angel's Leaf" because of its ability to cure various diseases [12], [14]. This plant also has antioxidant and anti-inflammatory properties and has the potential to be used as medicine for several health conditions, including liver disease, and cardiovascular disease. Some studies have shown that extracts from Ashitaba leaves can improve liver health and reduce inflammation in the body [19].

This study used the pre- and post-design technique in various doses to examine the impact of Ashitaba extract on blood glucose decrease. These dosages were utilized to measure Ashitaba levels' effectiveness in lowering blood glucose levels, which had not previously been the subject of investigations, particularly in Indonesia.

RESEARCH METHOD

The current study's experimental design includes a Pre- and Post-Test Only Control Group. Prior to the therapy and after the treatment at the conclusion of the study, data are collected by comparing the outcomes between the treatment and control groups.

Population and Sample: A total of 30 mice were used as the sample in this investigation. The population consisted of healthy mice that had been fed a high-glucose diet for at least one month.

Data Analysis: To determine the impact of giving Ashitaba extract to mice on a high-glucose diet, data from the Pre- and Post-Test Control Design experiment were analyzed using the Contingency Coefficient (c) and Phi Coefficient in the SPSS for Windows program.

Results

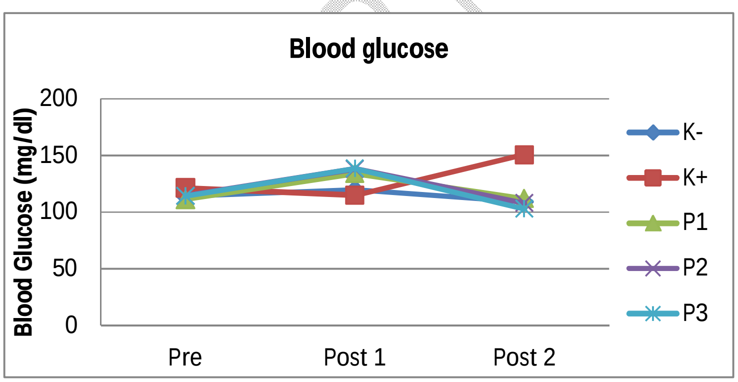

Figure 1: Average blood glucose levels of mice before and after treatment graph.

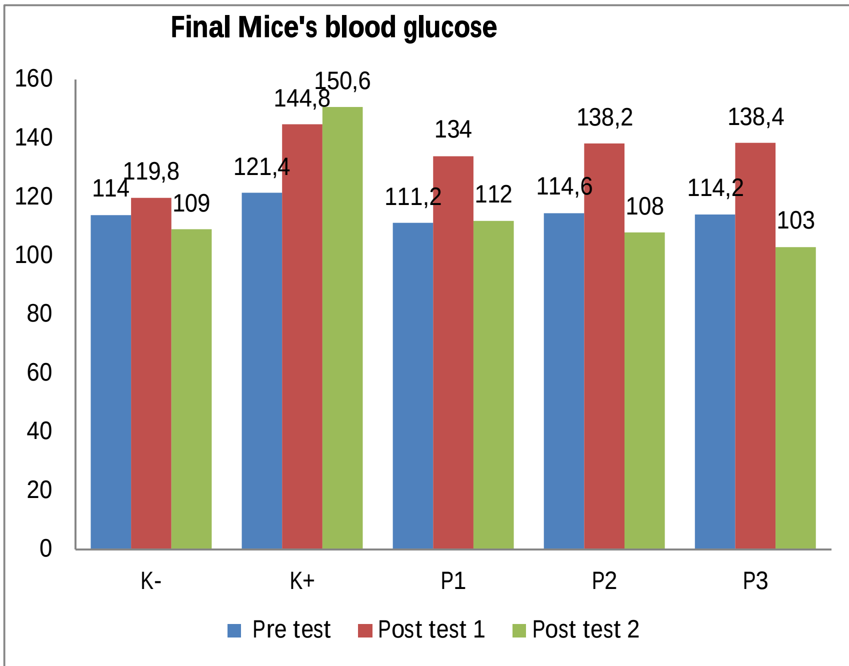

Figure 2: Results of observation on the final blood glucose level measurement

The graph above shows the effect of high glucose diet on blood glucose levels. The high-glucose diet in this study resulted in an increase in blood glucose levels compared to the previous levels, but it did not show a significant increase.

DATA ANALYSIS

1. Normality Test and Homogeneity Test between Groups

a. Normality Test

This statistical test is needed to compare the data distribution and blood glucose level measurement with a standard normal distribution. For this testing, the Kolmogorov-Smirnov normality test was performed with a sample size of 25. The test was conducted using SPSS version 25.0 with a significance level (α) of 0.05. The blood-glucose-level measurement data is said to have a normal distribution if the p-value > α.

Conversely, if the p-value < α, the data has a non-normal distribution (Ghozali, 2011, p. 34). The test results showed that the blood-glucose-level measurement data had a p-value of 0.054 with a normal distribution value of $p > 0.05$. This means that the blood-glucose-level measurement data has a normal distribution.

b. Homogeneity Test

Since the measurement data of blood sugar levels have a normal distribution, the next step is to perform a homogeneity test of variances (Levene's Test) which aims to determine whether the data groups (K-, K+, P1, P2, and P3) have homogeneous variances or not. This test is conducted using SPSS version 20.0 with a significance level (α) = 0.05.

