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

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Asian Journal of Medicine and Health

Volume 21, Issue 9, Page 106-112, 2023; Article no.AJMAH.101683
ISSN: 2456-8414

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJMAH/2023/v21i9864

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/101683

Original Research Article

***Received:** 20/04/2023*
***Accepted:** 21/06/2023*
***Published:** 27/06/2023*

ABSTRACT

Diabetes mellitus (DM) is a metabolic disorder characterized by elevated blood sugar levels brought on by a deficiency in insulin quality, production, or both. In order to achieve the projected target blood glucose levels and limit the progression of sickness, diet continues to be the first line of ongoing effort. This study aims to determine how ashitaba extract influences blood glucose decrease. The study's subjects were healthy mice over a month old weighing 30–40 grams. The sample consisted of 30 mice in total. 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.

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1. INTRODUCTION

The impact of globalization, which gave rise to the Western way of life, has altered the dietary habits and way of life of Indonesian society, particularly in large cities. Popular foods tend to be high in calories, fat, and cholesterol. People who work long hours and don't have much time to prepare healthy meals start favoring fast food because it's quick and easy. Lack of time, expertise, and motivation for exercise is currently a serious problem.

This circumstance affects a person's rise in blood glucose levels, or hyperglycemia. The American Diabetes Association [1] states that normal capillary blood glucose levels should be less than 200 mg/dl two hours after eating and less than 126 mg/dl while fasting. Long-term high blood sugar levels can result in a number of health issues, including damage to the kidneys, eyes, and nerves. In order to avoid problems from diabetes, it is crucial to keep blood sugar levels within the normal range [2,3].

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 [4]. 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 [5].

According to the International Diabetes Federation (IDF) [6], 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 [7].

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 [8].

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 [9].

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 [10,11]. 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 [12].

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.

2. METHODS

The Pre- and Post-Test Only Control Group experimental design was used by the researchers in the current investigation. In this design, data was gathered both before and after a particular therapy, and the results of a treatment group and a control group were compared.

30 mice in total made up the sample used in this study. These mice were chosen from a wider population of mice that had been fed a high-glucose diet for at least one month and were all healthy.

The researchers used the Contingency Coefficient (c) and Phi Coefficient for data analysis to determine the effects of giving Ashitaba extract to mice on a high-glucose diet. The SPSS for Windows application used these statistical metrics. The analysis involved looking at how the experiment's Pre- and Post-Test Control Design variables related to one another. The researchers attempted to identify any connections or dependencies between the therapy and the observed results by using the Contingency Coefficient and Phi Coefficient.

3. RESULTS

The graph below 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.

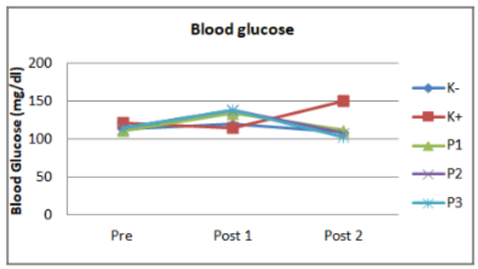

Fig. 1. Average blood glucose levels of mice before and after treatment graph

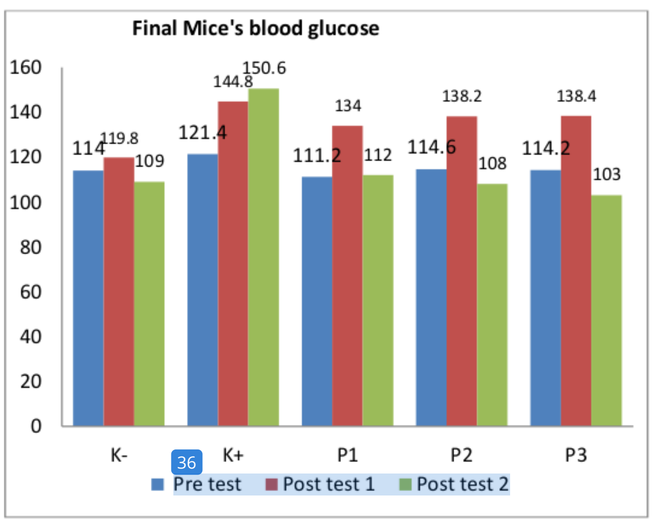

Fig. 2. Results of observation on the final blood glucose level measurement

4. DATA ANALYSIS

4.1 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, 2017, 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.

4.2 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.

The Table 1 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.

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)

5. DISCUSSION

Glucose, a simple sugar that serves as the body's main source of energy, is the end result of the digestive process. When we eat carbs, our bodies break them down during digestion, allowing glucose to enter the bloodstream completely.

The body's capacity to absorb and use nutrients determines how much glucose is present in the blood at any given time. Blood glucose levels increase after eating because of the release of glucose into the bloodstream. On the other hand, blood glucose levels fall during extended fasting intervals or when carbohydrate consumption is restricted.

Since glucose is a necessary fuel for cells, they can directly use it in the process of cellular respiration to generate energy. Furthermore, extra glucose can be changed into the storage compound known as glycogen, which is largely present in the liver and muscles. The hormone insulin, which is secreted by the pancreas, aids in this conversion process. Insulin aids in the conversion of glucose into glycogen for storage in liver cells.

The process of glycogenolysis allows the body to convert stored glycogen back into glucose when it needs energy. Two hormones, glucagon (also secreted by the pancreas) and adrenaline (secreted by the adrenal glands), control this breakdown. Together, the two hormones encourage the release of glycogen that has been stored and turn it back into glucose so that it may be released into the bloodstream and used as fuel by cells.

Overall, controlling blood sugar levels is a difficult process that involves the interaction of several hormones, including insulin, glucagon, and adrenaline. These hormones keep the body's energy metabolism in check by ensuring that glucose is effectively used for energy or stored as glycogen as required [13].

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 [14,15].

The body might exhibit a number of indications and symptoms of hyperglycemia. Some symptoms of hyperglycemia, according to the American Diabetes Association [16] and Mayo Clinic [17], 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 medical condition that is characterized by consistently high levels of sugar (glucose) in the blood. One of the classic symptoms associated with diabetes is the production of large amounts of urine that has a sweet taste, hence the historical term "mellitus," meaning honeyed or sweet.

The primary cause of high blood sugar levels in diabetes is attributed to defects in the secretion of insulin or its action, or a combination of both factors. Insulin is a hormone that is produced and released by the pancreas, specifically by beta cells in the islets of Langerhans. It plays a crucial role in regulating blood sugar levels by facilitating the uptake of glucose into cells from the bloodstream.

In individuals with diabetes, there are different mechanisms that can lead to elevated blood sugar levels. In some cases, there may be insufficient insulin production by the pancreas, resulting in reduced availability of this hormone to facilitate glucose uptake into cells. This is known as impaired insulin secretion. Alternatively, there may be defects in the action of insulin, where the cells in the body become less responsive to the hormone's effects, even when it is adequately secreted. This condition is referred to as insulin resistance.

In many instances, diabetes is a combination of both impaired insulin secretion and insulin resistance. When the body does not produce enough insulin or the available insulin is not utilized effectively, glucose is not efficiently taken up by the cells for energy production. As a result, glucose accumulates in the bloodstream, leading to high blood sugar levels, a condition known as hyperglycemia.

It is important to note that there are different types of diabetes mellitus, including type 1 diabetes, type 2 diabetes, gestational diabetes, and other specific forms. The underlying causes, progression, and management of these different types may vary. However, the common factor in all types of diabetes is the presence of elevated blood sugar levels resulting from defects in insulin secretion, action, or both [18,3].

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 [19]. 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.

6. 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.

CONSENT

It is not applicable.

ETHICAL APPROVAL

Animal Ethic committee approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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