The blood sugar measurement data is said to be homogenous if the p-value > α. Conversely, if the p-value < α, the data is not homogenous (Ghozali, 2011, p. 36). Levene's blood sugar test results have a p-value of 0.010. This means that the variance of the blood sugar data is not homogenous ($p < 0.05$). Therefore, the Kruskal-Wallis test is used to test for group differences.

2. Test for Significant Differences

To determine whether there are differences between the treatment groups, the Kruskal-Wallis test is used. The test results show a significant p-value of 0.004, which is < α (0.05), indicating a significant difference between the treatment groups.

Table 1. Results of Post-Hoc Mann Whitney test.

Treatment group	Blood Glucose
K-	109,00 ± 5,83^{a}
K+	150,60 ± 13,01^{b}
P1	112,00 ± 5,75^{a}
P2	108,00 ± 5,34^{a}
P3	103,00 ± 5,00^{a}

Note: Superscripts a,b,c,d, and e with the same letter in the variable research column (Blood Sugar) indicate no significant difference ($p > 0.05$).

The table above shows a significant difference in average blood sugar levels among treatment groups 1, 2, and 3, which are the groups given glucose + Ashitaba extract compared to the positive control group, proven by a significance value of <0.05. The mean blood sugar levels of treatment groups 1, 2, and 3 are lower than those of the positive control group. This indicates that the administration of Ashitaba extract affects lowering blood sugar levels in mice fed a high glucose diet.

DISCUSSION

The end product of digestion is glucose, which is fully absorbed as carbs. Blood glucose levels change according to the body's ability to absorb nutrients; they rise after meals and fall if there is a prolonged period of fasting. Cells can use glucose alone for energy, and glycogen can easily enter and exit cells. Insulin, a hormone released by the pancreas, converts glucose into glycogen for storage in liver cells. Glucagon, another hormone secreted by the pancreas, and adrenaline, a hormone secreted by the adrenal glands, convert glycogen back to glucose [18].

Hyperglycemia is a condition in which blood sugar levels spike or become excessive. This condition eventually results in Diabetes Mellitus (DM), a disorder brought on by the body's lack of the hormone insulin, which makes it difficult for glucose to enter cell walls and circulate in the bloodstream. This syndrome is typically brought on by stress, infections, and particular drugs. Along with extreme weariness and clouded eyesight, hyperglycemia is characterized by polyuria, polydipsia, and polyphagia [11], [13].

The body might exhibit a number of indications and symptoms of hyperglycemia. Some symptoms of hyperglycemia, according to the American Diabetes Association [2] and Mayo Clinic [8], include: (a) Frequent urination: The kidneys will attempt to eliminate any extra glucose through urine because of the elevated blood glucose levels, Dehydration can result from increased urine production since the body loses more fluids as a result. (c) Fruity breath: When the body is unable to adequately utilize glucose, it will begin to break down fat as a substitute energy source. This procedure might result in the blood containing ketones, which can give breath a fruity odor. (d) Headaches and fatigue: an increase in blood glucose levels can cause the body to lack energy, leading to fatigue and headaches, (e) Vision complaints: an increase in blood glucose levels can affect blood circulation in the eyes and can cause vision problems, (f) Slow healing wounds: high blood glucose levels can affect the wound healing process by reducing blood circulation to the affected area.

Diabetes mellitus is a chronic condition characterized by elevated blood sugar levels and typical symptoms of sweet-tasting urine in large amounts. High blood sugar levels are caused by defects in insulin secretion, action, or both [7], [9].

The study results indicate that the administration of Ashitaba extract reduces blood sugar levels in mice given a high-glucose diet. The highest average blood sugar level was found in the group of mice given a high-glucose diet without any treatment, at 150.60 mg/dl. The lowest average was found in group P3, which received a diet and Ashitaba extract at a dosage of 100mg/100g body weight, at 103 mg/dl. The test results show a significant difference between the groups, with a significance value of 0.004 (sig $\alpha < 0.05$), indicating a significant difference between the treatment groups. These results suggest that Ashitaba extract reduces blood sugar levels in mice made hyperglycemic through a high-glucose diet.

Because ashitaba extract includes flavonoid, alkaloid, and chalcone components, it can reduce blood sugar levels [6]. Because they can improve insulin sensitivity and enhance insulin production, flavonoids have hypoglycemic effects. Additionally, alkaloids and chalcones can lessen insulin resistance and improve insulin sensitivity. Together, these elements control and reduce blood sugar levels.

CONCLUSION

The study's findings suggest that giving Ashitaba extract to rats whose blood sugar levels have been elevated by a high-glucose diet can lower their blood sugar levels. The group of mice given a high-glucose diet without any therapy had the highest average blood sugar level, measuring 150.60 mg/dl. The group P3 average of 103 mg/dl, which had a diet and 100 mg/100 g of Ashitaba extract, was the lowest. With a significance value of 0.004 (sig 0.05), it was determined that there was a significant difference between the groups, which corresponded to the treatment groups.

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